CIPE4003 PRE-STRESSED CONCRETE (3-0-0)

Course Objective

- To have in-depth knowledge of the fundamental principles of prestressing.
- To cultivate a high level of expertise in the analysis and design of prestressed concrete elements.
- To obtain a widespread understanding of the essential code provisions important for the design of prestressed members.
- To have proficiently apply advanced statically indeterminate analysis techniques to the design of prestressed structures.

Module I (10 hours)

Introduction: Basic principles: Introduction - need for prestressed concrete - structural behaviour of prestressed concrete member - methods of prestressing - pre-tensioning and post-tensioning - anchorage systems - types of prestressed concrete -comparison with reinforced concrete. Materials: High tensile steel - types of prestressing steel - high strength concrete - properties of high tensile steel and high strength concrete. Losses in prestress: Immediate losses - time dependent losses - total losses. Analysis of sections:

Module II(10 hours)

Analysis at serviceability limit state - combined load approach - internal couple approach -equivalent load approach - concept of load balancing - decompression moment - cracking moment. Design for flexure: Modes of failure in flexure - ultimate moment of resistance of sections with bonded tendons -strain compatibility method - IS code procedure.

Module III (10 hours)

Design of shear and torsion: Design for shear and torsion: Effect of prestress in shear strength - zones for shear design - shear resistance of sections - design for shear - failure modes in torsion - design for torsion. Design of anchorage zones: Anchorage zones in pre-tensioned members - development length - end zone reinforcement - anchorage zones in post-tensioned members - bearing stresses - bursting forces - end zone reinforcement. Control of deflections: Deflection in type I and type II beams - short term and long term deflections - IS code procedures.

Module IV (10 hours)

Flexural members and Indeterminate structure: Design of flexural members: Governing stress inequalities for uncracked sections - design of prestressing force -Magnel's diagram - allowable cable zone - flexural efficiency factor. Composite members: Analysis at serviceability limit state - stresses due to differential shrinkage - ultimate moment of resistance. Indeterminate structures: Primary and secondary moments and shears - effective cable line - linear transformation of cable profile - concordant cable - analysis of sections.

After successfully studying this course, students will able to:

- Have conceptual ideal about prestressed concrete members and their application domains
- Analyse prestressed concrete structural members and estimate the losses of prestress.
- Analyse and design of prestressed concrete structural elements as per IS 1343.
- Design prestressed concrete flexural members, composite members and statically indeterminate structures.
- Apply this knowledge in construction of infrastructures having prestressed concrete members

Books:

1. Krishna Raju, N., Prestressed concrete, Tata McGraw Hill, 2000.Kumar, P. Elements of Fracture Mechanics, Tata McGraw Hill, 2009.
2. Singh Shamsher Bahadur, Analysis and Design of Prestressed Concrete Structures, Wiley India, 2023
3. Muthu K.U., Ibrahim A, Janardhana M. and Vijayanand M., Prestressed Concrete. Prentice Hall India Learning Private Limited, 2016
4. Bhavikatti S.S. Design of Prestressed Concrete, 2019.
5. Nagarajan P., Prestressed concrete Design, Pearson, 2013
6. Ghosh K.M., Prestressed Concrete: Analysis and Design Practice of Members: Analysis and Design Members, Prentice Hall India Learning Private Limited,2014.
7. Dayaratnam P., Prestressed Concrete, Oxford and IBH, 6th edition, 2018.
8. Annie J.P., Easwary P., Rao Y.R.M. Prestressed Concrete Analysis and Design, S K Kataria and Sons, first edition, 2018.
9. Rajagopalan N., Prestressed Concrete, Narosa publishers, New Delhi, 2004.