

**CL421.01: ADVANCED STRUCTURAL ANALYSIS (Elective)**  
**B TECH 7<sup>TH</sup> SEMESTER**

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**Credits and Hours:**

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

**A. Objectives of the Course:**

The objectives of this course are

- To impart analysis and design skills of bridge structures at advance level.
- To impart the adequate knowledge enabling the students can analyze and design of concrete water tanks.

**B. Outline of the Course:**

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Direct Stiffness Method	15
3	Finite Element Method	18
4	Domes	10

**Total Hours (Theory): 45**

**Total Hours (Lab): 30**

**Total Hours: 75**

### C. Detailed Syllabus:

<b>1</b>	<b>Introduction</b>	<b>02 Hours</b>	<b>04%</b>
1.1	Basic concepts of Analysis		
<b>2</b>	<b>Direct Stiffness Method</b>	<b>15 Hours</b>	<b>34%</b>
2.1	Overview of different stiffness & rotation-transformation matrices		
2.2	Analysis of grid, space truss and space frames under loading & various secondary effects like deformation of support, Prestrain & temperature effect		
2.3	Symmetry / Anti-symmetry		
2.4	Oblique supports and elastic supports		
<b>3</b>	<b>Finite Element Method</b>	<b>18 Hours</b>	<b>40%</b>
3.1	Introduction to FEM		
3.2	Types of problems, stresses & equilibrium, strain-displacement relations, stress-strain relations		
3.3	Application of FEM to one dimensional (for bar & beam) & two dimensional problems using constant strain triangles		
3.4	Two dimensional iso-parametric elements: Four node quadrilateral elements, numerical integration, higher order elements		
3.5	Application of FEM to two dimensional truss element		
<b>4</b>	<b>Domes</b>	<b>10 Hours</b>	<b>22%</b>
4.1	Introduction		
4.2	Nature of Stresses in Spherical Domes & Conical Domes		
4.3	Loads acting on Domes		
4.4	Spherical Domes subjected to UDL		
4.5	Spherical Domes subjected to Concentrated Load at Crown		
4.7	Conical Domes subjected to Concentrated Load at Crown		
4.7	Design of RC Domes		

### D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory which carries 10 Marks and 5 Marks weightage respectively.
- Two internal exams will be conducted and average of the same will be converted to equivalent of 15 Marks as a part of internal theory evaluation.
- Assignments/Surprise tests/Quizzes/Seminar will be conducted which carries 5 Marks as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

**E. Students Learning Outcomes:**

On the successful completion of this course

- Students will be able to analyze R.C.C. bridge super structure subjected to applied loads which are as per given in I.R.C. codes and also able to analyze the bridge structure using different methods
- Students will be capable enough to analyze and design of R.C.C. culverts and concrete water tanks.

**F. Recommended Study Material:**

**Text Books:**

1. Krishna Raju, N., Design of Bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
2. Deshmukh S. K. & Meghre A.S., Matrix Methods of Structural Analysis, Charutar Publishing House
3. Rethaliya R.P., Structural Analysis III, AtulPrakashan

**Reference Books:**

1. Raina, V.K., Concrete Bridges Practice – Analysis, Design and Economics, Shroff Publications, 2<sup>nd</sup> edition, New Delhi, 2005.
2. Jaikrishna and Jain O.P., Plain and Reinforced Concrete, Vol.-II, Nem Chand & Bros., Roorkee.

3. Vazirani&Ratwani, Concrete Structures, Khanna Publishers, New Delhi, 1990.
4. Sayal&Goel, Reinforced Concrete Structures, S. ChandPublication, New Delhi, 2004.
5. Dayaratnam, P., Design of Reinforced Concrete Structures, Oxford & IBH publication, New Delhi, 2000.
6. Vazirani, Ratwani and Aswani, Design of Concrete Bridges, Khanna Publishers, 2nd edition, 2008.

**Web Materials:**

1. <http://www.ajacks.com/OpenChannel/GeneralInfo/Culverts/Culvert%20Design.pdf>
2. <http://happytreeflash.com/culverts-ppt.html>
3. <http://www.springfieldmo.gov/stormwater/pdfs/Criteria/Chapter7.pdf>
4. [www.inti.gov.ar/cirsoc/pdf/puentes\\_hormigon/31-bridgedesign.ppt](http://www.inti.gov.ar/cirsoc/pdf/puentes_hormigon/31-bridgedesign.ppt)