Semester: I		
ADVANCED MATHEMATICAL METHODS (Theory)		
Course Code: MVJ22MPG11		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able	
1	To understand probability, sampling and fuzzy logic that serve as application of civil engineering
2	To acquaint the students with mathematical/logical fundamentals techniques

UNIT-I	
Statistical methods: standard deviation, coefficient of variation, skewness. Variables - scatter diagram, correlation linear regression, multiple linear regressions. Multivariate data analysis. Laboratory Sessions/ Experimental learning: • Data analysis using graphical representation Applications: • Test and verification of principles or hypothesis • Understand to draw histogram for the given frequency distribution of travel time of vehicle Video link / Additional online information: • https://nptel.ac.in/courses/105/105/105105150/	8Hrs
UNIT-II	
Time series analysis: Introduction, Stochastic process and its main Characteristics, Autoregressive-moving average models (ARMA), Forecasting in Box-Jenkins model. Laboratory Sessions/ Experimental learning: • Data analysis using Scilab Applications: • Time series analysis for traffic forecasting • Time series analysis for dataset produced by transportation system Video link / Additional online information: • https://nptel.ac.in/courses/103/106/103106123	8Hrs
UNIT-III	
Optimization technique and applications: Simplex Method, Big-M method,2 – Phase Simplex method-applications in Highway engineering problems Use of mathematical and statistical software packages. Laboratory Sessions/ Experimental learning: • Graphical method of optimization techniques • Data analysis using SPSS software Applications:	8Hrs

• Understand the application of mathematical and statistical software‟s in highway engineering problems Video link / Additional online information: • https://nptel.ac.in/courses/111/105/111105077/	
UNIT-IV	
Application of PDE: Classification of PDE- solution of one dimensional wave equation (Problems with non-zero initial displacement and zero initial velocity-problems with zero initial displacement and nonzero initial velocity) - Laplace equations-problems. Video links: • https://nptel.ac.in/pde	8Hrs
UNIT-V	
Fuzzy sets: Introduction –Fuzzy logic-Fuzzy systems: operation on Fuzzy sets, membership functions, Fuzzy relationships, Rules and Patches-Linguistic variable-DeFuzzification Techniques. Applications: • Fuzzy concepts are effectively used in construction field • Structural analysis and design Video links: • https://nptel.ac.in/ • https://www.khanacadamy.org	8Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concepts of linear and multi linear regressions.
CO2	Understand the concepts of time series in structural and transportation engineering.
CO3	Understand the concepts of optimization techniques in structural and transportation engineering
CO4	Understand the concepts of wave equations in structural engineering
CO5	Understand Fuzzy concept in civil field.

Reference Books	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10thedition,2014.
3.	T.Veerarajan: "Probability, Statistics and Random Process",3rdEdition,Tata Mc-Graw HillCo.,2016.
4.	Kadiyali.L.R. "Traffic Engineering and Transport Planning ", Khanna Publishers, Delhi, 2013

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: I		
SPECIAL CONCRETE AND LABORATORY (Theory and Practice)		
Course Code: MVJCSE12		CIE Marks:50+50
Credits: L:T:P: 3:0:1		SEE Marks: 50 +50
Hours: 40L + 26 P		SEE Duration: 03+03 Hours

Course Learning Objectives: The students will be able to	
1	Provide a comprehensive study of the constituent materials of concrete.
2	Learn the principles of concrete mix design, and assess the performance of special cement composite
3	Learn the characteristics and performance of various types of cement-based concrete.
4	Learn to characterize and predict the behaviour of special concrete
5	Give an insight to repair principles and quality control measures.

UNIT-I	
Constituent materials: Role of constituents, Components of modern concrete, Rheology, Mineral and Chemical admixtures and their effect on properties of concrete. **Special cements:** Need, Classifications, Blended cements, modified hydraulic cements, calcium aluminate cements, calcium sulphate based binders, calcium sulfo aluminate cements, shrinkage compensating (or) expansive cements, macro defect-free cements, phosphate cements, fast setting cements, their performance and prescriptive specifications, Methods of mix proportioning: IS method, ACI method and BS method. Laboratory Sessions/Experimental learning: • Experimental investigation on effect of different mineral and chemical admixtures on the properties of concrete. • Comparative study of IS, ACI and BS methods of mix proportioning. • Testing of special cements as per the code procedures. Applications: • Evaluating the effectiveness of admixtures on the rheological properties of concrete. • Provides insight of various techniques of mix proportioning using the standards. • Gain knowledge on the performance of blended cements. Video link / Additional online information: http://www.theconcreteportal.com- Rheology, effect of mineral and chemical admixtures on properties of concrete and mix design	8Hrs
UNIT-II	
Prerequisites: Knowledge in the fundamentals of concrete technology and material science. **Ferro cement**: Materials, mechanical properties, types and methods of construction, Design of ferrocement in tension and applications. **High density concrete:** Radiation shielding ability of concrete,	8Hrs

materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods. Self-compacting Concrete (SCC): Properties, microstructure, robustness, applications- adoption of SCC in the precast industry. Laboratory Sessions/Experimental learning: • Experimental investigation on the properties of ferrocement and SCC. • Experimental study on strength characteristics of high-density concrete. Applications: • Understanding the concepts and characteristic performance of ferro cement, high density and SC concrete. Video link / Additional online information: • http://www.theconcreteportal.com- Self-compacting Concrete. • https://nptel.ac.in/courses/105/102/105102012/- Self-compacting Concrete. https://www.understanding-cement.com	
UNIT-III	
Prerequisites: Knowledge in the fundamentals of concrete technology and material science. **Other concretes of special properties:** High-volume fly ash concretes, geo-polymer concrete, pervious concrete, aerated concrete, reactive powder concrete, bacterial concrete, Heat resistant and refractory concrete. Their significance, materials, general consideration strength and durability aspects. **Mixture proportioning and parameters in the development of Special concreting operations:** Shotcreting, Pre-placed aggregate, anti-washout concretes, concrete pumping, tremie placement for underwater applications. Laboratory Sessions/Experimental learning: • Experimental investigation on recent constituent materials used in concrete and evaluate their performance. Applications: • Gain knowledge on the feasibility of special properties concrete. • Provides knowledge on various concreting operations. Video link / Additional online information: • http://www.theconcreteportal.com- Concrete pumping, reactive powder concrete. • https://nptel.ac.in/courses/105/102/105102012/- High-volume fly ash concretes, geo-polymer concrete • https://www.understanding-cement.com- Shotcreting, aerated concrete. • https://ciks.cbt.nist.gov/garbocz/- Pervious concrete, Heat resistant and refractory concrete.	8Hrs
UNIT-IV	

