SCIB5101	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	EL	Credits	Total Marks
		3	1	0	1	4	100

COURSE OBJECTIVE

- To understand the concept of 3D stress, strain analysis and its applications to simple problems.
- To understand torsional concepts of noncircular section and beams on elastic foundation.
- To learn the concepts of plasticity and failure theories.

UNIT 1 ELASTICITY 9 Hrs.

Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship. Generalized Hooke's law.

UNIT 2 ELASTICITY SOLUTION 9 Hrs.

Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar coordinates.

UNIT 3 TORSION 9 Hrs.

Torsion of non-circular section-Method of analysis- Membrane analogy- Torsion of thin rectangular section and hollow thin walled sections.

UNIT 4 BEAMS ON ELASTIC FOUNDATIONS 9 Hrs.

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi Infinite and finite beams – Rigid and flexible – Uniform cross section – Point load and udl – Solution by finite differences.

UNIT 5 PLASTICITY 9 Hrs.

Physical Assumptions – Yield criteria – Failure theories –– Flow rule (Plastic stress strain relationship). Elasto- plastic problems in bending and torsion- Strain hardening.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - formulate equilibrium and compatibility equations.

CO2 - independently work with the problems of 2-D elasticity in Cartesian/Polar Coordinates.

CO3 - familiarize with the use of airy's stress function in 2-D problems of elasticity in Cartesian / Polar Coordinates.

CO4 - knowledge of various theories of torsion and can solve the problems of torsion.

CO5 - analyze and evaluate beams on elastic foundation.

CO6 - analyze using plastic theories.

TEXT / REFERENCE BOOKS

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," 4th Edition, Prentice Hall Professional Technical Reference, New Jersy, 2003.
2. Chakrabarty J., "Theory of Plasticity", 3rd Edition, Elsevier Butterworth, Heinmann, UK, 2006.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
4. Slater R.A.C., "Engineering Plasticity", John Wiley and Son, New York, 1977.
5. Timoshenko, S. and Goodier J.N., "Theory of Elasticity", McGraw Hill Book Co., New York, 1988.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks	**70 Marks**

SMTB5101	ADVANCED MATHEMATICS (Common to all M.E Branches and M.Tech Bio-Medical)	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVE

- The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgments.

UNIT 1 MATRIX THEORY 9 Hrs.

QR decomposition – Eigen values using shifted QR algorithm – Singular Value Decomposition – Pseudo inverse – Least square approximations

UNIT 2 CALCULUS OF VARIATIONS 9 Hrs.

Concept of Functionals – Euler's equation – functional dependent on first and higher order derivatives – Functionals on several dependent variables – Iso-perimetric problems – Variational problems with moving boundaries.

UNIT 3 TRANSFORM METHODS 9 Hrs.

Laplace transform methods for one dimensional wave equation – Displacements in a string – Longitudinal vibration of a elastic bar – Fourier transform methods for one dimensional heat conduction problems in infinite and semi infinite rod.

UNIT 4 ELLIPTIC EQUATIONS 9 Hrs.

Laplace equation – Properties of harmonic functions – Fourier transform methods for Laplace equations – Solution for Poisson equation by Fourier transforms method.

UNIT 5 LINEAR AND NON-LINEAR PROGRAMMING 9 Hrs.

S Simplex Algorithm – Two Phase and Big M techniques – Duality theory – Dual Simplex method – Non Linear Programming – Constrained extrenal problems – Lagranges multiplier method – Kuhn – Tucker conditions and solutions.

Max.45 Hrs.

Course Outcomes

On completion of the course, student will be able to

CO1 - define the concepts of Matrix theory.
CO2 - apply the concepts of calculus of variations and its applications.
CO3 - apply the concept of transform methods and elliptic equations.
CO4 - evaluate of one dimensional heat conduction problems using transform methods
CO5 - apply various techniques for solving linear programming problems.
CO6 - arrive the solution for non linear programming problems.

TEXT / REFERENCE BOOKS

1. Richard Bronson, Schaum's Outline Matrix Operations, McGraw-Hill, 2011
2. Venkataraman M K, Higher Engineering Mathematics, National Pub. Co, 2003
3. Elsgolts, L., Differential Equations and Calculus of Variations University Press of the Pacific,2003.
4. I.N., Elements of Partial differential equations, Dover Publications, 2006.
5. Sankara Rao, K., Introduction to partial differential equations. Prentice Hall of India,2011.
6. Taha H A, "Operations research - An introduction, McMilan Publishing co, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks	**70 Marks**

S38BPB11	ADVANCED REINFORCED CONCRETE STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

- To be familiar with the limit state design of advanced reinforced concrete structures.
- To design special structures like Shear walls, Bunkers, Silos, flat slabs, grid floor, corbel and deep beams.
- To execute a project on modeling, analyzing and designing a special structure.

UNIT 1 LIMIT STATE DESIGN OF BEAMS FOR FLEXURE 9 Hrs.

Review of Basic Concepts - Behaviour and Design of Reinforced Concrete members considering flexure, Torsion, combined with flexure and flexural shear, deflection and crack width as per IS456.

UNIT 2 DESIGN OF SHEAR WALLS AND DEEP BEAMS 9 Hrs.

Shear walls – Types of shear walls – Design of shear walls. Simply Supported and Continuous Deep beams.

UNIT 3 DESIGN OF SPECIAL RCC MEMBERS 9 Hrs.

Flat slabs, Flat plates, Grid floor and Corbel.

UNIT 4 BUNKERS AND SILOS 9 Hrs.

Introduction to Limit state design of Bunkers and Silos - Rectangular and Circular types.

UNIT 5 DESIGN PROJECT 9 Hrs.

Seismic Behavior and Design of RC Shear Walls - Influence of orientation of shear walls on structural behavior of RC buildings - Design of flat slab for a commercial building - comparison of structural behavior of conventional roof and flat slab system - Design of a deep beam for an aesthetic building.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Design reinforced concrete beams for bending, shear and torsion by Limit State Design method.

CO2 - Designs hear walls and deep beams.

CO3 - Design the flat slabs, grid floor and corbel.

CO4 - Design storage structures like bunkers and silos.

CO5 - Utilize computer applications for designing RC structures and its components.

CO6 - Execute a design project using analysis and design software.

TEXT / REFERENCE BOOKS

1. Ashok. K. Jain, “Reinforced concrete – Limit state design”, Nemchand& Bros, Roorkee, 1983.
2. Park and Pauley. T. “Reinforced concrete structures”, John Weily& Sons, Newyork, 1975.
3. Varghese, P.C. "Limit State Design of Reinforced Concrete", Prentice Hall of India Ltd, New Delhi, 2007.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. IS 456 -2000 – Code of practice for plain and reinforced concrete.
6. SP 16 (1980) - Design Aids for Reinforced concrete.
7. SP 34(1987) – Hand book on Concrete reinforcement and Detailing.
8. IS 1893:2002 – Indian Standard criteria for earthquake resistant design of structures.
9. IS 13920:1993 Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.
10. IS 4326:1993 – Code of practice for earthquake resistant design and construction of buildings.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SISB9101	RESEARCH METHODOLOGY AND IPR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of research.
- To provide an insight into the techniques of research.
- To learn the requisites of writing a research report.
- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection

UNIT 1 RESEARCH PREPARATION AND PLANNING 9 Hrs.

Objectives of research – Understanding research and its goals, Critical thinking, Techniques for generating research topics. Topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – Formulation of hypotheses and testing of the same – Development of a research proposal.

UNIT 2 RESEARCH RESOURCES 9 Hrs.

Sources of information. Literature search. World Wide Web, Online data bases – search tools. Citation in dices – Principles underlying impact factor – Literature review – Case studies, review articles and Meta analysis – Role of the librarian. Ethical and moral issues in Research, Plagiarism, tools to avoid plagiarism.

UNIT 3 ACADEMIC WRITING AND PRESENTATION 9 Hrs.

Proposal submission for funding agencies, Elements of Style. Organization of proposals, Basic knowledge of funding agencies, Research report writing, Communication skills, Tailoring the presentation to the target audience – Oral presentations, Poster preparations, Submission of research articles for Publication in Reputed journal, Thesis writing and Research report writing. Elements of excellent presentation: preparation, visual and delivery, oral communication skills and oral defense.

UNIT 4 DATA COLLECTION, ANALYSIS AND INFERENCE 9 Hrs.

Basic statistical distributions and their applications. Sample size determination and sampling techniques. Large sample tests and small sample tests.

UNIT 5 INTELLECTUAL PROPERTY RIGHTS 9 Hrs.

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT. Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

COURSE OUTCOME

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

CO1 - Understand the important basics of research and Intellectual Property Rights.

CO2 - Write research problem formulations through various methods of literature survey.

CO3 - Analyze research related information and Follow research ethics.

CO4 - Correlate the results of any research article with other published results. Write a review article in the field of engineering.

CO5- Differentiate patents, copyrights, trademark and designs.

CO6 - Apply the process for IPR protection.

TEXT / REFERENCE BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5. James C. Van Horne, Standford University, Financial Management and Policy, Prentice Hall.
6. James R. McGuigan, R. Charles Moyer, Frederick H. deB. Harris, Managerial economics – applications, strategy and Tactics, Cengage learning, India.
7. Philip Kotler, Marketing management Pearson Education, India.
8. Modern Production / Operations Management, Elwood S. Buffa & Rakesh Sarin, Wiley India.
9. Ronald R. Sims, Organizational success through effective human resources Management, Quorum books, London.
10. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks	**70 Marks**

SCIB6101	STRUCTURAL ANALYSIS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- To model the given structure in a structural analysis software like Staadpro.
- To analyze the modeled structure in a structural analysis software.
- To design and optimize the given structure in a structural analysis software.

