Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2023-2024

Course Handout Part II

Date: 09-01-2024

In addition to Part-I (General Handout for all courses appended to the time table), this portion gives further specific details regarding the course.

Course No. : CE F415
Course Title : DESIGN OF PRESTRESSED CONCRETE STRUCTURE
Instructor-in-Charge : Bahurudeen A

Scope and objective of the Course:

This course provides a basic and enhanced overview of the design of prestressed concrete structures. Basic concepts of prestressing, types of prestressing systems and their analysis are discussed in the course. Additionally, the course enlightens design details for flexure, shear, torsion, composite sections and statically indeterminate structures. Principles and methods of optimisation for prestressed concrete design are introduced. Relevant Indian Standard codes of practice will be emphasised throughout lecture and tutorial sessions.

Course Level Objectives:

- On the completion of the course, the learner will be able to choose choices of the prestressing method, current systems and accessories relevant to any method for a given construction project.
- On completion of the course, the learner will be able to analyse different sections used in prestressed concrete construction.
- On completion of the course, the student will be able to design and detail for flexure, shear and torsional reinforcement in various sections of prestressed concrete.
- On the completion of the course, the student will be able to evaluate laws of prestressing, the transmission of prestressing and durability of prestressed concrete structures.

Text Book:

T1. Krishna Raju, N., Prestressed Concrete, 6th Edition, Tata McGraw-Hill Publishing Company Ltd., 2018.

Reference Books:

R1. Collins, M. P. and Mitchell, D., Prestressed Concrete Structures, Prentice-Hall, Inc., 1997
R2. Khan, S. and Williams, M., Post-tensioned Concrete Floors, Butterworth Heinemann Ltd., 1995.
R3. Lin, T. Y. and Burns, N. H., Design of Prestressed Concrete, 3rd Edition, John Wiley & Sons, 2010.
R4. Rajagopalan, N., Prestressed Concrete, Narosa Publishing House, 2010.

R5. Relavant Indian and International Standards (IS:784-2001; IS:1343 – 2012)

Course Plan:

No. of Lectures	Learning Objectives	Topics to be covered	Chapter in the Text Book	SLO
1-3	Describe the importance and significance of prestressing. Discuss the evolution of prestressing techniques with time.	Basic Concept; Early Attempts of Prestressing	1, T1	**(h),(j)**
4-6	List the various types of prestressing techniques. Recommend suitable prestressing techniques for various structural applications. Explain the limitations of prestress techniques. Describe the merits of prestressing over the conventional reinforcement design.	Effect and Source of Prestressing Types of Prestressing; Partial prestressing Limitations of Prestressing Advantages of Prestressing	1, T1	**(a)**
7-9	List different accessories used in prestressing concept	Prestressing steel and concrete for construction. Materials and accessories used in prestressed concrete construction.	2, 3 T1	**(c)**
10-15	Outline the basic assumptions used in presetressing applications. Analyse prestressed concrete members. Solve and find out the cracking moments in prestressed members under specific loadings.	Elastic flexure analysis, Basic assumptions; Analysis; Resultant stresses; stresses in tendons; Cracking Moment	4, T1	**(h), (e)**

16-20	Define the phenomenon of elastic shortening. Describe the various prestressing losses and explain the reasons for them.	Losses due to prestress Elastic Shortening; Anchorage Slip; Creep of Concrete; Shrinkage of Concrete; Relaxation of Steel; Total Time-dependent Loss	5, T1	**(k),(a)**
21-22	Carry out Flexural design based on concrete stress limits	Magnel method of flexural design	7, T1	**(c)**
23-24	Perform Flexural design based on Load balancing concept	Load balancing method	4, T1	**(c)**
25- 31	List and examine the different components of shear resistance Describe the sequential design steps for prestressing .	Shear diagonal tension and web reinforcement: Components of Shear Resistance; Design of Transverse Reinforcement; Detailing of shear Reinforcement; Design Steps	8, T1	**(e), (k)**
32-36	Examine the effects of pure torsion on a prestressed concrete Summarise the concept of pure torsion and extend the theory to explain the failure modes Discuss in detail the limit state of collapse for torsion.	Crack Pattern Under Pure Torsion Components of Resistance for Pure Torsion; Modes of Failure; Effect of Prestressing Force Limit State of Collapse for Torsion; Design and Detailing Requirements	8, T1	**(a), (k), (e)**
37-39	Illustrate transmission of prestress in a structural concrete member Define bond stress and explain the concept of transmission length	Bond stress, transfer and development length, Anchorage Zone.	9, T1	**(a), (k)**
40-42	List the various types of deflections that occur in prestressed concrete members and explain the reasons.	Deflection due to Gravity Loads; Deflection due to Prestressing Force; Total Deflection; Limits of Deflection; Calculation of Crack Width and Limits of Crack Width	6, T1	**(e), (a)**
Total: 42				

***Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

a) an ability to apply knowledge of mathematics, science and engineering
b) an ability to design and conduct experiments, as well as to analyse and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
h) a recognition of the need for, and an ability to engage in life-long learning
i) a knowledge of contemporary issues
j) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid Semester Test	90 min	30	15/03 - 4.00 - 5.30PM	Closed Book
Term Project		15	Continuous	Open Book
Take-Home Assignments		15	Continuous	Open Book
Comprehensive Exam	180 min	40	17/05/24 AN	Closed book

Chamber Consultation Hour: Thursday 4:00 -5:00 pm

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester, and no type of academic dishonesty is acceptable.

Notices: Notices will be displayed on the Notice Board of the Civil Engineering Department and Google classroom - of the course.

Make-up Policy:

1. Prior permission is mandatory in genuine cases. Applications (preferably email/hardcopy) received 24 hours after (in case of medical emergencies) the test will not be entertained. Applications on informal forums will be ignored.
2. Medical emergencies have to be supported by valid certificates to the satisfaction of I/C.

INSTRUCTOR-IN-CHARGE
CE F415