Special Concretes: Sulfur concrete, Concrete made with waste rubber, Geo synthetics, Nano Concrete, Changes in concrete with respect to time. **High strength concretes:** Materials and mix proportion, properties in fresh and hardened state, applications. **Mass concrete and Roller compacted concrete:** Constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Laboratory Sessions/Experimental learning: • Experimental investigation on suitability and determining the strength parameters of special concretes. Applications: • Gain knowledge on the role of mix proportions and procedure to determine the fresh and hardened state of special concrete. Video link / Additional online information: • http://www.theconcreteportal.com- Changes in concrete with respect to time. • https://nptel.ac.in/courses/105/102/105102012/- Mass concrete and roller compacted concrete, high strength concrete. https://www.understanding-cement.com	8Hrs
UNIT-V	
Prerequisites: Knowledge in the fundamentals of concrete technology and material science. **Repair principles, materials and corrosion control measures:** Patches, overlay, repair mortars, sprayed concrete, FRP wrapping, corrosion, inhibitors, surface coatings and cathodic protection, Industrial waste materials in concrete Rapid wall panels. Sustainable & durable construction, Quality control and quality assurance during production/construction. Laboratory Sessions/Experimental learning: • Evaluation of corrosion protection methods by experimental investigations/studies. • Visit to construction site to understand construction quality management. Applications: • Gain knowledge on materials and methods of corrosion control. • Practical outlook on quality control and assurance as per the standards. • Understand the concept of recycling and reuse of materials in concrete with sustainable approach. Video link / Additional online information: • http://www.theconcreteportal.com- Quality control and assurance. • https://nptel.ac.in/courses/105/102/105102012/- Sustainable concrete.	8Hrs

• https://www.understanding-cement.com	

LABORATORY EXPERIMENTS

1. Determination of Compressive Strength of Self Compacting Concrete, including Mix design
2. Determination of Tensile Strength of Self Compacting Concrete Concrete, including Mix design
3. Determination of Compressive Strength of FRP Concrete, including Mix design
4. Determination of tensile strength of FRP concrete including mix design
5. Determination of compressive strength of high dtrength concrete
6. Determination of tensile strength of high strength concrete
7. Conducting test on beams for deflection
8. Conducting test on beams for flexure
9. Conducting test on beams for shear
10. Conducting NDT tests on materials using rebound hammer
11. Conducting NDt test on materials usind ultrasonic pulse velocity meter
12. Conducting NDt test on materials using profometer

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy.
CO2	Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete for special properties.
CO3	Evaluate the effect of the environment on service life performance, properties and failure of structural concrete.
CO4	Understand the concepts, mix proportioning of special concreting operations.
CO5	Understand the concepts of repair, sustainability and quality control.

Reference Books	
1.	Santhakumar A R, "Concrete Technology"- Oxford University Press, New Delhi, 2nd Edition, April 2018.
2.	Gambhir M L, "Concrete Technology: Theory and Practice", Tata McGraw Hill, Publishing Co. Ltd New Delhi, 5th edition, 2014.
3.	Krishnaraju N- "Design of concrete mixes" CBS Publishers and Distributors Pvt Ltd., Delhi, 5th edition, 2018.
4.	Mehta P K & P J M Monteiro, "Concrete: Microstructure, Properties and Materials", McGraw-Hill Education, 4th edition, 2013.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for

50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: I		
ADVANCED DESIGN OF RC STRUCTURES (Theory)		
Course Code: MVJ22CSE13		CIE Marks: 50
Credits: L:T:P: 3:1:0		SEE Marks: 50
Hours: 40L+10T		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	Make students to learn principle of structural design	
2	Design different types of structures	
3	Detail the structures	
4	Evaluate the performance of structures	
5	Develop analytical skills in solving structural problems.	

UNIT-I	
Basic Design Concepts: Limit state of Serviceability: Deflections of Reinforced concrete beams and slabs, short term deflection and long term deflection, estimation of crack width in RCC members, calculation of crack widths. Laboratory Sessions/ Experimental learning: • Cast a beam (either PCC or RC) and identify crack width Applications: • Design of multi-storey structures like apartments (10-20 storeys) • Video link / Additional online information: • https://nptel.ac.in/courses/105/106/105106117/	10Hrs
UNIT-II	
Limit Analysis of R.C. Structures: Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis for square and circular slabs with simple and continuous end conditions. Laboratory Sessions/ Experimental learning: • Compare the results of RC slab using normal and yield-line analysis and explain them Applications: • Design of multi-storey structures. Video link / Additional online information: • https://www.studocu.com/row/document/national-university-of-science-and-technology/structure-analysis/lecture-notes/chapter-1-9-yield-line-analysis-of-slabs/5916250/view	10Hrs
UNIT-III	
Design of Flat slabs: Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears – Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.	10Hrs

Laboratory Sessions/ Experimental learning: • Model making on flat slabs, Testing Flat slabs based on design and analysing failure criteria due to load Applications: • Design of multi-storey structures	
UNIT-IV	
Design of Reinforced Concrete Deep Beams & Corbels: Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels, Design of Procedure of Corbels. Laboratory Sessions/ Experimental learning: • Model making of Deep beams and corbels Applications: • Design of multistory and industrial structures	10Hrs
UNIT-V	
Design of Elevated Intz type of Water Tank, Design of silos and bunkers. Laboratory Sessions/ Experimental learning: • Model making on water tank, Silos and Bunkers Applications: • Design of industrial structures Video link / Additional online information: • https://nptel.ac.in/courses/105/105/105105105/	10Hrs

Course Outcomes: After completing the course, the students will 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.	Park A and Paulay, "Reinforced and Prestressed Concrete", John Wiley & sons,1st Edition, 2010.
2.	Kong K F and Evans T H, "Reinforced and Prestressed Concrete", CRC Press,3rd Edition ,2013.
3.	Varghese P.C., "Advanced Reinforced Concrete Design II Ed", Prentice-Hall of India, New Delhi,2nd Edition, 2005.
4.	Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Comprehensive RCC Design", Laxmi Publications,10th Edition 2015.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50

marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: I		
MECHANICS OF DEFORMABLE BODIES (Theory)		
Course Code: MVJ22CSE14		CIE Marks: 50
Credits: L:T:P: 2:1:0		SEE Marks: 50
Hours: 30L+10T		SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able to	
1	Make students to learn principles of Analysis of Stress and Strain
2	Predict the stress-strain behaviour of continuum
3	Evaluate the stress and strain parameters and their inter relations of the continuum
4	Develop the Propagation of waves in solid media
5	Apply the nonlinear stress strain relationship of concrete for design

