ADVANCED DESIGN OF RC STRUCTURES
As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
SEMESTER – I

Course Code	23SEC11	**CIE**	50
Number ofLecture Hours/Week	03+1	**SEE**	50
Total Number ofLecture Hours	52	**Exam Hours**	03

CREDITS – 04

Course objectives:

The objectives of this course are,

1. To make students to learn design principles of structures, design of different types of structures and detailing of the structures.
2. To evaluate performance of thestructures.

Course Outcomes(COs):

On completion of this course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	AchieveKnowledgeofdesignanddevelopmentofproblem-solvingskills.		
CO2	Understand the principles of structural analysis and design		
CO3	Design and development ofanalyticalskills.		
CO4	Summarize the principles,structural designand detailing.		
CO5	Understanding the concepts of formwork.		

Bloom's level of the course outcomes:

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√	√	√	√		
CO2	√	√	√	√	√	
CO3	√	√	√	√		
CO4				√	√	
CO5	√	√		√		

Course Articulation Matrix / Course mapping :

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	3	2	1					1			1	3		
CO2	3	3	3	1	1				1			1	3		
CO3	3	3	3	2	1				1			1	3		
CO4	3	2	3	2					1			1	3		
CO5	3	2	3	1					1			2	3		
Note: 1-Low, 2-Medium, 3-High															

Modules	Teaching Hours	RBT Level
Module -1		
Yield line method of design of slabs. Introduction, fundamental concepts of yield line theory, location of yield lines for standard cases, internal force in yield lines, methods of yield line by equilibrium approach, yield line analysis of one way and two-way rectangular slab, circular slab and rectangular slab supported on three sides. Yield line design of one way and two-way rectangular slab.	**10 Hours**	**L_1, L_2, L_3, L_4,**
Module -2		
Design of grid floors. Introduction, analysis, and design of grid floors by approximate method. **Designof flat slabs.** Introduction, Proportioning of flats labs, Determination of bending moment and shear force, direct design method, equivalent frame method – Reinforcement Detailing	**12Hours**	**L_1, L_2, L_3, L_4, L_5**
Module -3		
Deep Beams: General features, Parameter influencing design, Flexural bending, and shear stresses in deep beams. Design provisions of IS-456, Checking for local failures, Strut, and tie analysis of deep beams, Detailing of reinforcement in deep beams. Concept and design of any two simple cases for curved beam.	**10 Hours**	**L_1, L_2, L_3, L_4,**
Module -4		
RC bunkers and silos Introduction, Design of rectangular bunkers, circular bunkers, and silos, including Reinforcement Detailing.	**10 Hours**	**L_4, L_5**
Module -5		

Introduction, formwork as a temporary structure, Requirements for formwork, selection of formwork,classification or types of formworks, Materials for formwork: Timber, Plywood, Steel, Aluminum, Plastic, and other materials. Design concepts: loads on formwork, dead load, or permanent load, imposed load, environmental load, the design basis (Assumption made in formwork design) estimating permissible stresses, maximum bending moment, shear force and deflection, numerical problems.	**10 Hours**	**L_1, L_2, L4**

Question paper pattern:

- The question paper will have tenquestions.
- Each full question consists of 10marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full question from each module.

REFERENCE BOOKS:

1. N Krishna raju "Design of advance R C structure" CBS publication, New delhi
2. A.K.Jain "Limit state method of design neemchand and bros roorkee
3. Park and pandey "Reinforced concrete" john witney and bros
4. B.C Punmia , Ashokkumar and Jain A K Jain – "Limit state design of reinforced concrete" laxmi publication new delhi
5. V. Ram Krishnan and P.D Arthm "Ultimate strength design of structural concrete" Wheeler books Allahabad
6. IS 456-2000, SP-16

COMPUTATIONAL STRUCTURAL MECHANICS
As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
SEMESTER – I

Course Code	23SEC12	**CIE**	50
Number ofLecture Hours/Week	03+01	**SEE**	50
Total Number ofLecture Hours	52	**Exam Hours**	03
CREDITS – 04			

Course objectives:
The objective of this course is to make students to learn principles of Structural Analysis, andtoanalysevarioustypesofstructures.Toevaluatetheforceand displacement parameters of thestructures.

