

Course Title	ADVANCED DESIGN OF RCC STRUCTURES	Semester	I
Course Code	MVJ20CSE11	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	4	Exam Duration	3Hrs

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

- Make students to learn Principles of Reinforced Concrete Structures
- Design different types of structures
- Detail the structures.
- Evaluate the performance of structures
- Develop analytical skills in solving structural problems.

Module-1

L3,L4 & L5

12Hrs.

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.

Laboratory Sessions/ Experimental learning:

- Cast a beam (either PCC or RCC) 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/>

Module-2

L3,L4 & L5

12Hrs.

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, Introduction to Plastic Analysis.

Laboratory Sessions/ Experimental learning:

- Compare the results of RCC 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>

Module-3

L3,L4 & L5

12Hrs.

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.

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

Module-4

L3,L4 & L5

12Hrs.

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

Module-5

L3,L4,L5

12Hrs.

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/>

Course outcomes: On completion of the course, students would be able to	
CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Design
CO3	Design and develop analytical skills.
CO4	Summarize the principles of Structural Design and detailing
CO5	Understands the structural performance.

Reference Books:	
1.	R. Park and T. Paulay, “Reinforced Cement Concrete Structures”, MISL-WILEY Series, Wiley India Pvt. Ltd, 2009. .
2.	Kong K F and Evans T H, “Reinforced and Prestressed Concrete“, CRC Press,3 rd Edition ,2013.
3.	Varghese P.C., "Advanced Reinforced Concrete Design II Ed", Prentice-Hall of India, New Delhi,2 nd Edition, 2005.
4.	Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, “Comprehensive RCC Design”, Laxmi Publications,10 th Edition 2015.
5.	Bungey and Mosley, “Reinforced Concrete”, Palgrave Macmillan, 5 th Edition, 2012

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

High-3, Medium-2, Low-1

Course Title	MECHANICS OF DEFORMABLE BODIES	Semester	I
Course Code	MVJ20CSE12	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	4	Exam Duration	3Hrs

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

- Make students to learn principles of Analysis of Stress and Strain
- Predict the stress-strain behaviour of continuum
- Evaluate the stress and strain parameters and their inter relations of the continuum
- Restate the concepts of Propagation of waves in solid media
- Apply the nonlinear stress strain relationship of concrete for design

Module-1

L3

12Hrs

Theory of Elasticity: Introduction: Definition of stress and strain and strain at a point, components of stress and strain at a point 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:

- Octahedral stress representation on solids
- Load Carrying ability of Engineering Structures

Video link / Additional online information:

- Elasticity: <https://nptel.ac.in/courses/105105177/>

Module-2

L3

12Hrs

Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress, spherical and deviatoric strains maximum shear strain.

Laboratory Sessions/ Experimental learning:

- Formulating code of program for Principal stresses, Strains, hydrostatic and deviatoric stress

Applications:

- Invariant stress distribution
- Yield criteria for ductile materials

Video link / Additional online information:

- Transformation of stress : <https://nptel.ac.in/courses/112102284/>

Module-3

L3

12Hrs

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.

Laboratory Sessions/ Experimental learning:

- Model Making of beam under simple bending

Applications:

- Plate with riveted joint
- Gas Pipeline

Video link / Additional online information:

- Plane stress and Strain : <https://nptel.ac.in/courses/112101095/>

Module-4

L3,L4

12Hrs

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/>

Module-5	L3	12Hrs
<p>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.</p> <p>Laboratory Sessions/ Experimental learning:</p> <ul style="list-style-type: none"> • Check the stress condition in simple plastic problems • Model making of stress development in thick walled cylinder <p>Applications:</p> <ul style="list-style-type: none"> • Metal Forming • Failure Plane Prediction in Earthquake and its vibration <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Theory of plasticity: https://nptel.ac.in/courses/112/103/112103279/ 		
<p>Course outcomes: On completion of the course, students would be able to</p>		
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	Understand the concepts of elasticity and plasticity.	