UNIT-I	
Theory of Elasticity: Introduction: Definition of stress and strain and strain at a point, components of stress and strain at appoint of Cartesian and polar coordinates, Octahedral stresses, Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases, Generalized Hooke's law. Laboratory Sessions/ Experimental learning: • Formulating code of program for compatibility equation Applications: • Microscopic defects in solids • Load Carrying ability of Engineering Structures Video link / Additional online information: • Elasticity: https://nptel.ac.in/courses/105105177	8Hrs
UNIT-II	
Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatric stress, spherical and deviatric strains maximum shear strain. Laboratory Sessions/ Experimental learning: • Formulating code of program for Principal stresses, Strains, hydrostatic and deivatric stress Applications: • Continuum Mechanics • Yield criteria for ductile materials Video link / Additional online information: • Transformation of stress : https://nptel	8Hrs
UNIT-III	
Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentration due to the presence of a circular hole in plates.	8Hrs

Laboratory Sessions/ Experimental learning: • Model Making of Simple Bending of beam with instant result Applications: • Plate with riveted joint • Gas Pipeline Video link / Additional online information: • Plane stress and Strain : https://nptel.ac.in/courses/112101095/	
UNIT-IV	
Elementary problems of elasticity in three dimensions, stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media. Applications of finite difference equations inelasticity. Laboratory Sessions/ Experimental learning: • Development of Propagation of waves in solid media under given stress condition Applications: • Plate Analysis (Twist and Stretching) • Torsional effect in Circular Pipe Video link / Additional online information: • Prismatic Bar: https://nptel.ac.in/courses/105106049/	8Hrs
UNIT-V	
Theory of Plasticity: One-dimensional elastic-plastic relations, isotropic and kinematic hardening, yield function, flow rule, hardening rule, incremental stress-strain relationship, governing equations of elasto-plasticity, Yield and failure criteria-Stress strain relations for perfect elasto-plastic materials-Von Mises, Tresca and Mohr-Coulomb stress functions-simple elastic plastic problem-Expansion of a thick walled cylinder – incremental stress-strain relationship. Implementation of plasticity in metals and concrete – principles only – metals - plastic stress strain matrix for metals- nonlinear stress strain relation in concrete. Laboratory Sessions/ Experimental learning: • Check the stress condition in simple plastic problems • Model making of stress development in thick walled cylinder Applications: • Metal Forming • Failure Plane Prediction Video link / Additional online information: • Theory of plasticity:https://nptel.ac.in/courses/112/103/112103279/	8Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of stress-strain behaviour of
CO3	Design and develop analytical skills
CO4	Describe the continuum in 2and 3-dimensions

CO5	Describe the continuum in 2and 3-dimensions

Reference Books	
3.	Timoshenko &Goodier, "Theory of Elasticity", McGraw Hill,3rd Edition, 2017.
4.	Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 2nd Edition, 2015
3.	Varghese P.C., "Advanced Reinforced Concrete Design II Ed", Prentice-Hall of India, New Delhi,2nd Edition, 2005.
4.	Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd, 2nd Edition, 2012.

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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CO1	3	1	3	2	1	-	2	1	3	1	-	1
CO2	2	2	2	3	2	-	2	2	-	1	-	3
CO3	3	2	1	3	3	3	3	1	1	1	-	-
CO4	3	2	-	1	3	3	-	-	2	-	-	-
CO5	1	1	3	2	3	2	2	1	1	2	-	-

Semester: I		
STRUCTURAL DYNAMICS (Theory)		
Course Code: MVJ22CSE15		CIE Marks: 50
Credits: L:T:P: 2:1:0		SEE Marks: 50
Hours: 30L+10T		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	Learn principles of Structural Dynamics	
2	Implement these principles through different methods and to apply the same for free and forced vibration of structures	
3	Evaluate the dynamic characteristics of the structures	

UNIT-I	
Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, Basic Definition vibration of SDOF (Single Degree of Freedom) Systems , Damped, UnDamped, Free Vibrations equivalent Viscous damping, Logarithmic decrement. Mathematical models of Single-degree-of-freedom systems. Laboratory Sessions/ Experimental learning: • Experiments on determining the different vibration of Structure. Applications: • Understanding the different vibration acting on Structures. • Vibration mitigating materials like damping can be developed with thorough knowledge. Video link / Additional online information: • https://www.youtube.com/watch?v=pixaQGkM1-M/ • https://nptel.ac.in/courses/112105055	8Hrs
UNIT-II	
Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics **Response of Single-degree-of-freedom systems** to harmonic loading including support motion, vibration isolation, transmissibility, Principle of vibration measuring instruments–seismometer and accelerometer. Laboratory Sessions/ Experimental learning: Determining the complete response of an SDOF due to different Damping Condition. Applications: • The use of seismometer and accelerometer give the intensity of Vibration on a Structure. • The effect of damping can be understood using damped and un-damped SDOF. Video link / Additional online information: https://nptel.ac.in/courses/105101006/ • https://www.youtube.com/watch?v=RKfZ081epsM	8Hrs
UNIT-III	

Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics **Dynamics of Multi-degree freedom systems:** Mathematical models of multi-degree-of-freedom systems, Shear building. Concept, free vibration of un damped multi-degree-of-freedom systems–Natural frequencies and mode shapes – Orthogonality of modes. Laboratory Sessions/ Experimental learning: • Determining the Different Mode shapes in MDOF System using FEM software due to free and forced Vibration. • Determining the Different Natural frequency in MDOF System using FEM software due to free and forced Vibration. Applications: • The Different mode shapes and frequency can be determined due to free and forced Vibration. • Vibration on structures can be reduced using different damping condition. Video link / Additional online information: • https://nptel.ac.in/courses/105101006/ • https://nptel.ac.in/courses/105106151/	8Hrs
UNIT-IV	
Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics **Response of Shear buildings** for harmonic loading without damping using normal mode approach. Response of Shear buildings for forced vibration for harmonic loading with damping using normal modal approach. Laboratory Sessions/ Experimental learning: • Determining the Displacement in MDOF System using FEM software due to free and forced Vibration. • Determining the Displacement in MDOF System using FEM software due to free and forced Vibration Applications: • The Different Displacement can be determined due to free and forced Vibration. Video link / Additional online information: • https://nptel.ac.in/courses/105105166/ • https://nptel.ac.in/courses/105102016/	8Hrs
UNIT-V	
Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics **Approximate methods:** Rayleigh's method, Stodola & Dunkerley's method, Dynamics of Continuous systems: Flexural vibration of beams with different end conditions. Stiffness matrix, mass matrix (lumped and consistent).	8Hrs

