Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-2

Subject : Design of Prestressed Concrete Structures - METSE12515

Type of Course: Major Core

Prerequisite: Mechanics of Solids and Design of Reinforced Concrete Structures and Concrete Technology

Rationale: Prestressed concrete stands as a cornerstone within the construction landscape, renowned for its reliability, durability, and widespread adoption in both building and bridge projects worldwide. Its unparalleled attributes have propelled advancements across the construction, precast manufacturing, and cement industries, revolutionizing structural applications across various domains. From towering buildings to expansive bridges, robust foundations to towering water towers, and intricate offshore drilling platforms to essential nuclear reactors, prestressed concrete boasts a remarkable versatility and resilience that underpins its ubiquity.

This subject encompasses fundamental principles alongside comprehensive insights into the intricate design processes of prestressed concrete structures. Through a deep dive into its mechanics, applications, and methodologies, engineers gain the expertise needed to harness the full potential of this transformative construction material.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
04	00	02	05	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	**Introduction** Fundamentals of Prestressing, Varieties and Systems, Requirement for High-Strength Materials, Loading Phases, Loss Assessment, Deflection (Short to Long Term), Camber Application, and Cable Arrangements.	07	10
2	**Statically determinate PSC beams** Assessment and Design for Ultimate and Serviceability Limit States Regarding Flexural, Shear, Bond, and Torsion, Incorporating Applicable Code Guidelines.	08	15
3	**Transmission of prestress** Transmission of Prestress in Pre-Tensioned Elements: Analysis of Anchorage Zone Stresses and Design Considerations for Post-Tensioned Members.	07	10
4	**Statically indeterminate structures** Evaluation and Design of Continuous Beams: Selection of Cable Profile, Linear Transformation, and Concordance Analysis.	10	15
5	**Design of structural elements** Assessment and Design of Diverse Structural Elements such as Slabs, Columns, and Beam-Columns, with Application in the Design of Prestressed Pipes and Cylindrical Water Tanks.	14	25
6	**Composite construction** Evaluation and Design of Precast Prestressed Concrete (PSC) Beams and Cast-In-Situ Reinforced Concrete (RC) Slabs, Considering Creep and Shrinkage Effects. Exploring Partial Prestressing: Principles, Analysis, Design Concepts, and Crack Width Calculations.	08	15
7	**Miscellaneous structures** Introduction to Special Prestressed Structures: Prestressed Folded Plates, Prestressed Cylindrical Shells, and Prestressed Concrete Poles.	06	10

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
01	**Design of Diverse Structural Elements for Prestressed Pipes and Cylindrical Water Tanks**	10

	Faculty will give Designing the structural elements for a cylindrical water tank with a capacity of 500,000 liters. The tank will have a diameter of 10 meters and a height of 8 meters. Student will design the tank and submit it on GMIU Web Portal.	
02	**Analysis of Anchorage Zone Stresses and Design Considerations for Post-Tensioned Members** Faculty will assign A detailed analysis of anchorage zone stresses and providing design considerations for post-tensioned members in concrete structures Student will prepare the analysis report and upload on GMIU Web Portal.	10
03	**Design precast prestressed concrete (PSC) beams for a structural project considering the effects of creep and shrinkage** Faculty will assign the following data: Designing precast prestressed concrete (PSC) beams for a bridge project. The beams are to span 20 meters and support a uniformly distributed load of 100 kN/m. The design should consider the effects of creep and shrinkage over time. Student will prepare the design PSC beam and upload on GMIU Web Portal.	10
Total		**30**

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	15%	20%	20%	20%	15%	10%

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.

Course Outcome:

After learning the course the students should be able to:	
CO1	Apply principle of prestressing, determination of losses, deflections and cable profile.
CO2	Analyze and design pre-tensioned and post-tensioned prestressed concrete beam with limit state design method.
CO3	Apply principles of prestressing to slab, column, beam-column, pipes & cylindrical water tank.
CO4	Apply prestressing techniques to composite structures like Prestressed concrete beam over cast-in-situ slab.

CO5	Apply design principles of partial presetressing, prestressing of few special structures like folded plates, cylindrical shell and poles.

List of Practical:-

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Prestressed concrete - Krishna Raju
[2] Design of Prestressed Concrete Structures - T.Y.Lin
[3] Fundamentals of Prestressed Concrete - N.C.Sinha & S.K.Roy S.Chand & Co.,
[4] Prestressed Concrete- Design and Construction – Leonhardt F., Wilhelm Ernst and Shon, Berlin
[5] Prestressed Concrete – Freyssinet
[6] Prestressed Concrete, - Evans, R.H. and Bennett, E.W., Chapman and Hall
[7] Prestressed concrete – Rajgopalan
[8] IS:1343-Code for Practice for Prestressed Concrete
[9] IS:3370-3 : Code of Practice Concrete structures for the storage of liquids, Part 3: Prestressed concrete structures