SUGGESTED LIST OF EXERCISES

1. Carryout the analysis and design of RCC structures & Steel structures (single storey & Multi storey buildings).
2. Analysis of truss
3. Typical modeling of berthing structure(IS 4651)
4. P-delta analysis of G+12 building.
5. Bridge modeling
   i) Modeling of road bridges (load calculation as per IRC)
   ii) Modeling of railway bridges using load calculation as per IRS

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply dead, live and wind loads on the structure using the software.
CO2 - Model railway and highway bridges using Staad.pro software
CO3 - Incorporate design parameters from Indian Standard Codes into STAAD Pro
CO4 - Analyze the RCC and Steel structures.
CO5 - Design the single and multi-storey structures.
CO6 - Generate various reports from the software.

SCIB5201	STRUCTURAL DYNAMICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To expose the students the principles and methods of dynamic analysis of structures.
- To learn the concepts of developing mathematical models representing real time problems of discrete and continuous vibratory systems
- To prepare them for designing the structures for wind, earthquake and other dynamic loads.

UNIT 1 INTRODUCTION TO STRUCTURAL DYNAMICS 9 Hrs.

Formulation of equation of motion by different methods – Single degree of freedom – Free vibration – Forced response to harmonic –Periodic and impulsive loads – Response to general dynamic loading – Effect of damping - Methods of evaluation of damping.

UNIT 2 MUTI-DEGREE-OF FREEDOM SYSTEMS 9 Hrs.

Formulation of MDOF equations of motion – Evaluation of structural property matrices – Analysis of vibration frequency of motion – orthagonality conditions – approximate methods of extraction of eigen values.

UNIT 3 DYNAMIC RESPONSE OF MDOF SYSTEMS 9 Hrs.

Normal co-ordinates – Mode super position technique – Numerical integration process.

UNIT 4 CONTINUOUS SYSTEMS 9 Hrs.

Modeling – Analysis of free and forced response of beams and bars.

UNIT 5 APPLICATIONS 9 Hrs.

Idealization and mathematical model of multistory building frames, towers, examples of wind, earthquake and impact excitations.

Max. 45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.

CO2 - Apply knowledge of mathematics, science, and engineering by developing the equations of motion for multiple degrees of freedom systems.

CO3 - Illustrates the concepts of dynamic loading and to study the dynamic response of MDOF systems subjected to different types of dynamic loads.

CO4 - Develop mathematical models representing real time problems of discrete and continuous vibratory systems

CO5 - Apply dynamic analysis methods to practical problems in structural engineering and other disciplines

CO6 - Evaluate the dynamic susceptibility of structures and the limitations of modelling techniques.

TEXT / REFERENCE BOOKS

1. MarioPaz, “Structural dynamics”, Academic Press, 1985.
2. Anderson R.A., “Fundamentals of vibration”, Amerind Publishing Co.,1972.
3. Ray W. Clough and Joseph Penzien, “Dynamics of structures”, McGraw Hill, New York, 1993.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

S38BLH21	FINITE ELEMENT ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To study the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems.
- To learn the concept of meshing techniques for higher order elements and error evaluations
- To learn the concepts of analysing structures using dynamic equations for one dimensional problem.

UNIT 1 INTRODUCTION 9 Hrs.

Boundary Value Problems – Approximate Solutions – Variational and Weighed Residual Methods – Ritz and Galerkin Formulations – Concept of Piecewise Approximation and Finite Element – Displacement and Shape Functions –Weak Formulation – Minimum Potential Energy – Generation of Stiffness Matrix and Load Vector.

UNIT 2 STRESS ANALYSIS 9 Hrs.

Two Dimensional problems – Plane Stress, Plane Strain and Axisymmetric Problems – Triangular and Quadrilateral Elements –Natural Coordinates – Isoparametric Formulation - Numerical Integration – Plate Bending and Shell Elements –– Brick Elements –Elements for Fracture Analysis.

UNIT 3 MESHING AND SOLUTION PROBLEMS 9 Hrs.

Higher Order Elements – p and h Methods of Mesh Refinement – ill conditioned Elements – Discretisation Errors Auto and Adaptive Mesh Generation Techniques -Error Evaluation.

UNIT 4 NONLINEAR, VIBRATION AND THERMAL PROBLEMS 9 Hrs.

Material and Geometric Nonlinearity – Methods of Treatment – Consistent System Matrices – Dynamic Condensation – Eigen Value Extraction - thermal analysis.

UNIT 5 DYNAMIC ANALYSIS AND SOFTWARE APPLICATION 9 Hrs.

Dynamic equations – Consistent and lumped mass matrices - 1-D bar element - Formulation of element stiffness, mass and force matrices - Example problems. Natural frequencies - 1-D bar element - Formulation of element stiffness, mass matrices. Modeling and analysis using recent softwares.

SUGGESTED LIST OF EXERCISES

1. Analysis of Structures using Finite element Package – ANSYS.
2. Problem Formulation – input parameters – modeling – material properties – boundary conditions.
3. Mesh generation – Solution and post processing.
4. Modal Analysis, Buckling Analysis, Non-linear analysis, Non-linear material analysis and Contact Analysis of beam, column, beam-column, frames and plate elements.

Max.45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Understand to apply the various types of approximate methods in Boundary value problems
CO2 - Analysis of stress using finite element concept for Two dimensional problems.
CO3 - Understand the concept of meshing techniques for higher order elements and error evaluations.
CO4 - Study of Non linear, vibration and thermal problems using finite element methods.
CO5 - Analysis of structures using dynamic equations for one dimensional problem.
CO6 - Formulation of element stiffness matrix and modeling analysis using recent software.

TEXT / REFERENCE BOOKS

1. BhavikattiS.S.,"FiniteElementAnalysis",NewAgePublishers,2007.
2. KrishnamoorthyC.S.,"FiniteElementAnalysis:TheoryandProgramming",TataMcGraw-Hill,1995.
3. DavidHutton,"FundamentalsofFiniteElementAnalysis",TataMcGrawHillPublishingCompanyLimited,NewDelhi,2005.
4. Bathe,K.J.,"FiniteElementProceduresinEngineeringAnalysis",PrenticeHallInc.,1996.
5. Zienkiewicz,O.C.andTaylor,R.L.,"TheFiniteElementMethod",McGrawHill,1987.
6. Chandrupatla,R.T.andBelegundu,A.D.,"IntroductiontoFiniteElementsinEngineering",PrenticeHallofIndia,1997..
7. Moaveni,S.,"FiniteElementAnalysisTheoryandApplicationwithANSYS",PrenticeHallInc.,1999.
8. http://www.mech.port.ac.uk/sdalby/mbm/CTFRProg.htm.
9. http://www.me.mtu.edu/~bettig/MEEM4405.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB5203	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVES

- To learn the various modes of structural connections between a beam and a column.
- To conduct plastic design of beams and frames
- To design the components of pre-engineered building and tall structures
- To design cold formed steel column and beams.

UNIT 1 STRUCTURAL CONNECTIONS 9 Hrs.

Types of connections- Bolted and welded connections – Seated Connections – Unstiffened and Stiffened – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections – Introduction to Tekla software – Demonstration.

UNIT 2 PLASTIC ANALYSIS OF STRUCTURES 9 Hrs.

Introduction, Shape factor, classification of section, elastic and plastic section moduli - Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment– Design of continuous beams.

UNIT 3 PRE ENGINEERED INDUSTRIAL BUILDING 9 Hrs.

Design of gantry girder subjected to lateral loads and axial loads, Analysis and design of roof truss, Design of Purlins- wind pressure.

UNIT 4 ANALYSIS AND DESIGN OF SPECIAL STRUCTURES 9 Hrs.

Design of self supporting chimney and guyed steel stacks- Stresses due to wind and earthquake forces – Design of foundation –Gust factor method. Towers- Basic structural configurations – free standing and guyed towers – loads on towers– wind loads – foundation design.

UNIT 5 LDESIGN OF COLD FORMEDS TEELSTRUCTURES 9Hrs.

Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Design the connections of steel beam and column joint.
CO2 - Conduct plastic analysis for beams and frames.
CO3 - Design the components of pre-engineered building.
CO4 - Design tall structures like chimney and towers.
CO5 - Apply codal provisions in designing light gauge steel sections.
CO6 - Design the beams and columns using cold formed steel sections.

TEXT / REFERENCE BOOKS

1. Owens G.W. and Cheal B.D., “Structural Steelwork Connections”, Butterworths, London, 1989.
2. Dayaratnam P., “Design of Steel Structures”, A.H. Wheeler & Co. Ltd., Allahabad, 1996.
3. Subramanian N., “Design of Steel Structures”, Oxford University Press, 2008.
4. Murthy S.S. and Santhakumar A.R., “Transmission Line Structures”, McGraw Hill Publishing Co. Ltd., 1990.
5. Wie Wen Yu, “Design of Cold Formed Steel Structures”, McGraw Hill Book Company, New York, 1996.
6. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, “Design of Steel Structures“Vol. I and II, Arihant Publications, Mumbai, 1998.
7. Duggal.S.K., “Limit State design of steel structures”, Tata McGraw Hill Publishing Company, New Delhi, 2010.
8. IS: 800-2007, Indian Standard for General Construction in Steel, Code of Practice.
9. IS:801-1975, : Code of practice for use of cold – formed light gauge steel structural members in general building construction.
10. SP 6(1) – 1964 Hand book for Structures Engineers.
11. IS 811 - 1987, “Specification for cold formed light gauge structural steel sections.
12. IS 875-2015 part 3 Code of practice for design loads.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

S38BLH31	SEISMIC DESIGN OF STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To study the effect of earthquakes, analysis and design of earthquake resistant Structures.
- To learn the design concepts and cyclic load behavior of RCC, Steel and prestressed concrete elements.
- To design buildings for seismic using software packages.

UNIT 1 INTRODUCTION 9 Hrs.

Elements of Engineering Seismology–Theory of vibrations Response Spectrum. Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters.

UNIT 2 EARTHQUAKE HISTORY 9 Hrs.

Indian Seismicity–Earthquake History– Earthquake occurrence in the world-causes of earthquake. Behaviour of structures in the past Earthquakes.

UNIT 3 DESIGN CONCEPT AND BEHAVIOR OF STRUCTURES 9 Hrs.