Laboratory Sessions/ Experimental learning: • Determining the different Mode shapes and frequency in MDOF System using FEM software and comparing the result with Rayleigh's method. • Determining the different Mode shapes and frequency in MDOF System using FEM software and comparing the result with Stodola's method. • Determining the different Mode shapes and frequency in MDOF System using FEM software and comparing the result with Dunkarley's method. Applications: • The Different mode shapes and frequency can be determined due to free and forced Vibration by approximate methods. Video link / Additional online information: • https://swayam.gov.in/nd1_noc20_ce21/preview	

Course Outcomes: After completing the course, the students will be able to	
CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Dynamics
CO3	Design and develop analytical skills .
CO4	Summarize the Solution techniques for dynamics of Multi-degree freedom systems
CO5	Understand the concepts of damping in structures

Reference Books	
1.	Mukhopadhaya M , "structural dynamics Vibrations" Oxford IBH, 2nd Edition 2014.
2.	Mario Paz "Structural Dynamics" CBS publishers,5th Edition 2004
3.	Clough & Penzi "Structural Dynamics" en: TMH,2nd Edition 2018
4.	Timoshenko S, Van-Nostrand "Vibration Problems in Engineering" C, th Edition 2006

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: I		
RESEARCH METHODOLOGY AND IPR (Theory)		
Course Code: MVJ221PR16		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able to	
1	Give an overview of the research methodology and explain the technique of defining a research problem
2	Explain the functions of the literature review in research.
3	Explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
4	Explain various research designs and their characteristics
5	Explain the details of sampling designs, and also different methods of data collections.

UNIT-I	
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, **Research Ethics** and Problems Encountered by Researchers in India. Laboratory Sessions/Experimental learning: • Formulating Case study report on Problems Encountered by the Scholar's involved in research Applications: • Research Design • Layout Plan for Alternatives	8Hrs
UNIT-II	
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. **Reviewing the literature**: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Laboratory Sessions/Experimental learning: • Developing Conceptual Framework for Literature review under given issues Applications: • Review Paper Preparation	8Hrs

• Article Preparation for Research Video link / Additional online information: Review of Literatures: https://nptel.ac.in/courses/110/105/110105091/	
UNIT-III	
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. **Design of Sample Surveys:** Introduction, Sample Design, Sampling and Non- sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Laboratory Sessions/Experimental learning: • Preparation of particular layout for different types of sampling design Applications: • Strategy Planning for Resource Management • Alternatives Risk Management Video link / Additional online information: Qualitative Research : https://nptel.ac.in/courses/109105115/	8Hrs
UNIT-IV	
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method – Advanced Computing Techniques, Development of Software Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout, Records and Lab report Laboratory Sessions/Experimental learning: • Formulating Layout of Research Report for the given research work Applications: • Thesis Writing • Journal Writing Video link / Additional online information: Report Writing: https://nptel.ac.in/courses/121106007/	8Hrs
UNIT-V	
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992,	8Hrs

Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR.World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection. Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. Laboratory Sessions/Experimental learning: • Formulating Patent Draft for Provision Specifications with detailed diagrams Applications: • Provisional and Detailed Specification for filing the patent • Design patenting Video link / Additional online information: • Intellectual Property Rights: https://nptel.ac.in/courses/110105139/	

Course Outcomes: After completing the course, the students will be able to	
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs and their characteristics.
CO4	Explain the art of interpretation and the art of writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Reference Books	
1.	Pandey Neeraj &Dharni Khushdeep, "I*ntellectual Property Rights"*, PHI Learning Pvt Ltd 5th Edition,2014.
5.	Richard A. Spinello & Tavani H, "I*ntellectual Property Rights*", Information Science Publishing, 2nd Edition, 2004.
3.	Roger D. Blair, Thomas F. Cotter "*Intellectual Property Rights*", Cambridge University Press, 3rd Edition, 2005.
4.	"Research Methodology Methods and Techniques", C.R Kothari, New Age

	International Publishers,2004, 2nd Edition, ISBN (13) : 978-81-224-2488-1

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: I		
STRUCTURAL SOFTWARE LAB-I (Practice)		
Course Code: MVJ22CSEL17		CIE Marks:50
Credits: L:T:P: 1:0:1		SEE Marks: 50
Hours: 30		SEE Duration: 03 Hours

Course Learning Objectives: The students will be able	
1	To analyze the structure using FEM based Software.
2	To learn principles of design.
3	To investigate the performance of structural elements.
4	To design the structural components using excel sheets.

LABORATORY EXPERIMENTS
1. Static and Dynamic analysis and design of Multi-story Building structures using any FE based software 2. Modeling, Design and Analysis of RCC and Steel Tall structures using any FE based software 3. Analysis of folded plates and shells using any FE software. 4. Preparation of EXCEL sheets for structural design

Course Outcomes: After completing the course, the students will be able to	
CO1	Achieve Knowledge of design and development of experimenting skills.
CO2	Understand the principles of design of experiments
CO3	Design and develop analytical skills.
CO4	Summarize the testing methods and equipment's.

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, th Edition 2006

Continuous Internal Evaluation (CIE):

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: II		
ADVANCED DESIGN OF STEEL STRUCTURES (Theory)		
Course Code: MVJ22CSE21		CIE Marks: 50
Credits: L:T:P: 2:1:0		SEE Marks: 50
Hours: 30L+10T		SEE Duration: 3 Hrs.

Course Learning Objectives: The students will be able to	
1	Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them
2	Design different types of structures and to detail the structures
3	Proficiency in applying the provisions for design of columns, beams, beam-columns
4	Design structural sections for adequate fire resistance

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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)	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.	"Design of Steel Structures", N. Subramanian, , 5th Edition 2015, Oxford,IBH.
2.	Design of Steel structures, Duggal.S.K, 3rd Edition 2017.
3.	Advanced Mechanics of Solids, Srinath. L.S, 5th Edition 2019, McGraw-Hill Publishing Co ltd., New Delhi 3.
4.	IS 800: 2007, IS 811, IS 1641, 1642,1643
5.	INSDAG Teaching Resource Chapter 11 to 20

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: II		
FINITE ELEMENT METHOD AND LABORATORY (Theory and Practice)		
Course Code: MVJ22CSE22		CIE Marks:50+50
Credits: L:T:P: 3:0:1		SEE Marks: 50 +50
Hours:40 L+ 26 P		SEE Duration: 03+03 Hours
Course Learning Objectives: The students will be able to		
1	Make students to learn principles of Analysis of Stress and Strain	
2	Predict the stress-strain behaviour of continuum	
3	Evaluate the stress and strain parameters	
4	Study the inter relations of stress and strain parameters of the continuum	

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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	8 Hrs
UNIT-IV	
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	8 Hrs
UNIT-V	
Application of Finite Element Method for the analysis of two dimensional and three dimensional frame elements, Techniques for Non – linear Analysis.	8 Hrs
LABORATORY EXPERIMENTS	

1. Conducting Static analysis of multi-storied buildings using ETABS.Particle Size 2. Conducting Response spectrum analysis of multi-storied buildings using ETABS. 3. Conducting Time history analysis of multi-storied buildings using ETABS.

Course Outcomes: After completing the course, the students will 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.	"Finite Element Analysis"- Krishnamoorthy C S, 2nd Edition 2015, Tata McGraw Hill.
2.	"Introduction to the Finite Element Method", Desai C and Abel J F, 1972 - East West Press Pvt. Ltd.,
3.	"Finite Element Procedures in Engineering Analysis", Bathe K J, 3rd Edition 2015- Prentice Hall.
4.	"Finite Element Analysis in Engineering Design"-Rajasekaran. S, 4th Edition 2013, Wheeler Publishing,.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: II	
ADVANCED DESIGN OF PRE-STRESSED CONCRETE STRUCTURES (Theory)	
Course Code: MVJ22CSE231	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to	
1	Understand the general mechanical behaviour of prestressed concrete.
2	Able to analyze and design for deflection and crack control of prestressed concrete members
3	Perform analysis and design of prestressed concrete members
4	Be able to analyze transfer and development length as well as prestress losses.

UNIT-I	
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.	8 Hrs
UNIT-II	
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	8 Hrs
UNIT-III	
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	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.	"Prestressed concrete", Krishna Raju, Tata Mc Graw Hill Book – 6th Edition 2018.Co, New Delhi,
2.	"Design of prestress concrete structures", T.Y. Lin and Burn, John Wiley, 3rd Edition 2010, New York,
3.	"Prestressed concrete", S. Ramamrutham, Dhanpat Rai & Sons, 10th Edition 2019.Delhi,
4.	Prestressed Concrete by N.Rajagopalan, 2nd Edition 2005, Alpha Science,.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

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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

Semester: II	
EARTHQUAKE RESISTANT STRUCTURES (Theory)	
Course Code: MVJ22CSE232	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to	
1	The objective of this course is to make students to learn principles of engineering seismology.
2	To design the reinforced concrete buildings for earthquake resistance.
3	To evaluate the seismic response of the structures

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis, Static Push over analysis. Performance Based Seismic	8 Hrs

Engineering methodology, Seismic evaluation and retrofitting of structures.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principles of engineering seismology
CO2	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
CO3	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.	Theory and Application to Earthquake Engineering, 7th Edition 2018, Pearson Education,.
2.	Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (india), 3rd Edition 2016.
3.	Earthquake Resistant Design of Structures, Duggal, 5th Edition 2017, Oxford University Press,.
4.	Earthquake resistant design of structures – Pankaj Agarwal, Manish Shrikande – 4th Edition 2016, PHI India.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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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

Semester: II	
DESIGN OF PRECAST & COMPOSITE STRUCTURES (Theory)	
Course Code: MVJ22CSE233	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to	
1	Learn principles of precast materials preparation
2	Implement the Design of Precast Concepts.
3	Evaluate different methods of Analysis of precast materials.

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
Design of Precast Connections and Structural Integrity: Beam bearing, Socket Connection, Structural integrity, Avoidance of progressive collapse, Design of Structural Ties.	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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 precasted elements.

Reference Books	
1.	Precast Concrete, Hass A.M, Design and applications Applied Science, 1983.
2.	"Plant cast, Precast and Prestressed concrete David Sheppard –– 1989, McGraw Hill;
3.	NBC – 2005 (Part I to Part VII) BIS Publications, New Delhi, IS 15916- 2011, IS 11447, IS6061 – I and III
4.	Composite Structure of Steel and Concrete (Volume 1), R P Johnson: 1994, Blackwell Scientific Publication (Second Edition), U.K.,

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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

Semester: II	
RELIABILITY ANALYSIS OF STRUCTURES (Theory)	
Course Code: MVJ22CSE234	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to	
1	The objective of this course is to make students to learn principles of reliability.
2	To implement the Probability Concepts for the Reliability Analysis.
3	To evaluate different methods of reliability analysis.

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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).	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.	"Structural Reliability Analysis and design"- Ranganathan, R. (1999). 5nd Edition, Jaico publishing house, Mumbai, India,.
2.	"Probability concepts in engineering planning and design", Ang, A. H. S., and Tang, W. H. (1984). - Volume –I, 5th Edition 2015, John Wiley and sons, Inc, New York,.
3.	"Reliability based design in civil engineering"- Milton, E. Harr (1987). 3rd Edition, Mc Graw Hill book Co,.
4.	"Probability and reliability for Civil and Environmental Engineers", Nathabdndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, 2ndEdition - Mc Graw Hill international edition, Singapore.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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

Semester: II		
STABILITY OF STRUCTURES (Theory)		
Course Code: MVJ22CSE241		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	The objective of this course is to make students to learn principles of stability of structures.	
2	To analyse the structural elements for stability.	
3	To evaluate the use of strain energy in plate bending and stability.	

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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	8 Hrs

perpendicular to the direction of compression and having various edge condition along the other two sides.	

