INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

BRIDGE ENGINEERING								
II Semester: ST								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BSTE18	**Elective**	3	0	0	3	40	60	100
Contact Classes: 45	**Total Tutorials: Nil**	**Total Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Reinforced Concrete Structures Design and Drawing								

I. COURSE OVERVIEW:

This course focuses on the analysis and design of reinforced and prestressed concrete bridges, covering types of bridges, loading conditions, and general design requirements. It introduces design methods for solid slab, girder, and continuous bridges, fundamentals of prestressing, and design of prestressed components. Advanced analysis techniques such as grillage analogy, finite strip, and FEM are included, along with the design of substructures like piers and abutments. The course equips students with practical knowledge and computational skills for designing durable concrete bridges as per codes and standards.

II. COURSE OBJECTIVES:

The student will try to learn:

I. The basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
II. The sizing of bridge elements, i.e. Develop a clear understanding of conceptual design.
III. The load flow mechanism and identify loads on bridges.
IV. The design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Explain the classification of bridges, types of loads, and general design requirements considering structural, functional, and environmental effects.
CO 2 Apply methods of design for solid slab and girder bridges, and analyze continuous bridges using Courbon's theory and influence line methods.
CO 3 Demonstrate the fundamentals of prestressing, different systems of prestressing, and calculate losses in prestress for bridge members.
CO 4 Design prestressed concrete bridge components under various limit states, considering cracking, shear, diagonal tension, composite action, and reinforcement requirements.
CO 5 Analyze bridge decks using advanced methods such as harmonic analysis, grillage analogy, finite strip method, and FEM.
CO 6 Design sub-structural elements of bridges including bed blocks, piers, and abutments under different loading and site conditions.

IV. COURSE CONTENT:

MODULE-I: CONCRETE BRIDGES (09)

Introduction, types of bridges, economic span length, types of loading, dead load, live load, impact effect, centrifugal force, wind loads, lateral loads, longitudinal forces, seismic loads, frictional resistance of expansion bearings-secondary stresses, temperature effect erection forces and effects, width of roadway and footway, general design requirements.

MODULE-II: SOLID SLAB, GIRDER BRIDGES & CONTINUOUS BRIDGES (09)

Introduction, method of design. Girder bridges, introduction, method of design, courbon's theory. Continuous bridges, introduction span lengths, analysis of continuous bridges, decking of girders with constant moment of inertia, continuous bridges with variable moment of inertia, method of analysis, girders with parabolic soffit, method of plotting influence lines, girders with straight haunches, design steps for continuous bridges.

MODULE-III: PRE-STRESSED CONCRETE BRIDGES: FUNDAMENTALS (09)

Basic principles, method of pre-stressing-pre tensioning and post-tensioning, comparison, freyssinet method, magnel, blanet system-lee-mc call system basic assumptions.

Losses in pre stress-equation based on initial and final stress conditions cable zone, design of selections.

MODULE-IV: PRE-STRESSED CONCRETE BRIDGES: DESIGN (9)

Condition of first crack, ultimate load design, shear, vertical pre stressing, diagonal tension in i- section, end block, magnel's method, empirical method general design requirements, mild steel reinforcement in pre stressed concrete member, concrete cover and spacing of pre-stressing steel, slender beams, composite section, propped, design of propped composite section, un propped composite section, two stage pre stressing, shrinking stresses, general design requirements for road bridges

MODULE-V: ANALYSIS OF BRIDGE DECKS AND SUB-STRUCTURES (8)

Harmonic analysis and folded plate theory, grillage analogy, finite strip method and fem. Substructure, beds block, piers, pier dimensions, design loads for piers, abutments, design loads for abutments.

V. TEXTBOOKS:

1. E.C. Hambly, "*Bridge deck behavior*", E & FN SPON Publications, New York, 1991.
2. V.K. Raina, "*Concrete bridge practice, analysis, design and economics*", Tata McGraw Hills Publishing Company Limited, New Delhi, India, 1991.
3. M. G. Aswani, V.N.Vazirani, M.M. Ratwani, "*Design of Concrete Bridges*", Khanna Publishers, New Delhi, 2013.

VI. REFERENCE BOOKS:

1. Ryall, M.J., Hewson, N., Parke, G.A.R. and Harding, J.E, "*The manual of Bridge Engineering*" eds., Thomas Telford. 2000.
2. R. Rajagopalan, "*Bridge Super Structure*", Tata McGraw Hills Publishing Company Limited, 2008.
3. Ponnuswamy, "*Bridge engineering*", Tata McGraw - Hills Publishing Company Limited, 2008.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/syllabus/syllabus_pdf/105102011.pdf
2. http://www.highestbridges.com/wiki/index.php?title=10_Great_Bridge_Books_and_Web_Sites
3. http://www.highestbridges.com/pdf/Waddell%20-%20Bridge%20Engineering.pdf
4. https://accessengineeringlibrary.com/browse/bridge-engineering-second-edition
5. https://drive.google.com/file/d/0BwoIGOzEq0cMMy02VVFmR2Zad3M/edit

VIII. MATERIALS ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation