BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
AUGS/ AGSR Division

SECOND SEMESTER 2020-21
COURSE HANDOUT

Date: 18.01.2021

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 STRUCTURES**
Instructor-in-charge : **MANOJ KUMAR**

1. Course Description:

This course deals with the study of various pre-stressing techniques, pre-stressing systems, analysis of pre-stressed concrete members, various losses in pre-stress, load balancing concept, determination of cable profiles in simply supported prestressed girders, limit state design of simply supported prestressed concrete girders for flexure, shear and serviceability, and the design of anchorage zone.

2. Scope and Objective of the Course

Prestressed concrete design is an advance design technique of structural systems. The clear understanding of solid mechanics and design of reinforced concrete is prerequisite for this course. The primary objective of the course is to make students grasp the concepts of prestressed concrete and to enable them for designing the structural elements using steel stands. At end of the course, students will have the basic concepts of analysis and design of prestressed concrete structural elements required for supporting heavy loads and sustaining higher level of deformations.

3. Text Book

(i) Praveen Nagarajan, Prestressed concrete Design, Pearson Ed., New Delhi, 2013.

4. Reference Book

(i) IS 1343: 2012 Indian Standard Code of Practice for Prestressed concrete, BIS New Delhi.
(ii) IS 14268: 2017 Indian Standard, Uncoated Stress Relieved Low Relaxation Seven-Wire (Ply) Strand for Prestressed Concrete, BIS, New Delhi.

5. Course Plan:

Module No.	Lecture Session	Ref.	Learning outcomes
1. Basic Principles of Prestressing	***Lectures 1-5*** Need for Prestressed Concrete, Structural Behaviour of Prestressed Concrete Members, Methods of Prestressing; Post-tensioning systems; Classifications of Prestressed Concrete Members; Comparison with Reinforced Concrete	Ch. 1	To understand basic principle of Prestressing and advantages of prestressed members over reinforced members
2. Materials for Prestressed Concrete	***Lectures 6-7*** High tensile strength steel for Prestressing, Properties of High Tensile steel, High compressive strength concrete for Prestressing, properties of High compressive strength concrete	Ch. 2-3	To understand the necessity of high strength materials and their properties
3. Losses in Prestress	***Lectures 8-12*** *Short-term Losses in Prestress* Loss Due to Elastic Shortening of Concrete; Loss Due to Friction; Loss Due to Slip in Anchorage	Ch. 4	To determine various losses in Prestress

	Long-term Losses in Prestress Loss Due to Shrinkage of Concrete; Loss Due to Creep of Concrete; Loss Due to Relaxation of Steel; Total Loss in Prestress		
4. Analysis of Prestressed Concrete Sections	***Lectures 13-20*** *Analysis of Section at Elastic Stage:* Methods of Elastic Analysis of prestressed sections: Combined Load Approach; Internal Couple Approach; Equivalent Load approach Load Balancing Decompression Moment; Cracking Moment Additional Stress in Tendon; Due to Bending Flexural Behaviour of Prestressed Concrete Members; Modes of Failure in Flexure; Types of Section; *Analysis of section at Ultimate stage:* Analysis of Rectangular Sections with Bonded Tendons; Analysis of Post-tensioned Rectangular; Analysis of post-tensioned beams having Unbonded Tendons; Analysis of Flanged Sections	Ch. 5	To grasp understanding about the flexural response of prestressed sections at Service and ultimate stage
5. Design of Prestressed Concrete Sections for Flexure	***Lectures 21-26*** Governing Inequalities; Minimum Section Modulus; Design of Prestressing Force; Magnel Diagram; Cable Zone; Selection of Cross-sectional dimensions; Requirements for Flexural Reinforcement: Concrete Cover; Spacing of Tendons, Minimum Longitudinal Steel, Minimum Side Face Reinforcement, Steps for Flexural design of Prestressed Concrete Members	Ch. 9	To design the prestressed sections for flexure
6. Design of section for Shear	***Lectures 27-33*** Effect of Prestress on Shear Strength Of concrete; Identification of Zones for Shear Design; Ultimate Shear Resistance of concrete; Design of Shear Reinforcement; Minimum Shear Reinforcement; Maximum Ultimate Shear Force Steps for Shear Design of Prestressed members	Ch. 6	To design the prestressed sections for Shear
7. Design of Anchorage Zone	***Lectures 34-37*** *Design of Anchorage Zones in Pre-Tensioned Members:* Bond Mechanisms; Transmission Length; Flexural Bond Length; Development Length; End Zone Reinforcement *Anchorage Zones in Post-Tensioned Members:* Bearing Stresses Behind Anchorage; Bursting Forces in Anchorage Zones; End Zone Reinforcement	Ch. 7	To design the anchorage zone of prestressed sections
8. Deflections in Prestressed	***Lectures 38-40*** Deflections in Un-cracked Beams; Short-term Deflection at Transfer; Long Term Deflection at	Ch. 8	To check the design the prestressed sections for

Concrete girders	Service Condition; Deflection Limits in prestressed girders		serviceability requirement

6. Evaluation Scheme

S. N.	Evaluation Component	Duration	Weightage (%)	Date & Time	Nature of component (OB/CB)
1	Mid-Sem Test	90 Minutes	35	TBA by AUGSD	OB
3	Class-tests/Quizes/Assig.	TBA	25	TBA	OB
2	Compre. Exam.	3 Hours	40	07/05 FN	OB

7. Chamber Consultation Hour: To be announced in the class.

8. Notice: **N**otice if any, concerning this course will be uploaded at Nalanda or communicated through institute e-mail.

9. Make-up Policy: Make-up will be granted only to genuine cases. For cases related to illness, proper documentary evidence is essential. Prior permission is necessary if student is out of station on the test date.

Instructor-in-charge
CE F415