Philosophy and Principle of Earthquake Resistant Design, Guidelines for Earthquake Resistant Design SeismicDesignConcepts–CyclicloadbehaviourofRCC,SteelandPre-stressedConcreteElements–Designs Spectrum–Principles of capacity design.

UNIT 4 FRAME SAND SHEARWALLS 9 Hrs.

Provisions of Seismic Code (IS 1893) – Building systems frames, Shear Wall, Braced frames, combinations –Torsion. Design and Detailing of Frames–Shear Walls and Frame Walls.

UNIT 5 COMPUTATIONAL ANALYSIS, MODERN CONCEPTS 9 Hrs.

Performance of Regular buildings 3D Computer Analysis of building Systems (Theory only) – Structural Configuration–Seismic performance–Irregular Buildings–Soil performance, Modern Concepts–Base Isolation – Adoptive systems–Case Studies.

Max.45 Hrs.

SUGGESTED LIST OF EXERCISES

Carry out the Seismic analysis and design of RCC Structures & Steel Structures (Singlestorey & Multistorey Buildings)

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Construct design spectrum, site specific, probabilistic and uniform hazard spectrums.
CO2 - Understanding of earthquake hazards: sources, magnitude, seismic intensity and site effects
CO3 - Utilize various IS Codal provisions for seismic design
CO4 - Understand the principles of performance based seismic design, failure mode control and capacity design
CO5 - Design RC shear wall frame systems
CO6 - Design buildings for seismic using various software packages.

TEXT / REFERENCE BOOKS

1. Bungale S.Taranath “Structural Analysis and Design of Tall Buildings” - McGraw Hill Book company, NewYork,1999.
2. CourseNotes“DesignofReinforcedConcreteBuildings”,IIT,Kanpur,June1999.
3. S.K.Duggal,“EarthquakeResistantDesignofStructures”,OxfordUniversityPress,2007.
4. PankajAgarwalandManishShrikhande,“EarthquakeResistantDesignofStructures”,PrenticeHall,2007.
5. IS13920-2016,DuctileDetaillingofReinforcedConcreteStructuresSubjectedtoSeismicForces-CodeofPractice.
6. IS1893-2016, CriteriaforEarthquakeResistantDesignofStructures
7. AnilK.Chopra“DynamicsofStructures”PrenticeHall,2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB6101	STRUCTURAL ENGINEERING LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- To learn about various tests on RC Beams and Steel Beams
- To determine the forces, stresses, deflections and behaviour of various structural members

SUGGESTED LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for Strength and deflection behavior.
2. Testing of simply supported steel beam for strength and deflection behavior.
3. Testing of Reinforcement using Mechanical and electrical strain gauges.
4. Bending test of steel Flat.
5. Determination of Young's modulus of concrete.
6. Determination of Tensile and flexural strength of concrete.
7. Determination of insitu strength and quality of concrete using.
   i) rebound hammer ii) Ultrasonic Pulse Velocity Tester.
8. Torsion on open and closed sections.
9. Lateral torsional buckling of beams.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - design a concrete mix using IS code.
CO2 - perform non-destructive and durability tests and predict the strength of concrete.
CO3 - Explain the behavior of beams and columns under flexure and shear.
CO4 - Ability to install strain gauges on steel structural components and systems and collect data from strain gauges.
CO5 - Ability to perform column buckling tests.
CO6 - Develop the different types of concrete and study the structural behavior.

SCIB7001	MATRIX METHOD OF STRUCTURAL ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To learn about Stiffness, flexibility and energy concepts.
- Learn to represent structural systems using matrices, including the stiffness matrix and the flexibility matrix.
- Learn to formulate the element equations for different types of structural elements, such as beams, trusses, and frames, using the matrix method.

UNIT 1 FUNDAMENTAL CONCEPTS OF STRUCTURES 9 Hrs.

Introduction -Types of Matrices – Matrix addition, Matrix multiplication, Inverse of a matrix of fourth order – Force and Displacement measurements - Force and Displacement Methods of Structural Analysis- Principles of superposition.

CHARACTERISTICS OF STRUCTURES – STIFFNESS AND FLEXIBILITY

Introduction to Equilibrium – Structures with single coordinate – Two coordinates – Stiffness and flexibility matrices in coordinates – Stiffness and flexibility matrices in constrained measurements.

UNIT 2 ENERGY CONCEPTS IN STRUCTURES 9 Hrs.

Strain energy in terms of stiffness and flexibility matrices – Properties of stiffness and flexibility matrices – Interpretation of coefficients - Betti's Law – Other energy theorems - using matrix notations.

UNIT 3 TRANSFORMATION OF INFORMATION 9 Hrs.

Indeterminate Structures – Transformation of System force to element forces – Element Flexibility to System Flexibility – System Displacement to Element Displacement - Stiffness and Flexibility matrices of the elements- Normal coordinates and orthogonal Transformation.

UNIT 4 FLEXIBILITY METHOD 9 Hrs.

Statically Determinate and Indeterminate Structures – Choice of redundants leading to ill and well conditioned matrices – Automatic choice of redundant – Rank technique – Transformation to one set of redundant to another – Internal forces due to thermal expansion and lack of fit – Reducing the size of flexibility matrix – Application to pin- jointed plane truss – Continuous beams – Frames – Grids.

UNIT 5 STIFFNESS METHOD 9 Hrs.

Introduction – Development of the stiffness method – Analogy between flexibility and stiffness – Analysis due to thermal expansion - lack of fit – Application of stiffness approach to pin jointed plane and space trusses – Continuous beams – Frames.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the basic concept of Matrix related to structural analysis.
CO2 - Analyze structural members using strain energy concepts.
CO3 - Convert element flexibility in to system flexibility and element stiffness matrix into system stiffness matrix for indeterminate structures.
CO4 - Analyze determinate structures using flexibility matrix method.
CO5 - Analyze indeterminate structures using flexibility matrix method.
CO6 - Analyze indeterminate structures using stiffness matrix method.

TEXT / REFERENCE BOOKS

1. Rubinstein, F.M., "Matrix computer methods of Structural Analysis", Prentice Hall, 1967.
2. McGuire and Gallagher, R.H., "Matrix Structural Analysis", John Wiley, 2 nd edition,2000.
3. Meek, J.L., "Matrix Structural Analysis", McGraw Hill, 1971.
4. Prezemineicki, J.S., "Theory of matrix Structural Analysis", McGraw Hill Book Co., 1984.
5. William Weaver J.R and James M. Gere, "Matrix Analysis of Framed Structures", CBS Publishers & Distributors, 1990.
6. Wang C.K., "Intermediate Structural Analysis", McGraw Hill International Editions, 2017.
7. Ghali A. and Neville A.M., "Structural Analysis A unified Classical and Matrix Approach",4th Edition, E & FN Spon, Taylor & Francis Group, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks	**70 Marks**

SCIB7002	EXPERIMENTAL STRESS ANALYSIS AND TECHNIQUES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.
- To gain knowledge on various destructive and non-destructive techniques
- To understand the importance of model analysis and its practical applications

UNIT 1 STRAIN MEASUREMENT 9 Hrs.

Methods of Measurement -Calibration-Load calibration of testing machines-I.S. Code provisions - Measurement system - Strain measurement - Strain gauges - Principle, Types, Performance, Uses - Strain Rosettes- Wheatstone Bridge- Photo elasticity- Principle, Application-Moire fringe- Electronic load cells-Proving rings.

UNIT 2 MEASUREMENT OF VIBRATION AND WIND FLOW 9 Hrs.

Measurement of Vibration- Vibration Galvanometers- Vibrometer-Characteristics of Structural vibration-Pressure gauges- Velocity transducers- Seismic transducers – Linear Variable Differential Transformer-Cathode ray oscilloscope – X Y Plotter- Wind Tunnels-Flow meters- Venturimeter- Digital Data Acquisition systems.

UNIT 3 DISTRESS MEASUREMENT AND CONTROL 9 Hrs.

Diagnosis of distress in structures-Cracks in structures-Formation of cracks- Types of cracks-Causes of cracks- Crack measurement- Monitoring and measurement of crack movement- Corrosion of reinforcement in RCC- Half cell-Construction and use-Damage assessment-Controlled blasting for demolition.

UNIT 4 N.D.T.METHODS 9 Hrs.

Load testing on structures-In situ load testing-Ultimate load testing-Rebound hammer-Principle and Applications- Limitations- Ultrasonic testing- Principles and Applications- Brittle coating- Principle and Applications- Stress coat- All Temp- Comparison of brittle coatings- Evaluation of the coating.

UNIT 5 MODEL ANALYSIS 9 Hrs.

Model laws- Laws of similitude-Model materials- Model testing- Necessity for Model analysis-Advantages- Applications- Types of similitude- Scale effect in Models- Indirect model study- Direct model study- Limitations of model investigations- Structural problems that may demand model studies-Usage of influence lines in model studies.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the working principle of strain gauges.

CO2 - Apply the theoretical concepts for the Measurement of strains.

CO3 - Perform the model analysis using different theorems.

CO4 - Adopt the strategies of maintenance and repair.

CO5 - Assess the strength of existing structures using NDT.

CO6 - Understand the different patterns of Cracks.

TEXT / REFERENCE BOOKS

1. Dally J.W. and Riley W.F., “Experimental stress Analysis”, McGraw Hill, Inc. New York, 1991.
2. Srinath L.S. et al, “Experimental Stress Analysis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi,1984.
3. Rangan C.S., “Instrumentation – Devices and Systems”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1983.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.
5. Sirohi R.S., Radhakrishna H.C., “Mechanical Measurements”, New Age International Pvt. Ltd., 1997.
6. Bray D.E. and Stanley R.K., “Course Material on Non-destructive Evaluation”, McGraw Hill Publishing Company, New York.1989.
7. Ravisankar K. and Chellappan A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
8. Ganesan T.P., “Model Analysis of Structures”, University Press, India, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7003	ADVANCED CONCRETE TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To provide students with a comprehensive understanding of the properties and behavior of concrete.
- To equip students with the skills to develop advanced concrete mix designs.
- To explore advanced concrete technologies that promote environmental friendliness and resource efficiency.