Course Outcomes: After completing the course, the students will 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.	"Theory of Elastic Stability"-Stephen P.Timoshenko, James M Gere, 2nd Edition, McGraw – Hill, New Delhi, 8th Edition 2013.
2.	"Concepts and Applications of Finite Element Analysis"-T Robert D Cook et.al, 3rd Edition, John Wiley and Sons, New York.
3.	"Computations and Structural Mechanics"-S.Rajashekar, 6th Edition 2018, Prentice – Hall, India,
4.	"Dynamics of Structures" Ray W Clough and J Penzien, - 2nd Edition, McGraw Hill, New Delhi, 5th Edition 2017.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: II	
DESIGN OF HIGH RISE STRUCTURES (Theory)	
Course Code: MVJ22CSE242	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to	
1	The objective of this course is to make students to learn principles of reliability.
2	To implement the Probability Concepts for the Reliability Analysis.
3	To evaluate different methods of reliability analysis.

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.	"Structural Analysis and Design of Tall Buildings"- Taranath B.S, 3rd Edition 2011, .McGraw Hill,
2.	"High rise building structures"- Wilf gang Schuller, 4th Edition 2012, John Wiley.
3.	"Tall building structures Analysis and Design"- Bryan Stafford Smith & Alexcoull, 2nd Edition 2017John Wiley,.
4.	"Structural concepts and system for Architects and Engineers" T. Y Lin & D.Stotes Burry, 4Th Edition 2015, - John Wiley.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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

Semester: II	
REPAIR AND REHABILITATION OF STRUCTURES (Theory)	
Course Code: MVJ22CSE243	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to	
1	Investigate the cause of deterioration of concrete structures.
2	To strategize different repair and rehabilitation of structures.
3	To evaluate the performance of the materials for repair

UNIT-I	
General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods, Quality assurance for concrete construction, as built concrete properties strength, permeability, thermal properties and cracking	8 Hrs
UNIT-II	
Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.	8 Hrs
UNIT-III	
Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration, testing techniques.	8 Hrs
UNIT-IV	
Materials for Repair: Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete. Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning.	8 Hrs
UNIT-V	
Examples of Repair to Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures - case studies.	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Achieve knowledge of design and development of problem solving skills.

CO2	Understand the cause of deterioration of concrete structures.
CO3	Design and develop analytical skills.
CO4	Summarize the principles of repair and rehabilitation of structures
CO5	Achieve knowledge of design and development of problem solving skills.

Reference Books	
1.	"Deterioration, Maintenance and Repair of Structures", Sidney, M. Johnson 3rd Edition,2018
2.	"Concrete Structures, Denison Campbell, Allen & Harold Roper,– Materials, Maintenance and Repair"- 7th Edition,2013, Longman Scientific and Technical 3,
3.	"Repair of Concrete Structures"-R.T.Allen and S.C. Edwards, 9th Edition,2015,Blakie and Sons,
4.	"Learning for failure from Deficiencies in Design, Construction and Service"-Raiker R.N., 5th Edition,2012, R&D Center (SDCPL0,

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	3	3	-	1	-	1
CO2	1	3	2	2	-	-	3	3	-	1	-	1
CO3	3	2	1	3	-	3	3	-	1	1	2	1
CO4	3	2	-	1	2	3	1	3	2	-	2	1
CO5	3	1	-	2	3	3	2	1	1	-	3	1

Semester: II		
STRUCTURAL HEALTH MONITORING (Theory)		
Course Code: MVJ22CSE244		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	Learn the fundamentals of structural health monitoring.	
2	Examines the use of low-cost, long term monitoring systems to keep civil infrastructure under constant surveillance.	
3	Ensure the structural integrity.	
4	Develop the tools and skills the students will learn in this course can be implemented to develop sustainable maintenance and rehabilitation schemes and programs.	

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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	8 Hrs

studies.	

Course Outcomes: After completing the course, the students will 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.	"Structural Health Monitoring", Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes, 5th Edition 2006Published by ISTE Ltd., U.K..
3.	"Health Monitoring of Structural Materials and Components-Methods with Applications", Douglas E Adams, 6th Edition 2007, John Wiley and Sons,.
4.	"Repair and Rehabilitation of RCC Building", 4th Edition 2002, Published by Director General, CPWD, Govt. of India,.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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

Semester: II		
STRUCTURAL SOFTWARE LAB-II (Practice)		
Course Code: MVJ22CSEL25		CIE Marks:50
Credits: L:T:P: 1 : 0 : 1		SEE Marks: 50
Hours:30		SEE Duration: 03 Hours
Course Learning Objectives: The students will be able to		
1	Learn the application of SKETCHUP	

LABORATORY EXPERIMENTS
1. Introduction to SKETCHUP. User Interface 2. Basic Tools in SKETCH UP 3. Creating 3D Elevation of structure 4. Creating Interior view of structure

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the general considerations of Drafting.
CO2	Achieve Knowledge application of SKETCH UP.
CO3	Understand the basic tools in SKETCH UP
CO4	Acquire the knowledge and ability to create 3D Elevation.

Reference Books	
1.	"Building Blocks of SketchUp", Robert Lang, 2020
2.	"Construction Documents using SketchUp Pro and LayOut" Paul Lee, 2020
3.	"Create Scenery & Props with SketchUp", John Romeo. 2021

Continuous Internal Evaluation (CIE):

Laboratory- 50 Marks

The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE):

Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

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

Semester: III		
DESIGN CONCEPTS OF SUB STRUCTURES (Theory)		
Course Code: MVJ22CSE31		CIE Marks: 50
Credits: L:T:P: 3:1:0		SEE Marks: 50
Hours: 40L+10T		SEE Duration: 3 Hrs.
Course Learning Objectives: The students will be able to		
1	Learn principles of subsoil exploration	
2	Design the sub structures	
3	Evaluate the soil shear strength parameters	
4	Design of deep foundation	
5	Design of well foundation	

UNIT-I	
Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts.	10 Hrs
UNIT-II	
Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C-Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.	10 Hrs
UNIT-III	
Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – super structure interaction effects & general concepts of structural design, Basement slabs, Machine foundation.	10 Hrs
UNIT-IV	
Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.	10 Hrs
UNIT-V	
Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations – general concepts	10 Hrs

Course Outcomes: After completing the course, the students will be able to

CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of subsoil exploration
CO3	Design and develop analytical skills.
CO4	Identify and evaluate the soil shear strength parameters.
CO5	Understand the concepts of Settlement analysis.