Reference Books:	
1.	Timoshenko & Goodier, “ <i>Theory of Elasticity</i> ”, McGraw Hill, 3 rd Edition, 2017.
2.	Srinath L.S., <i>Advanced Mechanics of Solids</i> , , Tata McGraw Hill Publishing company, New Delhi, 10 th Edition, 1994.
3.	Sadhu Singh, “ <i>Theory of Elasticity</i> ”, Khanna Publishers, 2 nd Edition, 2015
4.	Verma P.D.S, “ <i>Theory of Elasticity</i> ”, Vikas Publishing Pvt. Ltd, 2 nd Edition, 2012.
5.	Chenn W.P and Hendry D.J, “ <i>Plasticity for Structural Engineers</i> ”, Springer Verlag, 5 th Edition 2007.
6.	Valliappan C, “ <i>Continuum Mechanics Fundamentals</i> ”, Oxford IBH Publishing Co.Ltd, 1 st

	Edition 2016.
7.	Xi Lu, “ <i>Theory of Elasticity</i> ”, John Wiley, 9 th Edition 2002
8.	Mohammed Ameen, “ <i>Computational Elasticity: Theory of Elasticity and Finite and Boundary Element Methods</i> ”, Alpha Science International, 2005.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	-	

High-3, Medium-2, Low-1

Course Title	STRUCTURAL DYNAMICS	Semester	I
Course Code	MVJ20CSE13	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	4	Exam Duration	3Hrs

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

- Learn principles of Structural Dynamics
- Implement these principles through different methods and to apply the same for free and forced vibration of structures
- Evaluate the dynamic characteristics of the structures

Module-1

L3,L5

12Hrs

Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics

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 and damping

Video link / Additional online information:

- <https://www.youtube.com/watch?v=pixaQGkM1-M/>
- <https://nptel.ac.in/courses/112105055>

Module-2

L3, L4, L5

12Hrs

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, Duhamel Integration.

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>

Module-3

L3, L4, L5

12Hrs

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/>

Module-4

L3, L4, L5

12Hrs

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.
- The displacement due to Earthquake loads

Video link / Additional online information:

- <https://nptel.ac.in/courses/105105166/>
- <https://nptel.ac.in/courses/105102016/>

Module-5

L3, L4

12Hrs

Prerequisites: Knowledge in the fundamentals of structural analysis and Engineering Mathematics

Approximate methods: Rayleigh's method, Stodola and Dunkerley's method Dynamics of Continuous systems: Flexural vibration of beams with different end conditions. Stiffness matrix, mass matrix (lumped and consistent).

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 wrt to bridges under moving load.
- Determining the different Mode shapes and frequency in MDOF System using FEM software and comparing the result with Stodola's method wrt to bridges under moving load.
- Determining the different Mode shapes and frequency in MDOF System using FEM software and comparing the result with Dunkerley's method wrt to bridges under moving load.

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

CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural 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 , “ <i>Structural Dynamics - Vibrations and Systems</i> ” Oxford IBH, 2 nd Edition 2014.
2.	Mario Paz “ <i>Structural Dynamics</i> ” CBS publishers,5 th Edition 2004
3.	R W Clough and J Penzien, 1993, Dynamics of Structures, 2nd Edition, McGraw-Hill, New York
4.	Timoshenko S, Van-Nostrand “ <i>Vibration Problems in Engineering</i> ” C, th Edition 2006
5.	Anil K. Chopra, Dynamics of Structures – “ <i>Theory and Application to Earthquake Engineering</i> ”, Pearson Education,2 nd Edition 2015
6.	Vinod Hosur, WILEY “ <i>Earthquake Resistant Design of Building Structures</i> ” (India),2 nd Edition 2014

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

High-3, Medium-2, Low-1

Course Title	SPECIAL CONCRETES	Semester	I
Course Code	MVJ20CSE14	CIE	50
Total No. of Contact Hours	60 L: T: P: 40: 0: 20	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	4	Exam Duration	3Hrs

Course objective is to:

- Provide a comprehensive study of the constituent materials of concrete.
- Learn the principles of concrete mix design, and assess the performance of special cement composite.
- Learn the characteristics and performance of various types of cement-based concrete.
- Learn to characterize and predict the behaviour of special concrete.
- Give an insight to repair principles and quality control measures.