UNIT 1 CONCRETE MAKING MATERIALS 9 Hrs.

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT 2 CONCRETE 9 Hrs.

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage, Variability of concrete strength, durability of concrete.

UNIT 3 MIX DESIGN 9 Hrs.

Principles of concrete mix design, Methods of concrete mix design, testing of Concrete. Statistical quality control- sampling and acceptance criteria.

UNIT4 SPECIAL CONCRETE 9 Hrs.

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete, Super plasticised concrete, hyper plasticized concrete, Epoxy resins and screeds for rehabilitation - properties and applications - high performance concrete. High performance fiber reinforced concrete, self- compacting-concrete.

UNIT 5 CONCRETING METHODS 9 Hrs.

Process of manufacturing of concrete, methods of transportation, placing and curing. Extreme weather concreting, special concreting methods. Vacuum dewatering - underwater concrete, special form work.

Max.45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Understand the properties of different concrete materials.
CO2 - Determine the properties of fresh and hardened concrete.
CO3 - Design the mix proportions of concrete as per Indian standards.
CO4 - Analyze the properties and applications of special concrete
CO5 - Evaluate various methods of batching, mixing, and quality control during manufacturing.
CO6 - Identify the challenges and considerations associated with concrete placement in extreme weather conditions

TEXT / REFERENCEBOOKS

1. Neville, A.M., "Properties of Concrete", Prentice Hall, 1995, London.
2. Shetty M.S., "Concrete Technology", S.Chand and Company Ltd., New Delhi, 2006.
3. Santhakumar, A.R., ”Concrete Technology”, Oxford University Press, 2018.
4. Rudhani G., "Light Weight Concrete Academic Kiado", Publishing Home of Hungarian Academy of Sciences, 1963.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7004	MECHANICS OF COMPOSITE MATERIALS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To develop an understanding of the behaviour and design study of Steel concrete composite elements and structures.
- To study the different types of composite materials and its applications
- To analysis the sandwich and modern composites structures.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites.

UNIT 2 STRESS STRAIN RELATIONS 9 Hrs.

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses.

UNIT3 ANALYSIS OF LAMINATED COMPOSITES 9 Hrs.

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates Static, Dynamic and Stability an analysis for Simpler cases of composite plates, Inter laminar stresses.

UNIT4 FAILURE AND FRACTURE OF COMPOSITES 9 Hrs.

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites ,Sandwich Construction.

UNIT 5 APPLICATIONS AND DESIGN 9 Hrs.

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues.

Max.45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Explain the various types of composites and its constituents.
CO2 - Derive the constitutive relationship and determine the stresses and strains in a composite material.
CO3 - Analyze a laminated plate and inter laminated stresses.
CO4 - Explain the various failure criteria and fracture mechanics of composites.
CO5 - Discuss the various applications of Composites.
CO6 - Design simple composite elements.

TEXT/REFERENCEBOOKS

1. Agarwal.B.D., Broutman.L.J. and Chandrashekara.K. “Analysis and Performance of Fiber Composites”, JohnWiley and Sons, 2006.
2. DanielI.M. and Ishai.O, “Engineering Mechanics of Composite Materials”, Oxford University Press, 2005.
3. Hyer M.W. and White S.R.,“Stress Analysis of Fiber- Reinforced Composite Materials”,D.Estech Publications Inc.,2009.
4. JonesR.M., “Mechanics of Composite Materials”, Taylor and Francis Group,1999.
5. Mukhopadhyay M., “Mechanics of Composite Materials and Structures”, Universities Press, India, 2005.
6. Datoo,“Mechanics of Fibrous Composites”, Elsevier Science Publishers Ltd,1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7005	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVE

- To understand the principles and techniques used for assessing the condition of structures.
- To explore different maintenance strategies and practices for extending the service life of structures.
- To study the repair and strengthening techniques of structural elements, such as beams, columns and slabs.

UNIT 1 MAINTENANCE AND REPAIR STRATEGIES 9 Hrs.

Maintenance, repair and rehabilitation, facets of maintenance and importance of maintenance, various aspects of inspection, Assessment procedures for evaluating damaged structures, causes of deterioration – Testing techniques, NDT, Rebound Hammer, types of failures in foundation, floors, roofs, walls etc., Safety evaluation of existing buildings.

UNIT 2 SERVICEABILITY AND DURABILITY OF CONCRETE 9 Hrs.

Quality assurance for concrete construction, concrete properties strength, workability, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, design and construction errors, corrosion mechanism, effects of cover thickness and cracking of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT 3 MATERIALS AND TECHNIQUES FOR REPAIR 9 Hrs.

Special concrete and mortars, concrete chemicals, special elements for accelerated strength gain, expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro-cement, fibre reinforced concrete, water-proofing materials, Admixtures. Polymer coating for rebars, vacuum concrete, gunite, shotcrete, Epoxy injection, Mortar repairs of cracks, Shoring & Underpinning.

UNIT4 REPAIR OF STRUCTURES 9 Hrs.

Repair of structures distressed due to Earthquake - Strengthening using FRP, Strengthening and Stabilization techniques for repair. Strengthening of bridge pier.

UNIT5 NDT OF STEEL 9 Hrs.

Correlating ASTM tensile test (or IS:1608) for rebar with chemical composition results with respect to IS:2062, use of digital thickness gauges and weld gauges, use of hardness testers – Correlation with fire damaged and virgin specimens simple surface NDT tests – Penetration tests, Magnetic particle tests, use of coating gauges for metallic and Non-Metallic coating and identification of details for corrosion (durability aspects) simple techniques in visual inspection of weldments.

Max.45 Hrs.

COURSE OUTCOMES

On the end of the course, student will be able to:

CO1 - Assess various types of structural deterioration and damage
CO2 - Analyze the parameters influencing the serviceability and durability of concrete
CO3 - Understand the materials and techniques for repair and rehabilitation of structures
CO4 - Apply the strengthening and stabilization techniques adopted for different types of structural elements
CO5 - Correlate the application of various Non-destructive testing of steel
CO6 - Develop the plan and procedure for strengthening of existing deteriorated structures

TEXT / REFERENCE BOOKS

1. Denison Campbell, Allen and Harold Roper, “Concrete Structures: Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, “Repair of Concrete Structures”, Blakie and Sons, UK, 1987.
3. Shetty, M.S., “Concrete Technology – Theory and Practice”, S. Chand and Company, New Delhi, sixth edition, 2008.
4. Santhakumar, A.R., “Training Courses notes and damage assessment and repair in low cost housing”, “RHDC-NBO” Anna University, 1992.
5. Raikar, R.N. “Learning from Failures – Deficiencies in Design, Construction and Service (SDCPL)”, Raikar Bhavan, Bombay, 1987.
6. B.Raj, T.Jayakumar and M.Thavasimuthu, "Practical Non-destructive testing", Wood Head Publishing Ltd., 2002.
7. IS:1608(1995) Mechanical Testing of metals.
8. IS: 2062(1999) Steel for general structural purposes.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7006	DESIGN OF BRIDGES	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVE

- To acquire knowledge of the IRC specifications for road bridges and various forces acting on bridges
- To analyze the loads, moments and shear in bridge components
- To develop skills in the design of different types of bridges and their structural elements

UNIT 1 INTRODUCTION 9 Hrs.

Classification, Investigation and Planning, Choice of type, I.R.C. Specifications for Road Bridges, Standard live, loads, other forces acting on bridges, General Design considerations - Bearings, substructures and footing for bridges.

UNIT 2 SHORT SPAN BRIDGES 9 Hrs.

Load distribution theories - Analysis and Design of Slab Culverts, Tee beam and Slab bridges, Design of panel and cantilever for IRC loading.

UNIT 3 LONG SPAN GIRDER BRIDGES 9 Hrs.

Design Principles of Continuous Bridges, Design of balanced cantilever bridges - Deck slab - Main girder.

UNIT 4 PRESTRESSED CONCRETE BRIDGES 9 Hrs.

Maximum and minimum prestressing forces - Eccentricity - Live load and dead load shear forces - cable zone in girder, Design of Prestressed Concrete Bridges –Check for stresses at various sections - Short term and long term Deflections.

UNIT 5 PLATE GIRDER BRIDGES 9 Hrs.

Design of Plate Girder Bridges, Design of plate girder railway bridges for railway loading - Wind effects - Design of web and flange plates - Vertical and horizontal stiffeners.

Max. 45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Apply IRC codal provisions in the design of bridges
CO2 - Examine the functions and suitability of various types of bridges
CO3 - Design the components of short span bridges
CO4 - Design the components of long span girder bridges
CO5 - Design the components of prestressed concrete bridges
CO6 - Design the components of plate girder bridges

TEXT / REFERENCE BOOKS

1. Krishna Raju N., “Design of Bridges”, Oxford and IBH Publishing Co., 4th Edition, New Delhi, 2009.
2. Jagadeesh T.R. and Jayaram M.A., “Design of Bridge Structures”. PHI Learning Private Ltd., New Delhi, 2009.
3. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Co., New Delhi, 1990.
4. Ponnuswamy S., "Bridge Engineering", Tata McGraw Hill, New Delhi, 1996.
5. Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990.
6. Railway Loading Standards modified broad gauge, 1987.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7007	THEORY OF PLATES AND SHELLS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To study the behaviour and analysis of thin plates
- To Study the design principles of shells.
- To study the analysis and design of folded plates

UNIT 1 DIFFERENTIAL EQUATION OF THIN PLATES 9 Hrs.

Thin plates with small deflection –Laterally loaded thin plates. Governing differential equations. Various boundary conditions.

UNIT 2 RECTANGULAR PLATES 9 Hrs.

Simply supported rectangular plates. Plates with various edge conditions. Navier's and Levy's method.

UNIT 3 MEMBRANE THEORY OF SHELLS 9 Hrs.

Classical theory of shells. Structural behavior of thin shells. Classification of Shells. Membrane theory of doubly curved shells. Edge disturbances.

UNIT 4 DESIGN OF SHELL STRUCTURES 9 Hrs.

Design of spherical shells, conical shells, hyperbolic, paraboloid shells. Cylindrical shells.