Reference Books	
1.	"Foundation Analysis and Design", J.E. Bowles –2nd Edition 1996, McGraw-Hill Int. Editions, Fifth Ed.,.
2.	"Design of Foundation Systems"- Nainan P Kurian –1st Edition 1992, Narosa Publishing House,.
3.	"Analysis & Design of Substructures"- Swami Saran –2nd Edition 1998. Oxford & IBH Pub. Co. Pvt. Ltd.,
4.	"Foundation Design"- W.C. Teng –3rd Edition 1983, Prentice Hall of India Pvt. Ltd.,.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	1	1	-	1
CO2	2	2	-	1	-	-	-	-	1	1	-	1
CO3	2	2	-	1	-	-	-	-	1	1	-	1
CO4	2	2	1	2	1	-	-	-	1	1	-	1
CO5	2	2	1	2	1	-	-	-	1	1	-	1

Semester: III		
DESIGN OF CONCRETE BRIDGES (Theory)		
Course Code: MVJ22CSE321		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	Make students to learn principles of bridge design	
2	Illustrate the various loads to be considered in bridge design.	
3	Design different types of bridge structures and to detail them using Limit State method of design.	
4	Evaluate performance of the Bridge structure.	
5.	Design and understand bridge substructures.	

UNIT-I	
Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges. Bridge substructures: Abutments, piers and wing walls. Economic span length-Types of loading-Dead load live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Seismic loads Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements.	8 Hrs
UNIT-II	
Box Culvert and Slab Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details. Specification for culverts as per MORTH Specifications for Road and Bridge Works, IRC Publication.	8 Hrs
UNIT-III	
Analysis and design of T-beam bridge: Proportioning of components, analysis of slab using IRC Class AA tracked vehicle, structural design of slab, analysis of cross girder for dead load & IRC Class AA tracked vehicle, structural design of cross girder, analysis of main girder using Courbon's method, calculation of dead load BM and SF, calculation of live load B M & S F, Structural design of main girder. Guidelines per MORTH Specifications for Road and Bridge Works, IRC Publication	8 Hrs
UNIT-IV	
PSC Bridges: Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force, cable profile and calculation of stresses, Design of End block and detailing of main girder Guidelines per	8 Hrs

MORTH Specifications for Road and Bridge Works, IRC Publication	
UNIT-V	
Substructures and Balanced Cantilever Bridge: Substructures - Design of Piers and abutments, Introduction to Bridge bearings, Hinges and Expansion joints. Specification for bearings as per MORTH Specifications for Road and Bridge Works, IRC Publication. Balanced Cantilever Bridge: Introduction and proportioning of components, Design of simply supported portion and design of cantilever portion, design of articulation	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe historical growth, various forces acting on bridges and select ideal site for bridge.
CO2	Analyse and design box and slab culverts using limit state method of design.
CO3	Analyse and design T-beam bridges using limit state method of design.
CO4	Analyse and design psc slab bridge and T-beam bridge using limit state method of design.
CO5	Design piers and abutments and describe the proportioning of components of a Balanced Cantilever bridge.

Reference Books	
1.	"Essentials of Bridge Engineering", Johnson Victor. D, 6th Edition, 2019.Oxford Publishing Company,
2.	"Design of Bridges, N Krishna Raju, 5th edition, 2019.Oxford and IBH publishing company,
3.	"Design of bridge structures", T R Jagadeesh and M A Jayaram, 2nd Edition, 2009, Prentice Hall of India,.
4.	Design of Concrete Bridges, M.G. Aswani, V.N. Vazirani and M.M. Ratwani, 8th Edition, 2014.

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):
Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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CO1	2	2	2	1	1	1	-	-	2	1	1	1
CO2	3	3	2	2	3	2	1	1	1	1	-	1
CO3	3	3	2	2	3	2	1	1	1	1	-	1
CO4	3	3	2	2	3	2	1	1	1	1	-	1
CO5	3	3	2	2	3	2	1	1	1	1	-	1

Semester: III	
DESIGN OF INDUSTRIAL STRUCTURES (Theory)	
Course Code: MVJ22CSE322	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able to	
1	Learn principles of design of industrial building.
2	Design different components of industrial structures and detail the structures.
3	Design industrial storage structures.
4	Design various cold formed light gauge sections.
5	Evaluate the performance of the Pre- engineered buildings.

UNIT-I	
Analysis of industrial building - Gravity and Wind load. Analysis and design of framing components namely, girders, trusses, gable frames.	8 Hrs
UNIT-II	
Analysis and design of gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections.	8 Hrs
UNIT-III	
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.	8 Hrs
UNIT-IV	
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.	8 Hrs
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.	"Design of Steel Structures", N Subramanian- 4th Edition, (2018), oxford University Press,
3.	"Design of Steel Structures", B.C. Punmia, A.K. Jain, 2nd revised Edition 2012Laxmi Publications, New Delhi..
4.	"Design of Steel Structures, Vol 1 (11th edition, 2012) and Vol.2 Ramchandra and Virendra Gehlot " (9th revised edition,2015), Scientific Publishers, Jodhpur.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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

Semester: III	
THEORY OF PLATES AND SHELLS (Theory)	
Course Code: MVJ22CSE323	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able to	
1	Make students learn different methods of analysis of plates and shells.
2	Make students learn different methods of design of plates and shells.
3	Energy methods for different types of plates.
4	To critically detail the plates & folded plates.
5	To evaluate the performance of spatial structures.

UNIT-I	
Introduction: Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions,Numerical Study of Buckling of Thin Plates.	8 Hrs
UNIT-II	
Energy Methods: Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.	8 Hrs
UNIT-III	
General Introduction to Shell Theory: Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids	8 Hrs
UNIT-IV	
Bending Theory of Shells: Axially symmetric bending of shells of revolution, Closed cylindrical shells, Buckling of thin cylindrical shells ,water tanks, spherical shells and Geckler's approximation. Bending theory of doubly curved shallow shells.	8 Hrs
UNIT-V	
Folded Plates: Introduction, folded plate behaviour, methods of analysis by Simpson's method, Design and detailing of folded plates with numerical examples.	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of Analysis and Design
CO3	Design and develop analytical skills.