Module-1

L3 & L5

12Hrs

***Prerequisites:** Knowledge in the fundamentals of concrete technology and material science.*

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.
- Test on cement as per IS: 4031 & IS: 456, IS: 10262; SP 23”

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.
- <https://nptel.ac.in/courses/105106176>- Role of constituents of concrete, Rheology, effect of mineral and chemical admixtures on properties of concrete and mix design.
- <https://www.understanding-cement.com>
- <https://ciks.cbt.nist.gov/garboch/>

Module-2	L3 & L5	12Hrs
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Prerequisites: Knowledge in the fundamentals of concrete technology and material science.

Fibre Reinforced Concrete: Materials, mechanical properties, types and methods of construction, Design of ferrocement in tension and applications.

High density concrete: Radiation shielding ability of concrete, 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>

Module-3	L3 & L4	12Hrs
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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/garboz/>- Pervious concrete, Heat resistant and refractory concrete.

Module-4

L3 & L4

12Hrs

Prerequisites: Knowledge in the fundamentals of concrete technology and material science.

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>

Module-5

L3

12Hrs

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.
- <https://www.understanding-cement.com>

Course outcomes: On completion of the course, students would 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, 2 nd Edition, April 2018.
2.	Gambhir M L, “Concrete Technology: Theory and Practice”, Tata McGraw Hill, Publishing Co. Ltd New Delhi, 5 th edition, 2014.
3.	Krishnaraju N- “Design of concrete mixes” CBS Publishers and Distributors Pvt Ltd., Delhi, 5 th edition, 2018.
4.	Mehta P K & P J M Monteiro, “Concrete: Microstructure, Properties and Materials”, McGraw-Hill Education, 4 th edition, 2013.
5.	Aitcin P C, “High Performance Concrete”- Boca Raton: CRC Press, 2019.
6.	Rafat Siddique “Special Structural Concretes”, Galgotia publications, New Delhi, 2000.
7.	Neville. A. M “Properties of Concrete”, Prentice Hall, 5 th edition, 2012.
8.	M S Shetty and A K Jain, “Concrete Technology”, S. Chand publishing House Ltd., New Delhi, Eighth edition, 2018.
9.	Rixom R and Mailvaganam N, “Chemical admixtures in concrete”- E and FN Spon, London, 3 rd Edition, 1999.
10.	Newman J & Choo B S, “Advanced concrete technology 3: processes”, Butterworth-Heinemann, 1 st edition, 2003.
11.	ACI 211, Code for Mix Design.
12.	IS 10262-2009, Concrete Mix Proportioning – Guidelines, BIS, New Delhi.
13.	BS 8110: Part 1- Structural use of concrete - Code of practice for design and construction.

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

High-3, Medium-2, Low-1

Course Title	REPAIR AND REHABILITATION OF STRUCTURES	Semester	I
Course Code	MVJ20CSE15	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	SEE	50
No. of Contact Hours/Week	3	Total	100
Credits	3	Exams Duration	3Hrs

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

- Investigate the cause of deterioration of concrete structures.
- To strategize different repair and rehabilitation of structures.
- To evaluate the performance of the materials for repair

Module-1	L3, L5	12 Hrs
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Prerequisites: Knowledge in the fundamentals of Advanced Concrete Technology

General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, 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.

Laboratory Sessions/ Experimental learning:

- Investing on Deterioration of Concrete Structures by Chemical tests.
- Experiment on concrete structures by NDT methods.

Applications:

- Deterioration of concrete can be reduced by great extent.
- NDT gives the quality of the concrete structures.

