



**Birla Institute of Technology & Science, Pilani**  
Hyderabad Campus

**SECOND SEMESTER 2018-2019**  
Course Handout Part II

Date: 07-01-2019

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 the basic and enhanced overview on design of pre-stressed 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 optimization for prestressed concrete design are introduced. Relevant Indian Standard codes of practice will be given emphasis throughout lecture and tutorial sessions.

**Course Level Objectives:**

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

**Text Book:**

**T1.** Krishna Raju, N., Prestressed Concrete, 5<sup>th</sup> Edition, Tata McGraw-Hill Publishing Company Ltd., 2014.

**Reference Books:**

- R2.** Collins, M. P. and Mitchell, D., Prestressed Concrete Structures, Prentice-Hall, Inc., 1997  
**R4.** Khan, S. and Williams, M., Post-tensioned Concrete Floors, ButterworthHeinemann Ltd., 1995.  
**R6.** Lin, T. Y. and Burns, N. H., Design of Prestressed Concrete, 3rd Edition, John Wiley & Sons, 2010.



**R6.** Rajagopalan, N., Prestressed Concrete, Narosa Publishing House, 2010.

**R7.** Relevant Indian and International Standards (IS:784 – 2001; IS:1343 – 2012; IRC:18 – 2000; ACI 318M-05; BS 8110 : Part 1 : 1997)

**Course Plan:**

No. of Lectures	Learning Objectives	Topics to be covered	References	SLO
1-3	Describe the importance and significance of prestressing.  Discuss the evolution of prestressing techniques with time.	Basic Concept; Early Attempts of Prestressing; Brief History.	1, T1	<b>(h),(j)</b>
4-5	List the various types of prestressing techniques.  Recommend suitable prestressing techniques for various structural applications.  Explain the limitations of prestressing techniques.  Describe the merits of prestressing over the conventional reinforcement design.	Types of Prestressing Limitations of Prestressing Advantages of Prestressing	3, T1	<b>(a)</b>
6-9	Outline the basic assumptions used in prestressing applications.  Analyse prestressed concrete members.  Solve and find out the cracking moments in prestressed members under specific loadings.	Basic assumptions; Analysis; Resultant stresses; stresses in tendons; Cracking Moment	4, T1	<b>(h), (e)</b>
10-13	Define the phenomenon of elastic shortening.	Elastic Shortening; Anchorage Slip; Creep of Concrete; Shrinkage of Concrete; Relaxation of Steel; Total	5, T1	<b>(k),(a)</b>



	Describe the various prestressing losses and explain the reasons for them.	Time-dependent Loss		
14-16	List the various types of deflections that occur in prestressed concrete members and explain the reasons.  Define prestressed member design parameters and their limits.	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	<b>(e), (a)</b>
17-19	Explain the difference between the analysis of prestressed members at 'transfer' and at 'service'.  Define ultimate limit state.  Differentiate between the analysis procedure for prestressed concrete members with different sectional geometry.	Introduction; Analyses at Transfer and at Service; Analysis for Ultimate Strength; Variation of Stress in Steel; Condition at Ultimate Limit State; Analysis of a Rectangular Section; Analysis of a Flanged Section; Choice of Sections Choice of Sections; Detailing Requirements for Flexure Tendon Profile; Minimum Amount of Reinforcement	7, T1	<b>(a), (c), (h)</b>
20-25	List and examine the different components of shear resistance  Describe the sequential design steps for prestressing .	Components of Shear Resistance; Design of Transverse Reinforcement; Detailing of shear Reinforcement; Design Steps	8, T1	<b>(e), (k)</b>
26-29	Examine the effects of pure torsion on a prestressed concrete member Summarize 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	<b>(a), (k), (e)</b>

30-31	Illustrate transmission of prestress in a structural concrete member  Define bond stress and explain the concept of transmission length	Pre-tensioned Members Post-tensioned Members Bond stresses and Transmission Length	9, T1	<b>(a), (k)</b>
32-33	Summarize the principles and methods of optimization	Principles and methods of optimization	20, T1	<b>(c), (e), (f)</b>
34-36	Elaborate the effects of prestressing on indeterminate structures	Effect of prestressing in Indeterminate structures; Concordant Cable Profile Guyon's theorem	15, T1	<b>(k)</b>
37-40	Compare the types of composite sections  Differentiate between the analysis steps of composite prestressed members and conventional prestressed members.	Types and Analysis of Composite Sections; Design of Composite Sections; Flexural and shear strength of composite sections	4, 14, T1	<b>(e)</b>
Total: 40				

**\*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 analyze 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
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.



### Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Remarks
Mid Semester Test	90 min	25	16/3 11.00 -12.30 PM	Closed Book
Surprise Quiz	-	10	Continuous	Closed Book
Term project and presentation		10 (OB)	Continuous	Open Book
Take Home Assignments		15 (OB)	Continuous	Open Book
Comprehensive Exam	180 min	40	13/05 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 Civil Engineering Department and Google class room 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 satisfaction of I/C.

**INSTRUCTOR-IN-CHARGE**  
**CE F415**