UNIT 5 ANALYSIS AND DESIGN OF FOLDED PLATES 9 Hrs.

Design of Folded Plates – Assumptions in the analysis of folded plates. Types of folded plates. Analysis and design of folded plates.

Max. 45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Discuss the governing differential equation for thin plates.
CO2 - Analyse the rectangular plates using Navier's and Levy' s method.
CO3 - Explain the classical theory and classification of shells
CO4 - Design the spherical shells and conical shells
CO5 - Explain the assumptions of folded plates
CO6 - Discuss the types of folded plates.

TEXT / REFERENCE BOOKS

1. Ansel C.Ugural, "Stresses in plate and shells", McGraw Hill International Edition, 1999.
2. Bairagi, "Plate Analysis", Khanna Publishers, 1996.
3. Bulson.P.S.,"Stability Of Flat Plates.,American Elsevier Publisher. Co.,1969.
4. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.
5. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006.
6. Szilard, R., "Theory and Analysis of Plates – classical and numerical methods, Prentice Hall Inc., 2004. 7. Timoshenko.S.P, and Krieger S.W. "Theory of Plates and Shells", McGraw Hill Book Company, New York, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7008	OFFSHORE STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVE

- To study the concept of wave theories and forces involved in designing offshore structures.
- To learn the different methods of analysis for offshore structures.
- To explore the various design concepts foe designing platform, helipads and Jacket tower

UNIT 1 WAVE THEORIES 9 Hrs.

Wave generation process, Small and finite amplitude wave theories.

UNIT 2 FORCES OF OFFSHORE STRUCTURES 9 Hrs.

Wind forces, Wave forces on vertical, inclined cylinders, structures-Current forces and use of Morison equation.

UNIT 3 OFFSHORES OIL AND STRUCTURE MODELLING 9 Hrs.

Different types of offshore Structures, foundation Modelling, Structural modelling.

UNIT 4 ANALYSIS OF OFFSHORE STRUCTURES 9 Hrs.

Static Method of Analysis, foundation analysis and dynamics of offshore structures.

UNIT 5 DESIGN OF OFFSHORE STRUCTURES 9 Hrs.

Design of Platforms, helip ads, Jacket tower and mooring cables and pipelines.

Max.45 Hrs.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Explain wave generation process and wave theories concept
CO2 - Discuss wave forces and Morison equation.
CO3 - Explain the modeling for offshore structure and its foundation
CO4 - Analyse off shore structures by means of static and dynamic methods
CO5 - Design of platforms and helipads
CO6 - Design of jacket towers, mooring cables and pipelines

TEXT / REFERENCE BOOKS

1. Chakrabarti,S.K.,"Hydrodynamics of Offshore Structures", Computational Mechanics Publications,1987.
2. Thomson H.Dawson,"Offshore Structural Engineering", Prentice HallInc. Englewood Cliffs, N.J.1983.
3. Reddy D.Vand Arockiasamy M."Offshore Structures', Vol.1, Krieger Publishing Company, Malabar, Florida,1991.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7009	DESIGN OF SUB STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVES

- To learn the various theoretical concepts to determine the bearing capacity of foundations.
- To gain familiarity and design of different types of foundation like shallow foundations and deep foundations.
- To understand the concept of designing well, machine and special foundations.

UNIT 1 SITE INVESTIGATION, SELECTION OF FOUNDATION AND BEARING CAPACITY 9 Hrs.

Objectives – Methods of exploration – Depth of exploration – Sample disturbance – Factors governing location and depth of foundation – Insitu testing of Soils – Plate load test – Geophysical methods – Selection of foundation –Bearing capacity of shallow foundations by Terzaghi's theory, Meyerhof's theory, and codal provisions – Bearing capacity of footing subjected to inclined and eccentric loading – problems – Types of shear failure – General principles of foundation design.

UNIT 2 DESIGN OF SHALLOW FOUNDATIONS 9 Hrs.

Types of shallow foundations–General principles of design of reinforced concrete shallow foundations – Structural design of isolated and combine footing– Structural design of rafts by conventional method– Principles of design of buoyancy raft and basement (no design problems).

UNIT 3 PILE FOUNDATION 9 Hrs.

Pile foundations –Types–General principles of design – Estimation of load capacity of piles by static and dynamic formulae Detailing of reinforcement as per IS 2911 -Design of pile caps –Settlement analysis of pile groups –Negative skin friction Pile load tests.

UNIT 4 WELL AND CAISS ON FOUNDATIONS 9 Hrs.

Well and caisson foundations – Structural elements of Caisson and Well foundations – Elements of well foundation – Forces acting on Caisson and well foundations –Design of individual components of Caisson and well foundation(only forces acting and design principles)–Sinking of well–Shifts and tilts in Well foundations Preventive measures.

UNIT 5 TOWER FOUNDATION 9 Hrs.

Types of Foundations–Design of foundation for transmission towers.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Understand the procedures of site investigation and soil exploration methods

CO2 - Compute the bearing capacity of foundations, types of shear failure and general principles of design of foundation

CO3 - Understand the types and general principles of design of reinforced concretes hallow foundations, design of isolated, combined footing and Raft Foundation

CO4 - Estimate the Load carrying capacity of piles, Negatives k in friction and Settlement of pile group, Design of Pile cap

CO5 - Comprehend the types, forces acting and the design principles of structural components of well and caisson foundations

CO6 - Compute the design of foundation for Transmission Towers.

TEXT / REFERENCE BOOKS

1. Tomlinson M.J. and Boorman R., “Foundation design and construction”, 6th Edition, ELBS Longman, 1995.
2. Nayak N.V., “Foundation design manual for practicing engineers”, Dhanpat Rai and Sons, 1982.
3. Arora, K.R., “Soil Mechanics & Foundation Engineering”, Standard Publishers & Distributors, 2005.
4. Winterkorn.H.F.and Fang H.Y., “Foundation Engineering Hand Book, Van Nostrard, Reinhold,1976.
5. SwamiSaran, “Analysis and Design of Substructures Limit State Design”, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi,2010.
6. Barken, “Dynamics of Bases and Foundations”, Mc.Graw Hill Company, 1962.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7010	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To possess the skills to develop efficient and safe designs for composite beams, slabs, columns, and connections.
- To learn the design principles and considerations specific to composite structures, including load distribution and composite action.
- To apply design codes and standards for steel-concrete composite structures.

UNIT 1 INTRODUCTION 9 Hrs.

Review of Limit State Design of steel columns and beams - Introduction to steel concrete composite structures - concepts and Theory - Typical shear connectors and interaction with concrete - Tests for strength of shear connection.

UNIT 2 DESIGN AGAINST EARTHQUAKES 9 Hrs.

Ultimate behavior of simply supported and continuous steel - concrete composite beams with solid deck slabs and profiled deck slabs.

UNIT 3 DESIGN AGAINST BLAST AND IMPACT 9 Hrs.

Behaviour and design of steel concrete composite Trusses - Shear connection details - Design of Steel concrete columns.

UNIT 4 DESIGN AGAINST WINDS 9 Hrs.

Introduction to behaviour of box girder bridges - Design concepts.

UNIT 5 CASE STUDIES 9 Hrs.

Introduction to steel concrete sandwich construction - Seismic behavior of composite structures - Case studies on steel- concrete composite construction in buildings.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Critically assess and improve the design of steel columns and beams, as well as comprehend the fundamental principles and components of steel-concrete composite structures.
CO2 - Design steel-concrete composite beams with solid deck slabs and profiled deck slabs to resist earthquake forces.
CO3 - Develop the ability to design steel-concrete composite trusses and columns to withstand blast and impact loads.
CO4 - Develop the ability to design box girder bridges to withstand wind loads.
CO5 - Analyze the case studies on steel concrete composite construction in buildings.
CO6 - Examine the seismic behavior of composite structures.

TEXT / REFERENCE BOOKS

1. Johnson R.P., Composite Structures of Steel and Concrete, Blackwell Scientific Publications (2nd Edition), UK, 1994.
2. "Teaching Resources for Structural Steel Design", Vol. I & II, INSDAG, Kolkatta.
3. IS 11384, Code of Practice for Composite Construction in Structural Steel and Concrete.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7011	PRESTRESSED CONCRETE STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn the Principles of prestressing, analysis and design of prestressed concrete structures.
- To study the behavior of beams under elastic and ultimate loading conditions.
- To learn the design of tension and compression members.

UNIT 1 PRINCIPLES OF PRESTRESSING 9 Hrs.

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strength materials, Analysis methods, losses of prestress–Shortand Long term deflections–Cable layouts.

UNIT2 DESIGN OF FLEXURAL MEMBERS 9 Hrs.

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Designof flexural members, Design for shear, bond and torsion. Transfer of prestress – Block design and cantilever beams.

UNIT3 TRANSFER OF PRESTRESS AND DESIGN OF CANTILEVER BEAMS 9 Hrs.

Transmission of Prestressing force by Bond– Transmission length – factors affecting transmission length– check for Transmission length–Anchorage Zone stresses in Post tensioned members–Methods of achieving continuity-concept of linear transformations, concordant cable profile and gap cables – Analysis and design of cantilever beams.

UNIT4 DESIGN OF TENSION AND COMPRESSION MEMBERS 9 Hrs.

Design of tension members application in the design of prestressed pipes and prestressed concrete cylindrical water tanks Design of compression members with and without flexure - its application in the design piles, flagmasts and similar structures.

UNIT5 DESIGN OF COMPOSITE MEMBERS AND CIRCULAR PRESTRESSING 9 Hrs.

