

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING

SUBJECT NAME: DESIGN OF PRESTRESSED CONCRETE STRUCTURES & BRIDGES

SUBJECT CODE: 2180612

B.E. SEMESTER-VIII

Type of course: Department Elective

Prerequisite:

Structural Analysis-I & II, Concrete technology, Design of Reinforced concrete structure

Rationale:

For improving the behavior and strength of concrete structure under various service conditions, prestressing is one of the most effective methods. It is widely used in long span building structures and bridges. Bridge is an important infrastructure facility required to construct for passage over railways, road ways etc. Hence this subject is designed to combine both things, which are most relevant to the field of Civil Engineering. The subject focused on various aspects related to design of prestressed concrete slab & girders and design of the simple girder type bridges. This course would add the knowledge of designing long span structures using prestressing.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
03	01	00	04	70	PA	ALA	ESE	OEP	20	150

ESE-End Semester Exam, PA-Progressive Assessment, E-External, M-Mid semester, V-Viva (External) , I-Internal, ALA-Active Learning Assignment, OEP-Open Ended Problem

Note: IS:1343(2012), IRC: 5, 6, 78, 112-2011 are permitted in the examination.

Content:

Sr. No.	Content	Total Hrs	% Weightage
A	Prestressed Concrete		
1	Introduction, Basic Concepts, History of development of materials and prestressing, different methods of prestressing, Advantages and Limitations, IS provisions related to materials properties & prestressing.	04	25
2	Analysis of member for prestress and bending stresses at various stages; Pressure Line; Stress, strength and Load Balancing concepts; Losses in prestress; short term and long term deflections; flexural ,shear and torsional strength, Estimation of crack width. Fatigue and impact strength, resistance to fire and corrosion.	08	

3	Transfer of prestress in pretensioned and posttensioned members, stress distribution at end anchorages, anchorages and end block design; Limit state design criteria, design of pre and post tensioned girders; design of post tensioned one way and two way slabs.	10	25
B	Bridges		
4	Classification of bridges, investigations and planning, choice and type of bridges, General design specifications, Loads acting on bridges, Live load specifications for road bridges as per IRC, Load distribution theories - Courbon's Method, Grillage analogy, Pigeaud's curves.	06	15
5	Design of Superstructure: General design considerations, analysis and design of simply supported RC slab type, T beam type bridges, Forces acting on bearing, Design of bearing, General aspects of pre-tensioned and Post tensioned prestressed bridge decks- Principles of design only.	08	20
6	Design of Substructure : Types of substructures, Loads acting on substructure, Transfer of loads from superstructure to substructure, Analysis and design of substructure elements, shallow foundation, deep foundations (only design principles), Design of other components like wing wall, return wall	06	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	30	20	10	5

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

(A) Prestressed Concrete

1. Krishna Raju N. Pre stressed Concrete, Tata McGraw Hill Co.
2. Rajagopal N., Prestressed Concrete, Narosa Publishing House.
3. Dayarathnam P., Prestressed Concrete Structures, S.Chand Publishers.
4. Sinha N.C. and Roy S.K., Fundamentals of Pre-stressed Concrete, S.Chand & Company limited.
5. T. Y. Lin, Design of Prestressed Concrete Structures, Wiley India Pvt. Ltd.
6. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt. Ltd.1997.
7. A. Nilson, Design of Prestressed Concrete, John Willey & Sons.2nd edition, 1987.
8. Leonhardt F., Wilhelm Ernst and Shon, Prestressed Concrete- Design and Construction –, Berlin
9. Evans, R.H. and Bennett, E.W., Prestressed Concrete Theory and Design, Chapman and Hall, London.
10. Prestressed Concrete by The Freyssinet Prestressed Concrete Co. Ltd.,
11. IS:1343 (2012) - Code for Practice for Prestressed Concrete.

(B) Bridges

1. Victor J., Essential of Bridge Engineering, Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1980
2. Raina V.K. "Concrete Bridge Practice" , Tata McGraw Hill Publishing Company, New Delhi, 1991.
3. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1988
4. Hambly E. C., "Bridge Deck Behaviour",CRC Press, 2nd edition
5. Surana C. S., "Grillage Analogy in Bridge Deck Analysis ", Alpha Science International Ltd.
6. Bakht, B. and Jaegar, L.G., "Bridge Analysis simplified", McGraw Hill, 1985.
7. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 1989
8. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York, 1955.
9. IRC: 5, 6, 78, 112-2011

Course Outcome:

After learning the course the students should be able to:

1. apply concepts & methods for pre stressing systems for different materials.
2. compute stresses in beams due to transverse loads & prestressing.
3. determine the losses in beams due to prestress, short and long term deflection, flexural and shear strength of beam.
4. design the pre-tensioned and post-tensioned concrete beams & slab, anchorage zones.
5. know various specifications of IRC for planning, analysis & design of bridges.
6. analyse and design of simply supported RC slab & girder type superstructure as per IRC specifications,
7. analyse and design substructure, foundation and adjoining elements.

Term-Work:

The students will have to solve at least one full design of T-beam type bridge superstructure or Prestressed concrete Girder and prepare General arrangement drawing, structural details of various components in A2 size drawing sheet. In addition to this, solve at least five design examples of remaining components (not covered in full design problem) with proper detailing in sketch book/A3 size sheet.

Practical examinations shall consist of oral based on term work and above course.

Design based problem/ Open ended problem may also considered as a part of Term-work.

List of Experiments: - NIL -

Design based Problems (DP)/Open Ended Problem:

A group of students has to undertake one open ended problem/case study. Few examples of the same are given below:

1. Advance Techniques of Prestressing.
2. Site visit related to prestressing practice and report preparation
3. Application of Circular prestressing
4. Prestressing in Slab
5. Prestressing in Box Girder
6. Failure study: during prestressing and at service
7. Development of spread sheets for design of various structural elements of bridges.

8. Design of any one type of bridge from the course using any open-source / professional software and/or self-developed spread sheet/programs.
9. Site visit related to construction stages and report preparation
10. Failure study : during and/or after construction

Major Equipment: - NIL -

List of Open Source Software/learning website:

1. <http://nptel.ac.in>
2. <http://www.icri.org>
3. <http://www.nbmw.com>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides: which include videos, animations, pictures, graphics for better understanding theory and practical work. The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus can be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.