Course Outcomes(COs):
*On completion of this course,*the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Achieve Knowledge of Basic concepts of structural analysis and development of problem-solvingskills.		
CO2	Understand the principles of Flexibility and Stiffness in structural analysis.		
CO3	Develop analyticalskills using stiffness method		
CO4	Develop analyticalskills using flexibility method		
CO5	Analyse the structures by direct stiffness method		

Bloom's level of the course outcomes:

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√	√	√			
CO2	√	√	√			
CO3	√	√	√	√	√	
CO4	√	√	√	√	√	
CO5	√	√	√	√	√	

Course Articulation Matrix / Course mapping :

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2	1								1			
CO2	3	2	2	1								1			
CO3	3	2	1	1								1			
CO4	3	2	1	1								1			
CO5	3	2	1	1								1			

Modules	Teaching Hours	RBT Level
Module -1		
Basic concepts of structural analysis and methods of solving simultaneous equations: Introduction, Types of framed structures, Static and Kinematic Indeterminacy, Equilibrium equations, Compatibility conditions, Equivalent joint loads, Methods of solving linear simultaneous equations- Gauss elimination method, Cholesky method and Gauss-Siedal method.	**10 Hours**	**L_1, L_2, L_3, L_4,**
Module -2		
Fundamentals of Flexibility and Stiffness Methods: Concepts of stiffness and flexibility, Local and Global coordinates, Development of element flexibility and element stiffness matrices for truss, beam and rigid plane frame elements. Force-transformation matrix, Development of global flexibility matrix for continuous beams,plane trusses and rigid plane frames, Displacement-transformation matrix, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.	**12 Hours**	**L_1, L_2, L_3, L_4, L_5**
Module -3		
Analysis using Stiffness Method: Continuous beams, plane trusses and rigid plane frames.	**10 Hours**	**L_1, L_2, L_3, L_4,**
Module -4		
Analysis using Flexibility Method: Continuous beams, plane trusses and rigid plane frames	**10 Hours**	**L_4, L_5**
Module -5		
Direct Stiffness Method: Stiffness matrix for truss element in local and global coordinates, Analysis of plane trusses, Stiffness matrix for beam element, Analysis of continuousbeams and orthogonal frames.	**10 Hours**	**L_1, L_2, L4**

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 10marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full question from each module.

REFERENCE BOOKS:

1. Rajasekaran, "**Computational Structural Mechanics**", PHI, New Delhi 2001.
2. F.W.Beaufait et al., "**Computer methods of Structural Analysis"**, Prentice Hall,1970.
3. W.Weaver and J.H.Gere, "**Matrix Analysis of Framed Structures"**, Van Nastran,1980.
4. H.Karde Stuncer, "**Elementary Matrix Analysis of Structures"**, McGraw Hill1974.
5. A.K.Jain "**Advanced Structural Analysis with ComputerApplication"**Nemchand and Brothers, Roorkee, India.
6. C.S.Reddy "**Basic Structural Analysis**" Tata McGraw Hill – 1996
7. G.S.Pandit & S.P.Gupta "**Structural Analysis A Matrix Approach"** TataMcGraw Hill – 1981

STRUCTURAL DYNAMICS
As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

Course Code	23SEC131	**CIE**	50
Number of Lecture Hours/Week	03	**SEE**	50

Total Number of Lecture Hours	42	**Exam Hours**	03

CREDITS – 03

Course objectives:

The objective of this course is to make students to learn principles of Structural Dynamics, to implement these principles through different methods and to apply the same for free and forced vibration of structures. To evaluate the dynamic characteristics of thestructures

Course Outcomes (COs):

On completion of this course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	AchieveKnowledgeofdesignanddevelopmentofproblem-solvingskills.		
CO2	Understand the principles of StructuralDynamics		
CO3	Design and develop analyticalskills.		
CO4	Summarize the Solution techniques for dynamics of multi-degree freedom systems		
CO5	Understand the concepts of damping instructures.		

Bloom's level of the course outcomes:

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√	√			√	
CO2			√	√	√	
CO3	√	√		√	√	
CO4			√	√	√	
CO5		√		√		

Course Articulation Matrix / Course mapping :

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2		1				1			1			
CO2	3	2	2		1				1			1			
CO3	3	2	2		1				1			1			
CO4	3	2	2		1				1			1			
CO5	3	2	2		1				1			1			

Modules	Teaching Hours	RBT Level
Module -1		
Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, Principle of virtual displacement and energy principles Dynamics of Single degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems system, Free vibration response of damped and undamped systems, critical damping, Logarithmic decrement	**10 Hours**	**L_1, L_2, L_5**
Module -2		
Response of Single-degree-of-freedom systems to harmonic loading (rotation unbalance, reciprocating unbalance) including support motion, vibration isolation, transmissibility, Impulsive and general dynamic loading. Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral,	**08 Hours**	**L_3, L_4, L_5**
Module -3		
Two degrees of freedom system: free and forced vibration of undamped freedom system, viscous damping in free vibration, co-ordinate coupling, vibration absorber of two-degree of freedom system. Forced vibration of damped two degrees of freedom system.	**08 Hours**	**L_1, L_2, L_4, L_5**
Module -4		
Dynamics of Multi-degree freedom systems: multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of-freedom systems – Natural frequencies and mode shapes – orthogonalityproperty of mode.	**08 Hours**	**L_3, L_4, L_5**
Module -5		
Approximate methods: Rayleigh's method Dunkarley's method, Stodola's method. Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions, Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrix form.	**08 Hours**	**L_2, L_4**