Composite members - analysis and design, ultimate strength - applications. Partial prestressing – advantages and applications – Circular prestressing in liquid retaining tanks – Analysis for stresses – Design of tank wall incorporating recommendations of IS: 3370 Part III Code – Types of Prestressed Concrete Pipes – Design of Pipes.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Analyse a composite section
CO2 - Evaluate the losses in different types of prestressed flexural beams
CO3 - Analyse and design of Tension and compression members
CO4 - Analysis of stresses in flexural member
CO5 - Design of prestressing concrete pipes
CO6 - Understand behavior of flexural members subjected to external loads

TEXT / REFERENCE BOOKS

1. Krishna Raju.N., "Design of Prestressed Concrete Structures",6th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2018.
2. Lin.T.Y and Burns H., "Design of Prestressed Concrete Structures", John Wiley and SonsInc, New York, 2009.
3. RajagopalanN., "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
4. "IS1343,Indian Standard Code of Practice for Pre-stressed Concrete", Indian Standard Institution ,New Delhi,2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7012	DESIGN OF TALL BUILDINGS	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

COURSE OBJECTIVE

- To acquire knowledge of advanced structural systems and analysis techniques for tall buildings.
- To study the behavior and failure modes associated with different structural forms.
- To be familiar with construction techniques and materials used in building assemblies.

UNIT 1 DESIGN PRINCIPLES AND LOADING 9 Hrs.

Design philosophy, Reliability Based design, working stress design, limit state design, plastic design. loading, sequential loading, Gravity loading, dead load, live load, Construction load, Combined loading, Wind Loading – Static and dynamic approach – Analytical and wind tunnel experimental method. Earth quake loading – Equivalent lateral force materials, high performance concrete – Fiber reinforced concrete –High strength concrete – Light weight concrete – Self compacting Concrete.

UNIT 2 BEHAVIOR OF VARIOUS STRUCTURAL SYSTEMS 9 Hrs.

Factors affecting growth, Height and structural form – High rise behavior, rigid frames – braced forms – infilled frames, shear walls, coupled shear walls, wall frames, tubular, cores, outrigger - braced and hybrid mega systems. Behavior of structural form –and modes of failure- flexure, shear, combination of flexure and shear.

UNIT 3 ANALYSIS AND DESIGN 9 Hrs.

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of a building as total structural system considering overall integrity and major sub system interaction, Analysis of member force, drift and twist, computerized general three dimensional analysis. Deflection, cracking, prestressing, shear flow, design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT 4 STABILITY OF BUILDINGS 9 Hrs.

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, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

UNIT 5 CONSTRUCTION TECHNOLOGY FOR TALL BUILDINGS 9 Hrs.

Assembly of buildings, Safety Policy, Stages of Site investigation, On site tests, Foundation, Basement construction and Water proofing, Materials, Selection & handling, Wall & Floor construction, Roof Construction.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Demonstrate a comprehensive understanding of the principles and considerations underlying different design approaches

CO2 - Assess the behavior and failure modes associated with these structural forms and propose appropriate design measures to ensure the stability and safety of high-rise structures.

CO3 - Develop proficiency in modeling techniques for approximate and accurate analysis of building structures

CO4 - Perform overall buckling analysis of frames and wall frames, considering various factors

CO5 - Oversee the assembly process, ensuring adherence to safety regulations, and maintaining the structural integrity and quality of the building.

CO6 - Adopt modern materials and methods for constructing tall buildings.

TEXT / REFERENCE BOOKS

1. Taranath. B. S. “Structural Analysis in tall buildings”, McGraw Hill, 1988.
2. Bryan Stafford Smith, Alexcoull. “Tall building structures”, Analysis and Design, John Willey and Sons inc., 1991.
3. Beedle. L.S. “Advances in Tall Buildings” , CBS Publishers & Distributors, Delhi, 1986.
4. Lin T.Y., Stotes Burry D., “Structural Concepts and systems for Architects and Engineers”,1981.
5. Chew Yit Lin, Micheal, "Construction Technology for Tall Buildings", Singapore University Press, 2nd Edition, 2006.
6. Draft Indian code for Tall Buildings Design.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks	**70 Marks**

SCIB7013	STABILITY OF STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To acquire the knowledge and skills to assess stability risks in structural design and implement appropriate measures to ensure the stability and safety of structure
- To learn the fundamental principles of structural stability under different modes of instability, including buckling, torsional instability, and lateral-torsional buckling
- To analyze and design structures for stability under various loading conditions

UNIT 1 CONCEPTS OF STABILITY AND APPROACHES 9 Hrs.

Concepts of stability – Approaches to Stability analysis – Equilibrium approach, energy approach, imperfection approach, dynamic approach. Higher order governing equations. Large deformation theory.

UNIT 2 APPROXIMATE TECHNIQUES 9 Hrs.

Approximate techniques – Timoshenko's method, Rayleigh-Ritz method, Galerkin's technique, Finite difference method and problems.

UNIT 3 ANALYSIS AND DESIGN 9 Hrs.

Inelastic buckling of columns – Double modulus theory, Tangent modulus theory, Shanley's model-eccentrically loaded columns- empirical relations for short columns.

UNIT 4 STABILITY OF BUILDINGS 9 Hrs.

Torsional load deformation characteristics, torsional buckling, torsional flexural buckling – equilibrium approach. Buckling of Open Sections. Numerical solutions.

UNIT 5 CONSTRUCTION TECHNOLOGY FOR TALL BUILDINGS 9 Hrs.

Beam-column – Beam-column with concentrated lateral load, beam-column with distributed lateral load, beam-column with several concentrated load – problems.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Analyze the stability of structures through various approaches.
CO2 - Estimate the buckling load of beam – columns and frames using different approximate techniques
CO3 - Assess the lateral buckling of columns using various theorems
CO4 - Analyze the stability of buildings against torsional and flexural buckling
CO5 - Analyze the beam column joint subjected to lateral load.
CO6 - Analyze beam-column joint subjected to several concentrated loads

TEXT / REFERENCE BOOKS

1. Timoshenko S.P. and Gere, "Theory of elastic stability", Prentice Hall Book Co., 2008.
2. Iyengar N.G.R., "Structural stability of column and plates", East - West Pvt. Ltd., 1988.
3. Chajes A., "Principles of structural stability", Prentice Hall, 1993.
4. Ashwini Kumar, "Stability Theory of Structures", Tata McGraw Hill, 1985.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7014	NON-LINEAR ANALYSIS OF STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the concept of nonlinear behaviour of structural elements
- To explore finite element analysis for non-linear problems in analyzing the complex structural systems
- To learn the identification and assessment of critical points such as limit states, buckling, and post-buckling behavior

UNIT 1 INTRODUCTION 9 Hrs.

Introduction- Types of Non-Linearities-Non-linear Governing equations for Beams-Geometrically non linear beams for various supports- vibrations of Beams with various boundary conditions-forced vibrations of Beams-Post buckling of Colunm- Behaviour of Beams with Material Non linearity.

UNIT 2 RECTANGULAR PLATES 9 Hrs.

Governing Non linear equations of Plates-Boundary conditions –Large deflections of Rectangular plates-Free and forced vibration of Rectangular plates- Free and forced vibration of Non Rectangular plates-Large deflections of Rectangular, Non Rectangular plates- Post buckling of Plates- Effects of Transverse Shear Deformation.

UNIT 3 SHELLS 9 Hrs.

Non linear analysis of Shells-Circular Cylindrical shells-Shallow Spherical shells-Non Circular Cylindrical shells-Forced Non- linear vibration of shells-Post buckling of shells.

UNIT 4 TRUSSES AND FRAMES 9 Hrs.

Non linear analysis of curved beams-trusses-frames- Three Dimensional Mechanism-Large and small deformation and large angle of rotation- classical linear theory- Non linear material properties – finite element method- stiffened structures.

UNIT 5 COMPOSITE MATERIAL 9 Hrs.

Non linear analysis of composite materials- composite beams- non linear vibrations- Post buckling behavior- composite plates governing equation-laminated plates cylindrical bending- laminated plates large amplitude vibration.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Analyze bar system considering material and geometric nonlinearity
CO2 - Understand the concepts of non-linear equations for rectangular plates.
CO3 - Apply the non-linear analysisin the design of shells
CO4 - Execute nonlinear analysis on curved beams and trusses
CO5 - Assess the nonlinear and instability analysis of elastically supported beams
CO6 - Analyze the nonlinear behaviour of composite plates

TEXT / REFERENCE BOOKS

1. Fertis, D.G., "Nonlinear Mechanics", CRC Press, 1999.
2. Reddy.J.N., "Non linear Finite Element Analysis", Oxford University Press, 2008.
3. Sathyamoorthy M., "Nonlinear Analysis of Structures", CRC Press, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7015	STRUCTURAL OPTIMIZATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To learn the optimization methodologies applied to structural engineering.
- To apply the Linear and Non-linear programming in the structural applications.
- To evolve the applications of fuzzy optimization techniques and Genetic Algorithms.

UNIT 1 BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9 Hrs.

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space- Feasible and infeasible - Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints-(Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).

UNIT 2 LINEAR AND NON-LINEAR PROGRAMMING 9 Hrs.

LINEAR PROGRAMMING: Formulation of problems - Graphical solution - Analytical methods - Standard form Slack, surplus and artificial variables - Canonical form - Basic feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm.

NON-LINEAR PROGRAMMING: OneDimensional minimization methods: Unidimensional - Unimodal function Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method – Golden section method – Interpolation methods. Unconstrained optimization Techniques.

UNIT 3 GEOMETRIC PROGRAMMING 9 Hrs.

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty – Concept of solving problems with one degree of difficulty.

UNIT 4 DYNAMIC PROGRAMMING 9 Hrs.

Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods.

UNIT 5 STRUCTURAL APPLICATIONS–GENITICA LGORITHMS, FUZZY OPTIMIZATION TECHNIQUES 9 Hrs.

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C.structures such as multistorey buildings, water tanks and bridges.

Max.45 Hrs.

COURSE OUTCOME

On the end of the course, student will be able to

CO1 - Apply the concept of classical optimization techniques to solve the engineering problems.
CO2 - Identify the engineering applications of linear and non-linear programming.
CO3 - Analyze the problem and reducing G.P.P to a set of simultaneous equations.
CO4 - Apply the Engineering concept of dynamic programming.
CO5 - Design various structural elements with minimum weight.
CO6 - Understand the Bellman's principle of optimality.