Video link / Additional online information:

- <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ce26/>
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104030/lec38.pdf

Module-2	L3, L4, L5	12 Hrs
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Prerequisites: Knowledge in the fundamentals of Advanced Concrete Technology

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.

Laboratory Sessions/ Experimental learning:

- Testing of Concrete due to Environmental impacts.

Applications:

- Behavior of Concrete due to environmental impacts can be understood.
- Metals can be protected against Corrosion.

Video link / Additional online information:

- <https://nptel.ac.in/courses/113108051/>
- <https://www.youtube.com/watch?v=5OxdXq91TV0>

Module-3	L2, L3, L5	12 Hrs
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Prerequisites: Knowledge in the fundamentals of Advanced Concrete Technology

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.

Laboratory Sessions/ Experimental learning:

- Determining the causes of deterioration the different methods.

Applications:

- Structures can be maintained which fulfills the efficient usage of structure.
- By understanding the causes of deterioration, respective maintenance and repair strategies can be adopted.
- The Structures can be repaired against deterioration.

Video link / Additional online information:

- <https://nptel.ac.in/courses/105/106/105106202/>
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105102176/lec54.pdf

Module-4	L2	12 Hrs
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Prerequisites: Knowledge in the fundamentals of Advanced Concrete Technology

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, Guniting and Shot Crete

Epoxy injection, Mortar repair for cracks, shoring and underpinning.

Laboratory Sessions/ Experimental learning:

- Testing of concrete by special elements for accelerated strength gain.
- Manufacturing of Fibre Reinforced Concrete.
- Analysing the strength of concrete by repairing the crack.

Applications:

- Strength of Concrete can be increased by repairing the crack.
- The fibre reinforced concrete can be used for improved strength.
- The rust formation can be eliminated by rust eliminators.
- Concrete repair can be achieved by various methods.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104030/lec38.pdf
- https://swayam.gov.in/nd1_noc20_ce26/preview

Module-5

L2,L5

12 Hrs

Prerequisites: Knowledge in the fundamentals of Advanced Concrete Technology

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.

Laboratory Sessions/ Experimental learning:

- Determining the amount of deflection in concrete by external loading.
- Analyzing the concrete for its reduction in strength due to Cracking.

Applications:

- Increasing the strength of structures can be achieved by repairing the cracks.
- The deterioration of structure against chemical, fire, marine effects can be understood

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104030/lec38.pdf

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

CO1	Achieve knowledge of design and development of problem solving skills.
CO2	Understand the cause of deterioration of concrete structures.
CO3	Design and develop analytical skills.
CO4	Summarize the principles of repair and rehabilitation of structures

CO5	Understands the concept of Serviceability and Durability.
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Reference Books:	
1.	Sidney, M. Johnson “Deterioration, Maintenance and Repair of Structures”.3 rd Edition,2018
2.	Denison Campbell, Allen & Harold Roper, “Concrete Structures – Materials, Maintenance and Repair”- Longman Scientific and Technical 3, 7 ^h Edition,2013
3.	R.T.Allen and S.C. Edwards, “Repair of Concrete Structures”-Blakie and Sons, 9 th Edition,2015
4.	Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service”- R&D Center (SDCPL0, 5 th Edition,2012

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	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

High-3, Medium-2, Low-1

Course Title	ADVANCED CONCRETE LAB	Semester	I
Course Code	MVJ20CSEL16	CIE	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	2	Exam Duration	3Hrs

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

- To learn principles of design of experiments.
- To investigate the performance of structural elements
- Use of Non-destructive testing (NDT) equipment's –Rebound hammer, Ultra sonic pulse velocity meter and Profometer

SL.NO	Experiments	L3
1	Determination of Tensile and Compressive Strength of Concrete, including Mix design	
2	Conducting Test on beams for deflection, flexure and shear	
3	Conducting Non-destructive testing on materials using (NDT) equipment's –Rebound hammer, Ultra sonic pulse velocity meter and Profometer	

Video link / Additional online information:

- <https://www.csiamerica.com/products/etabs>
- <https://www.youtube.com/watch?v=LOtuwW9-G68>

Course outcomes: On completion of the course, students would 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.	Santhakumar R, (2007) "Concrete Technology"-Oxford University Press, New Delhi,3 rd Edition, 2007.
2.	Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House,3 rd Edition 1978.
3.	Aitcin P.C. "High Performance Concrete"-E and FN, Spon London, 2 nd Edition 2004.