CO4	Summarize the performance of shells
CO5	Understand the concepts of energy principle

Reference Books	
1.	"Theory of Plates and Shells" ,Timoshenko, S. and Woinowsky-Krieger, W., 2nd Edition, McGraw-Hill Co., New York.
2.	"Theory and analysis of plates - classical and numerical methods", R. Szilard, 3rd Edition,1994, Prentice Hall,
3.	"Theory and Design of Concrete Shell", Chatterjee. B. K. –– 3rd edition, 1988, Chapman & Hall, New York-
4.	"Design and Constructions of Concrete Shell Roofs", Ramaswamy G.S. –– 2nd Edition1986, CBS Publishers and Distributors – New Delhi –.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
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CO1	3	2	1	2	2	3	1	2	2	3	2	
CO2	2	2	2	3	1	2	1	1	3	2	1-	-
CO3	3	3	2	3	1	3	2	2	1	1	2	-
CO4	2	1	2	-	3	2	3	-	2	3	2	1
CO5	3	2	2	1	2	3	2	3	1	2	2	3

Semester: III	
FRACTURE MECHANICS APPLIED TO CONCRETE (Theory)	
Course Code: MVJ22CSE324	CIE Marks: 50
Credits: L:T:P: 3:0:0	SEE Marks: 50
Hours: 40L	SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to	
1	Learn basic concepts of fracture mechanics.
2	Impart knowledge on the mechanisms of failure during static and dynamic loading.
3	Understand the failure mechanism of creep rupture.
4	Study nonlinear fracture mechanics.

UNIT-I	
Fracture mechanism and crack growth: Fundamentals of Fracture Mechanics, Mechanisms of fracture and crack growth	8 Hrs
UNIT-II	
Different Fractures and Cracking: Cleavage fracture, ductile fracture, fatigue cracking, Environment assisted cracking, Quasi-brittle materials.	8 Hrs
UNIT-III	
Fracture Analysis : Service failure analysis, linear elastic fracture mechanics, Griffith's criteria, stress intensity factors, crack tip plastic zone, Erwin's plastic zone correction, R curves, compliance, J Integral, nonlinear analysis, Review of concrete behaviour in tension and compression, Basic frameworks for modelling of quasibrittle materials.	8 Hrs
UNIT-IV	
Nonlinear Fracture Mechanics: Nonlinear Fracture Mechanics, Discrete crack concept/smeared crack concept, Size effect, Plasticity models for concrete, Associated and non-associated flow, Failure surfaces for quasibrittle materials.	8 Hrs
UNIT-V	
Continuum Damage Mechanics : Concept of CTOD and CMD, Material models, crack models, band models	8 Hrs

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the behaviour of concrete with tension and compression failure surfaces
CO2	Ability to design the structure to prevent fatigue and creep.
CO3	Ability to define different deformation and related theories.
CO4	Understand the concepts of CTOD and CMD
CO5	Identify the behaviour of concrete with tension and compression failure surfaces

Reference Books	
1.	"Elementary Engineering Fracture Mechanics", David Broek, Sijthoff & Noordhoff and Alphen aan den Rijn, Netherlands, 3rd Edition,2015
2.	, "Fracture Mechanics of Concrete Structures, Rilem Report– Theory and Applications", Edited by L. Elfgreen, Chapman and Hall,1st Edition, 1989.
3.	"Fracture Mechanics – Applications to Concrete", Victor, C., Li and Z. P. Bazant, ACI SP 118.
4.	"Continuum Mechanics Fundamentals", Valliappan S., 2nd Edition,1982, Oxford IBH, New Delhi,

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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CO3	3	3	1	1	-	3	3	3	-	1	-	1
CO4	3	3	-	-	-	3	3	3	-	-	-	1
CO5	3	2	-	-	-	3	3	1	-	-	-	1

Semester: III		
SUSTAINABILITY CONCEPTS IN ENGINEERING (Theory)		
Course Code: MVJ22CSE331		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	Describe about the principles, indicators, and general concept of sustainability	
2	Apprehend the local, regional, and global impacts of unsustainable designs, products and processes	
3	Student shall be able to apply the sustainability concepts in engineering	
4	Know built environment frameworks and their use	
5	Analyze how building and design is judged and valued by clients and stakeholders and how to implement sustainability	

UNIT-I	
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.	8 Hrs
UNIT-II	
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	8 Hrs
UNIT-III	
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,	8 Hrs

Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.	
UNIT-IV	
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.	8 Hrs
UNIT-V	
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	8 Hrs

Course Outcomes: After completing the course, the students will 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.	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

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

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Semester End Examination (SEE):
Total marks: 50+50=100
SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

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CO3	1	2	2	1	-	1	-	-	-	-	-	1
CO4	3	1	1	1	1	-	-	-	1	-	2	-
CO5	1	1	1	-	-	2	-	-	3	-	-	1

Semester: III		
REMOTE SENSING AND GIS (Theory)		
Course Code: MVJ22CSE332		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.

Course Learning Objectives: The students will be able to	
1	State the basic concepts of Remote Sensing.
2	Identify the various Remote Sensing Platforms and its limitations
3	Illustrate various international space programs
4	Brief various Geographical Information System (GIS) method
5	Solve real time problem by the application of RS & GIS

UNIT-I	
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.	8 Hrs
UNIT-II	
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.	8 Hrs
UNIT-III	
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	8 Hrs
UNIT-IV	
Introduction to Geographical Information System (GIS): Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. **Data Structure:**	8 Hrs

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)	
UNIT-V	
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.	8 Hrs

Course Outcomes: After completing the course, the students will 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.

Reference Books	
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
3.	Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
4.	John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2nd dition – by Pearson Education 2007

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):
Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	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

Semester: III		
OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT (Theory)		
Course Code: MVJ22CSE333		CIE Marks: 50
Credits: L:T:P: 3:0:0		SEE Marks: 50
Hours: 40L		SEE Duration: 03 Hrs.
Course Learning Objectives: The students will be able to		
1	To understand the concepts of global scenario of Health & safety	
2	Students should be able to analyze and solve basic agronomical issues	
3	To be efficient in the operation of industrial hygiene equipment	
4	To illustrate the importance and need of Fire & Safety	
5	Students should be able to know the basics of fire and its classification	

UNIT-I	
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	8 Hrs
UNIT-II	
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	8 Hrs
UNIT-III	
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	8 Hrs
UNIT-IV	
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	8 Hrs
UNIT-V	
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	8 Hrs

Course Outcomes: After completing the course, the students will 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 analyze 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.	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
3.	Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, United Kingdom
4.	Handbook Of Fire Technology By: R.S. Gupta, Orient Longman Publishers, Second Edition, 2005
5.	Handbook Of Fire And Explosion Protection Engineering By: Dennis P Nolan, Crest Publishing House, First Edition, 2007

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

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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