TEXT/REFERENCEBOOKS

1. Rao S.S., “Optimization theory and applications”, Wiley Eastern Pvt. Ltd., 1984.
2. Uri Krish, “Optimum Structural Design”, McGraw Hill Book Co.,1981.
3. Spunt, “Optimization in Structural Design”, Civil Engineering and Engineering Mechanics Services, Prentice Hall, New Jersey,1971.
4. Iyengar N.G.R. and Gupta S.K., “Structural Design Optimisation”, Affiliated East West Press Ltd., New Delhi, 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7016	INDUSTRIAL STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To plan the layout of various classes of industries according to their function.
- To design the components of Industrial buildings.
- To study the design principles of power plant and transmission structures.
- To learn the design principles of various machine foundations.

UNIT 1 PLANNING AND FUNCTIONAL REQUIREMENTS 9 Hrs.

Classification of Industries and industrial structures – planning for layout requirements regarding Lightening, Ventilation and Fire safety – Protection against Noise and Vibration – Guidelines from Factories Act.

UNIT 2 INDUSTRIAL BUILDINGS 9 Hrs.

Components of Industrial Structure -Roofs for Industrial buildings – Design of Gantry girder – Design of Corbels.

UNIT 3 POWER PLANT STRUCTURES 9 Hrs.

Chimneys and Cooling Towers – high-pressure boilers and piping design – Nuclear Contaminant structures.

UNIT 4 POWER TRANSMISSION STRUCTURES 9 Hrs.

Cables – Transmission Line Towers – Substation structures – Tower foundations – Testing Towers.

UNIT 5 MACHINE FOUNDATIONS 9 Hrs.

Types – Design Principles – Foundation for Turbo generators.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Plan the layout for various classes of Industrial structures

CO2 - Design the industrial roof, girder and corbels based on limit state method

CO3 - Adopt the design principles of power plant structures

CO4 - Adopt the design principles of power transmission structures

CO5 - Utilise the design principles of machine foundations

CO6 - Adopt the design principles of foundation for turbo generators

TEXT / REFERENCE BOOKS

1. Process of Advanced course on Industrial structures, Structural Engineering Research Centre, Chennai 1982.
2. Srinivasalu P. and Vaidiyanathan C.V., “Handbook on foundations”, Tata McGraw Hill 1976.
3. Manohar S.N., “Tall Chimneys – Design and Construction”, Tata McGraw Hill 1985.
4. Santhakumar A.R. and S.S. Murthy, “Transmission Line Structures”, Tata McGraw Hill, 1992.
5. Jakkula& Stephenson, “Fundamentals of Structural Analysis”, Von Nostrand, East West Press,1953.
6. Arya&Ajmani, “Design of Steel Structures”, Nemchand Publishers,1974.

CODE BOOKS

1. IS 4998 (PART 1) : 1992 Criteria For Design of Reinforced Concrete Chimneys.
2. IS 2974 (PART 1 to PART 5) : Design and Construction of Machine Foundations.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7017	ENERGY EFFICIENT STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To study the energy efficient and energy conservation concepts with energy auditing.
- To learn the various environmental factors affecting the building design.
- To gain knowledge on appliances in buildings for energy conservation.

UNIT 1 INTRODUCTION TO ENERGY 9 Hrs.

Energy- Power - Need of energy in buildings and its assessment. Energy consumption pattern of various types of buildings. Factors influencing the energy use in building - Concepts of energy efficient building – Energy efficient buildings in India.

UNIT 2 STUDY OF CLIMATE 9 Hrs.

Study of Weather and Climate–Classification of climate for various zones-influence of climate in building design-Tropical climate-Orientation-Environmental factors affecting building design. Analysis of thermal and visual environment.

UNIT 3 HEAT AND LIGHT 9 Hrs.

Heat gain and heat loss phenomenon in buildings. Thermal performance parameters. Role of building enclosures, openings and materials in thermal environment. Basic principles of light and daylight. Energy efficient light design of buildings. Daylight design of buildings.

UNIT 4 APPLIANCES IN BUILDINGS – ENERGY CONSERVATION 9 Hrs.

Major appliances in building and their energy consumptions. Principles of solar heating, cooling and power (PV)systems. - energy rating- Integration of energy efficient appliances with the buildings – concepts of Energy conservation.

UNIT 5 ENERGY AUDIT AND GREEN BUILDINGS 9 Hrs.

Energy survey and energy audit of buildings. Calculation of energy inputs and utilization in buildings. Energy audit reports of buildings. Concepts of Green Buildings–ratings of Green buildings. Case studies, LEED ratings, IGBC,GRIHA.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the Energy consumption pattern of various types of buildings.

CO2 - Analyze the thermal performance of materials used in the building envelope with respect to the climatic conditions.

CO3 - Compute the heat gain and heat loss phenomenon in the buildings for the selection of suitable material

CO4 - Apply Energy efficient lighting design in the buildings for energy conservation.

CO5 - State the concepts of Energy conservation by applying the Principles of solar heating, cooling and power (PV) systems.

CO6 - Understand the various existing ratings of Green buildings and to conduct the Energy auditing of buildings.

TEXT / REFERENCE EBOOKS

1. Lal Jayamaha,"Energy Efficient Building Systems: Green Strategies for Operation and Maintenance", Mc Graw Hill ,2007.
2. KrishnanA.,BakerN.,Yannas S and Szokolay S.V., "Climate Responsive Architecture–A Design Hand Book for Energy Efficient Buildings", Tata McGraw Hill Publishing Company Ltd.,New Delhi, 2001.
3. 'Handbook on functional requirements of buildings', Parts1-4,SP:41(S&T)-1987,Bureau of Indian Standards, Manak Bhavan,9 Bahadur Sha ZhfarMarg,NewDelhi,India,BIS-2012.
4. ChandI. and Bhargava P.K., "'The Climatic Data Handbook", Tata McGraw Hill Publishing Company Limited, New Delhi 2001.
5. Threlkeld J.L., "Thermal Environmental Engineering", Print ice Hall, Engle woodCliffs,NJ,2010.
6. Mili Majumdar, "Energy–Efficient Building in India", Ministry of non–conventional Energy Sources, TERI, Thomson Press India Ltd., New Delhi,2002.
7. Energy Conservation Building code user Guide, Bureau of Energy Efficiency, New Delhi,2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7018	ENVIRONMENTAL ENGINEERING STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSEOBJECTIVE

- To gain knowledge on basic theoretical concepts about the various environmental structures.
- To learn the design concepts for designing water supply and water treatment units.
- To explore the various operation and maintenance procedures of structural units.

UNIT 1 PIPE MATERIALS 9 Hrs.

Characteristics Study of Reinforced Concrete Structures, cast iron, mild steel, ductile iron, Anchorage for pipes. Design Principle of Hydro dynamic forces, Methods of Pipe laying.

UNIT 2 DESIGN OF ELEVATED TANKS 9 Hrs.

Types of water tanks-Design for Cylindrical, conical, spherical and Intz shaped RCC and prestressed concrete tanks.

UNIT 3 DESIGN OF TREATMENT UNITS 9 Hrs.

Design of screening, Grit chamber, Sedimentation and Flocculation, Settling tank, aeration tank, Trickling Filter, Oxidation ditch including hydraulic pressure and earth pressure.

UNIT 4 OPERATION PROCEDURE 9 Hrs.

Mechanism of erosion and corrosion- Precaution to be considered to prevent corrosion in planning, design, execution and maintenance. Rehabilitation measure for distress due to erosion & corrosion.

UNIT 5 MAINTENANCE 9 Hrs.

Maintenance Schedule for clogging, scouring, rotator and accessories - Man power for maintenance Structural Maintenance: maintenance for peeling of plastering, reinforcement exposure, baffle wall damage, floor damage due to uplift pressure.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the guidelines and design concepts for the environmental structures.
CO2 - Analyze the different types of pipe materials and connections for the effective design of pipe networks.
CO3 - Design the elevated water tanks with different geometry.
CO4 - Plan and design the various components in the water and waste water treatment units.
CO5 - Develop the various structural and non structural measures to prevent corrosion and erosion.
CO6 - Apply the technological advancement for maintenance and rehabilitation of environmental structures.

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. HulseR.and Mosley,W.H.,"Reinforced Concrete Design by Computer",Macmillan Education Ltd.,2006.
2. RamaswamyG.S.,"Design and Construction of Concretes hell roofs",CBS Publishers,India,2006.
3. Krishna RajuN.,"Advanced RCC Design",CBS Publishers,1986.
4. 'Manualon Sewerage and Sewage Development', CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2003.
5. GargS.K., "Sewage Disposal and Air pollution Engineering",Khanna Publishers,Volume-I,2006.
6. GargS.K., 'Water Supply Engineering', Khanna Publishers, New Delhi, 2005.
7. Krishna Raju,"Prestressed Concrete",Tata Mc Graw Hill Publishing Co.,2nd Edition, 2008.
8. IS4998(PART1):1992 Criteria For Design of Reinforced Concrete Chimneys.
9. IS2974(PART1toPART5): Design and Construction of Machine Foundations.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7019	PREFABRICATED STRUCTURES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To Study the design principles, analysis and design of elements.
- To study the design considerations in the process of prefabrication.
- To understand the joining techniques in prefabrication.

UNIT 1 GENERAL PRINCIPLES OF FABRICATION 9 Hrs.

Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns - Symmetrical frames.

UNIT 2 PREFABRICATED ELEMENTS 9 Hrs.

Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings – Expansion joints in pre- cast construction.

UNIT 3 PRODUCTION TECHNOLOGY 9 Hrs.

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening.

UNIT 4 HOISTING TECHNOLOGY 9 Hrs.

Equipments for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads.

UNIT 5 MAINTENANCE 9 Hrs.