Question paper pattern:

- The question paper will have tenquestions.
- Each full question consists of 10marks.
- There will be 2 full questions (with a maximum of four sub questions) from eachmodule.
- Each full question will have sub questions covering all the topics under a module.
- Thestudentswillhavetoanswer5fullquestions,selectingonefull question from each module.

Reference Books:

- Dynamics of Structures –Theory andApplication to Earthquake Engineering"- 2nd ed., Anil K.Chopra, PearsonEducation.
- Earthquake Resistant Design of Building Structures,VinodHosur, WILEY(India)
- Vibrations, structural dynamics- M. Mukhopadhyay: OxfordIBH publishing co-pvt.ltd. New Delhi.
- Structural Dynamics- Mario Paz: CBSpublishers.
- Structural Dynamics- Clough &Penzien:TMH
- Vibration Problems in Engineering Timoshenko, S, Van-NostrandCo

SPECIAL CONCRETE
As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
SEMESTER – I

Course Code	23SEC142	**CIE**	50
Number of Lecture Hours/Week	03	**SEE**	50
Total Number of Lecture Hours	42	**Exam Hours**	03

CREDITS – 03

Course objectives:

The objective of this course is to make students to learn principles of Concrete mix design,
To differentiate between different types of concrete. To characterize the high-Performanceconcrete.

COURSE OUTCOMES

CoS	PoS	PSoS
Achieve Knowledge of design and development of problem-solvingskills		
Understand the principles of Concrete mixdesign		
Design and develop analyticalskills.		
Summarize the lightweight concrete, Fibre reinforced concrete.		
Understand the concepts of RMC and high-Performanceconcrete		

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√			√	
CO2	√	√				
CO3	√	√			√	
CO4	√	√			√	
CO5	√	√				

Course Articulation Matrix / Course mapping :

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	2	3		2	1						1		3		
CO2	2	3		2	1						1		3		
CO3	2	3		1	1						1		2		
CO4	1	2		1	1						1		2		
CO5	2	2		1	1						1		2		

Modules	Teaching Hours	RBT Level
Module -1		

Components of modern concrete and developments in the process and constituent materials: Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures. Mix proportioning of Concrete: Principles andmethods.	**8 Hours**	**L_1, L_2, L_5**
Module -2		
Light Weight concrete: Introduction, classification, properties, strength and durability, mix proportioning and problems. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placementmethods.	**10 Hours**	**L_1, L_2**
Module -3		
Ferro cement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength and behaviour in tension, compression and flexure, ferrocement constructions, durability, andapplications. Self-Compacting Concrete, Reactive powder concrete, and bacterialconcrete	**8 Hours**	**L_1, L_2, L_5**
Module -4		
Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, crack arrest and toughening mechanism,applications.	**8 Hours**	**L_1, L_2, L_5**
Module -5		
High Performance concrete: constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete-QCI-RMCPC scheme requirements.	**8 Hours**	**L_1, L_2**

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 10marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

REFERENCES:

1. Neville A.M, “Properties of Concrete” Pearson Education Asia,2000
2. P. Kumar Mehta, Paul J.N. Monterio, CONCRETE: Microstructure, Properties and Materials”, Tata McGrawHill
3. A.R. Santhakumar, (2007) “Concrete Technology”-Oxford University Press, New Delhi,2007
4. Gambhir “Concrete Technology”TMH.
5. Short A and Kinniburgh.W, “Light Weight Concrete”- Asia Publishing House,1983
6. Aitcin P.C. “High Performance Concrete”-E and FN, Spon London1998
7. Rixom.R. and Mailvaganam.N., “Chemical admixtures in concrete”- E and FN, Spon London1999
8. Rudnai.G.,“LightWeightconcrete”-Akademiaikiado,Budapest,1983
9. http://qcin.org/CAS/RMCPC/

RESEARCH METHODOLOGY AND ETHICS

As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

Course Code	23RM15	CIE Marks	50
Number of Lecture Hour/Week	03	SEE Marks	50
Total Number of Lecture Hours	36	Exam Hours	03

CREDITS-03

Course Objectives: This course will enable students to:

1. To give an overview of the research methodology and explain the technique of defining a research problem.
2. To explain the functions of the literature review in research.
3. To explain carrying out a literature search, its review and writing a review.
4. To explain various research designs and different methods of data collections.
5. To explain an overview of ethics in research.