4.	Rixom.R. and Mailvaganam.N., “Chemical admixtures in concrete”- E and FN, Spon, London, 2 nd Edition 2000
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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

High-3, Medium-2, Low-1

Course Title	STRUCTURAL SOFTWARE LAB-1	Semester	I
Course Code	MVJ20CSEL17	CIE	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	SEE	50
No. of Contact Hours/Week	4	Total	100
Credits	2	Exam Duration	3Hrs

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

- To analyze the structure using FEM based Software.
- To learn principles of design.
- To investigate the performance of structural elements.
- To design the structural components using excel sheets.

SL.NO	Experiments	L4, L5, L6
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	

Video link / Additional online information:

- <https://www.nptel.ac.in/courses/121106007/>
- <https://nptel.ac.in/courses/107108011/>

Course outcomes: On completion of the course, students would 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 , “ <i>structural dynamics Vibrations</i> ” Oxford IBH, 2 nd Edition 2014.
2.	Mario Paz “ <i>Structural Dynamics</i> ” CBS publishers,5 th Edition 2004
3.	Timoshenko S, Van-Nostrand “ <i>Vibration Problems in Engineering</i> ” C, th Edition 2006

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

High-3, Medium-2, Low-1

Course Title	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	Semester	I
Course Code	MVJ20IPR18	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	SEE	50
No. of Contact Hours/Week	2	Total	100
Credits	2	Exam Duration	3Hrs

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

- Give an overview of the research methodology and explain the technique of defining a research problem
- Explain the functions of the literature review in research.
- Explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs and their characteristics
- Explain the details of sampling designs, and also different methods of data collections.
- Explain the art of interpretation and the art of writing research reports.
- Explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Module-1	L3	12Hrs
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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

Module-2	L3	12Hrs
<p>Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.</p> <p>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.</p> <p>Laboratory Sessions/Experimental learning:</p> <ul style="list-style-type: none"> • Developing Conceptual Framework for Literature review under given issues <p>Applications:</p> <ul style="list-style-type: none"> • Review Paper Preparation • Article Preparation for Research <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Review of Literatures: https://nptel.ac.in/courses/110/105/110105091/ 		
Module-3	L3	12Hrs
<p>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.</p> <p>Design of Sample Surveys: Introduction, Sample Design, Sampling and Non- sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.</p> <p>Laboratory Sessions/Experimental learning:</p> <ul style="list-style-type: none"> • Preparation of particular layout for different types of sampling design <p>Applications:</p> <ul style="list-style-type: none"> • Strategy Planning for Resource Management • Alternatives Risk Management <p>Video link / Additional online information:</p> <ul style="list-style-type: none"> • Qualitative Research : https://nptel.ac.in/courses/109105115/ 		
Module-4	L3	12Hrs
<p>Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of</p>		

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/>

Module-5

L3

12Hrs

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) Act 1999, 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, 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: On completion of the course, students would 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>Intellectual Property Rights</i> ”, PHI Learning Pvt Ltd 5 th Edition, 2014.
2.	Richard A. Spinello & Tavani H, “ <i>Intellectual Property Rights</i> ”, Information Science Publishing, 2nd Edition, 2004.
3.	Roger D. Blair, Thomas F. Cotter “ <i>Intellectual Property Rights</i> ”, Cambridge University Press, 3 rd Edition, 2005.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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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

High-3, Medium-2, Low-1