Designing and detailing of precast unit for factory structures – Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames – Single storeyed buildings – slabs, beams and columns.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand general principles of pre-fabrication.
CO2 - Plan simple buildings using various types of prefabricated elements.
CO3 - Design simple prefabricated elements
CO4 - Knowledge about types of connections and design of abnormal loads.
CO5 - Outline the various phases involved in precast/pre-fabricated technology
CO6 - Distinguish pre-engineered buildings from conventional units

TEXT / REFERENCE BOOKS

1. Mokk L., “Prefabricated Concrete for Industrial and Public Structures”, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 2009
3. IS 4998 (PART 1) : 1992 Criteria For Design Of Reinforced Concrete Chimneys.
4. IS 2974 (PART 1 to PART 5): Design And Construction of Machine Foundations.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7020	DESIGN OF STRUCTURES FOR DYNAMICLOADS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To expose the students with the principles and methods of dynamic analysis of structures.
- To learn the design philosophies of structures to resist earthquake, blast and impact.
- To design tall structures according to wind speeds and other special considerations

UNIT 1 INTRODUCTION 9 Hrs.

Factors affecting design against dynamic loads – behavior of concrete , steel , masonry and soil under n impact and cyclic loads – Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems - Ductility and its importance.

UNIT 2 DESIGN AGAINST EARTHQUAKES 9 Hrs.

Earth quake characterization – response spectra – Seismic coefficient and response spectra method for estimating loads – response of framed, braced frames and shear wall buildings – Design as per BIS Codes of practice ductility based design.

UNIT 3 DESIGN AGAINST BLAST AND IMPACT 9 Hrs.

Characteristics of internal and external blast – Impact and Impulse loads – Pressure distribution on buildings above ground due to external blast – Under ground explosion – Design of buildings for blast and impact as per BIS codes of practice.

UNIT4 DESIGN AGAINST WINDS 9 Hrs.

Characteristics of wind – Basic design and wind speeds – effect of permeability of the structure – pressure coefficient – Aero elastic and aerodynamic effects – Design as per BIS code of practice including Gust Factor approach – Tall buildings - Chimneys.

UNIT 5 SPECIAL CONSIDERATIONS 9 Hrs.

Energy absorption capacity – Ductility of the material and the structure – Detailing for ductility – Passive and active control of vibrations – New and Favorable materials.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the behaviour of concrete, steel, masonry under impact and cyclic loads.
CO2 - Adopt seismic coefficient and response spectra methods for estimating seismic loads on frames
CO3 - Design buildings to resist blast and impact as per Indian Standards
CO4 - Design tall buildings and chimneys against wind pressure.
CO5 - Analyze the energy absorption capacity of structures during vibrations.
CO6 - Adopt active and passive methods to control vibrations.

TEXT / REFERENCE BOOKS

1. Belagoschy, “Design of Buildings to with stand abnormal loading”, Butterworths, 1990.
2. Paulay T. and Priestly, M.N.J.A., “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wiely and Sons,1991.
3. Dowling C.H., Blast Vibration, “Monitoring and control”, Prentice Hall Inc., Engle Wood Cliffs, 1985.
4. Kolusek V. et al., “Wind effects on Civil Engineering Structures”, Elsevier, 1984.
5. Concrete Structures under impact and impulsive loading, Synthesis Report, CEB, Loussane, Germany.1988.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7021	INDUSTRY 5.0 FOR STRUCTURAL ENGINEERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide a comprehensive understanding of Industry 5.0 and its impact on structural engineering.
- To familiarize students with advanced tools, technologies, and practices in structural analysis and design within the context of Industry 5.0.
- To develop ethical awareness, professionalism, and a forward-looking mindset in the field of structural engineering in the era of Industry 5.0.

UNIT 1 INTRODUCTION TO INDUSTRY 5.0 AND ITS IMPACT ON STRUCTURAL ENGINEERING 9 Hrs.

Overview of Industry 5.0 and its key features - Role of structural engineers in Industry 5.0 - Integration of advanced technologies (AI, IoT, Robotics) in structural engineering - Digital transformation in structural design and analysis - Industry case studies on the application of Industry 5.0 in structural engineering.

UNIT 2 ADVANCED STRUCTURAL ANALYSIS AND DESIGN TOOLS IN INDUSTRY 5.0 9 Hrs.

Application of artificial intelligence (AI) in structural analysis and design - Integration of Building Information Modeling (BIM) and Structural Analysis Software - Automated design optimization techniques - Performance-based design approaches in Industry 5.0 - Case studies on the use of advanced analysis and design tools.

UNIT 3 COLLABORATIVE DESIGN AND CONSTRUCTION PRACTICES IN INDUSTRY 5.0 9 Hrs.

Collaborative design platforms and virtual collaboration tools - Digital twin technology and its applications in structural engineering - Real-time monitoring and control systems for construction projects - Integration of prefabrication and modular construction in Industry 5.0 - Industry case studies on collaborative design and construction practices.

UNIT 4 SUSTAINABLE AND RESILIENT DESIGN IN INDUSTRY 5.0 9 Hrs.

Sustainable design principles and practices in Industry 5.0 - Resilient design strategies for structural engineering

Life-cycle assessment and green building certifications - Smart materials and their applications in sustainable design - Case studies on sustainable and resilient design in Industry 5.0.

UNIT 5 ETHICS, PROFESSIONALISM, AND FUTURE TRENDS IN INDUSTRY 5.0 9 Hrs.

Ethical considerations in Industry 5.0 for structural engineers - Professional responsibilities and standards in the digital era - Emerging trends and future prospects in structural engineering - Continuous professional development and lifelong learning in Industry 5.0.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze and evaluate the implications of Industry 5.0 on structural engineering practice.
CO2 - Apply advanced structural analysis and design tools to solve complex engineering problems.
CO3 - Implement collaborative design and construction practices using virtual platforms and digital twin technology.
CO4 - Incorporate sustainable and resilient design principles in structural engineering projects.
CO5 - Demonstrate ethical behavior and professionalism in the field of structural engineering in Industry 5.0.
CO6 - Adapt to future trends in the field of Structural Engineering

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. Brown, P., & Marr, B. (2020). The Rise of Industry 5.0 and How It Will Transform the Economy. Forbes.
2. Gürbüz, B., & Koç, M. (2021). A Conceptual Framework for Industry 5.0: The Next Industrial Revolution.
3. Wang, C., & Xu, X. (2020). The evolution paths of Industry 4.0 and Industry 5.0: A comparative analysis.
4. Xiong, Z., & Lu, Y. (2021). Application of Artificial Intelligence in Structural Engineering: A Comprehensive Review.
5. Li, Y., & Ren, L. (2020). Integration of BIM and Structural Analysis Software: A Review.
6. Zhang, Y., & Khiabani, H. (2020). Optimization in Structural Engineering: A Review.
7. Liu, D., & Liu, Q. (2021). Digital Twin in Construction: Recent Advances and Future Trends.
8. Zhu, Q., & Zhao, Y. (2020). Real-Time Monitoring and Control Systems for Construction Projects.
9. El Zohairy, Y. (2020). Design for Manufacturing and Assembly in Construction: A Comprehensive Review.
10. Piroozfar, P. A., et al. (2021). Sustainable Building Design: Current State and Future Challenges.
11. Devasia, S., & Selvan, M. P. (2020). Resilient Design Approaches for Structural Engineering.
12. Ashour, A. F., et al. (2020). Smart Materials in Structural Engineering: A Review.
13. NSPE Code of Ethics for Engineers.
14. Amadi-Echendu, J. E., et al. (2021). Engineering Ethics and Integrity: Challenges in Industry 5.0.
15. Attaran, M. (2020). Challenges for Structural Engineers in the Era of Industry 5.0.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**
PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**

SCIB7022	BUILDING AUTOMATION SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To outline the need for Building Automation Systems to create better environments for people to work and live in.
- To familiarize the students with building automation systems applied to various services for efficient energy management.
- To Learn the concept of Intelligent design and Construction

UNIT 1 INTRODUCTION 12 Hrs.

Introduction and Origins of the Intelligent Buildings Concept - Definition and characteristics of Intelligent Buildings with brief history and contemporary concept. Automated buildings, Responsive buildings, Evaluation of natural ventilation in buildings and indoor wind speed.

UNIT 2 ENERGY MANAGEMENT AND SERVICES 13 Hrs.

Demands on building and services, Control systems, Study of development of Computer Integrated Building from single function systems to integrated solutions. Use of building intelligence in energy management. Factors that affect energy use in buildings - functional factors, environmental factors, envelope factors, air-conditioning systems factors, energy source factors and electrical systems factors. Fenestration design for optimal daylighting.

UNIT 3 KEY ISSUES FOR INTELLIGENT BUILDINGS 10 Hrs.

Multiple activity settings, Generic analysis of space utilization. Models for shared space use. The development of briefing process including design activity and building elements, life cycles, Coordination between life cycle, building technologies. Study of issues related to site, shell, skin, services and technology.

UNIT 4 INTELLIGENT DESIGN AND CONSTRUCTION 10 Hrs.

Effective Space utilisation, Energy conservation through site selection, siting & orientation. Energy conservation through integration of building and site, site planning & site design. Expectations of user, effective communication of architectural concepts to user, Locating people and information, Introduction to building efficiency with respect to life cycle costs.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understanding various concepts of natural ventilation, heating, ventilation and cooling strategies systems and the origin of intelligent buildings.

CO2 - Integration of building services and demonstration of various energy saving practices.

CO3 - Analyzing and interpreting various factors and building components that impact the energy management

CO4 - Critically evaluating and studying the importance of life cycle cost assessment and various issues and parameters relating to building automation.

CO5 - Analyzing and designing the various components and techniques for building automation and installation techniques through effective space utilization.

CO6 - Analyzing through intelligent design and Construction for the efficiency of Building life cycle.

TEXT/REFERENCE BOOKS

1. Henrik Missen, Industrialized Building and Modular Design, C & CA K, 1972.
2. Konz T, Manual of Precast concrete Construction, Vol, I, II, III, Banverlag GMBH, 1971.
3. William P. Spence, Construction Materials, Methods, and Techniques, 2006.
4. Bansal, N.K., Hauser, G., & Minke, G., Passive Building Design, Elsevier, Amsterdam, 1994
5. Directory of Indian Building Materials Products Building materials and Technology Promo tion Council and Centre for Symbiosis of Technology, Environment Management, Bangalore, 2000-2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 Marks each–No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice each carrying 14 Marks **70 Marks**