Modules	Teaching Hours
Module -1	
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, and Problems Encountered by Researchers in India.	**07 Hours**
Module -2	
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem. **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.	**08 Hours**
Module -3	
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design. **Data Collection**: Collection of Primary Data, Collection of SecondaryData, Selection of Appropriate Method for Data Collection.	**07 Hours**
Module -4	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Precautions for Writing Research Reports.	**07 Hours**

Philosophy And Ethics: Introduction to Philosophy: definition, nature and Scope, Concept, Branches. Ethics: definition, moral philosophy, nature of moral judgements and reaction	
Module-5	
Scientific Conduct: Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism(FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.	**07 Hours**
Course Outcomes: After studying this course, students will be able to: CO-1-Discuss research methodology and the technique of defining research problem. CO-2-Understand the functions of the literature review in research, carrying out a literature search. CO-3-Explain various research designs and data collection in research. CO-4- Explain the art of interpretation and the art of writing research reports. CO-5-Understand the concept and significance of ethics in research.	
Textbooks: **1.** Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018. **2.** Research Methodology step-by- Research Methodology step-by- Ranjit Kumar, SAGE Publications Ltd, 3rd Edition, 2011. **3.** Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1-7.	

ADVANCE CONCRETE TESTING LABORATORTY As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS) SEMESTER – I			
Course Code	23SECL16	**CIE**	50
Number of Lecture Hours/Week	02	**SEE**	50
Total Number of Lecture Hours	20	**Exam Hours**	03
CREDITS – 01			

Modules	**Teaching Hours**	**RBT Level**
Module -1		
Properties of cement, fine aggregates, coarse aggregates. Mix ratio and design mix	**04 Hours**	**L_1, L_2**
Module -2		
Test on concrete- Slump cone, compaction factor, vee-vee consistometer test, flow table	**04 Hours**	**L_1, L_2**
Module -3		
Testing of beams for deflection andflexure.	**04 Hours**	**L_1, L_2**
Module -4		
Design and manufacture of self-compacting concrete	**04 Hours**	**L_1, L_2**
Module -5		
Use of Nondestructive testing (NDT) equipment's –Rebound hammer, Ultra sonic pulse velocity meter andProfometer	**04 Hours**	**L_1, L_2, L3**

STRUCTURALANALYSIS AND DESIGN LABORATORTY-I

As per NEP, Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

SEMESTER – I

Course Code	23SECL17	**CIE**	50
Number of Lecture Hours/Week	03	**SEE**	50
Total Number of Lecture Hours	20	**Exam Hours**	03

CREDITS – 01

Course objectives: The objective of this course is to make students

1. To learn principles of designof experiments.
2. To investigatetheperformanceofstructuralelements.
3. Toevaluatethedifferenttestingmethodsandequipment's.

Course Outcomes (COs):

On completion of this course, the student will be able to

CO#	Course Outcomes	POs	PSOs
CO1	Achieve Knowledge of design and development of programming skills.		
CO2	Understand the principles of structural analysis and design.		
CO3	Designanddevelopanalyticalskills.		
CO4	Summarizetheperformanceofstructuresforstaticanddynamicforces.		
CO5	To understand the concept of management software.		

Bloom's level of the course outcomes:

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√				
CO3	√	√				
CO4	√	√				
CO5	√	√	√			

Course Articulation Matrix / Course mapping :

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3

CO1	3	3	3		2				2			2	3		
CO2	3	3	3		2				2			2	3		
CO3	3	3	2		2				2			2	3		
CO4	3	3			2				2			2	3		
CO5	3			1	2				2			2	3		

Note: 1-Low, 2-Medium, 3-High

Modules	Teaching Hours	RBT Level
Module -1		
Static and Dynamic analysis and design of Multistorey Building structures using software (ETABS / STAADPRO)	**04 Hours**	**L_1, L_2**
Module -2		
Steel structures using software (ETABS / STAADPRO)	**04 Hours**	**L_1, L_2**
Module -3		
DesignofRCCusing Software (ETABS/STAADPRO)	**04 Hours**	**L_1, L_2**
Module -4		
PreparationofEXCELsheetsforstructuraldesign	**04 Hours**	**L_1, L_2**
Module -5		
PROJECT MANAGEMENTsoftware “primavera P6”.	**04 Hours**	**L_1, L_2, L3**