NPTEL Syllabus Template

Course Title	Advanced Prestressed Concrete Design
Discipline	Civil/ Structural Engineering
Duration of course **4/8/12 weeks**	12 weeks
Number of times you have taught this course totally and in the last 5 years (2-3 times is preferable, if not more)	More than ten times
Is this course syllabus approved by AICTE or by Senate in your/any institute? If yes, please give the course name and institute under which this is approved.	CE 6222
The time frame of when you would want to offer the course: Jan 2022/July 2022	July 2024/ Jan 2025
Will it map to any course in the AICTE model curriculum. **LINK to AICTE Curriculum** **LINK 1** **LINK 2** **LINK 3**	Professional core elective / Design of Prestressed Concrete Structures
Will it map onto any of the NPTEL domain **LINK to Domain page:** https://nptel.ac.in/noc/Domain/	Advanced Structural Engineering (Structural Design)

Instructors of the course – Please attach a scanned photograph of each instructor and the TAs also						
S.No	**Name of the Instructor**	**Department**	**Institute**	**Mail -Id**	**Mobile Phone number**	**Website of instructor**
1	Prof S. Suriya Prakash	Civil Engineering	IIT Hyderabad	suriyap@ce.iith.ac.in	9959527775	https://civil.iith.ac.in/suriya-prakash-s-profile/index.html

Intended audience	PG students
Is it a core/elective course?	Elective
Is it a UG/PG/PhD course?	PG and PhD level course
Is this course relevant for GATE exam preparation?	Yes
Which degrees would it apply to? (BE/ME/MS/BSc/MSc/PhD etc)	MS/ ME/ MTech/ PhD
What are the next set of courses that can be taken by students who complete this?	Bridge Engineering, Seismic Analysis and Design
Pre-requisites in terms of educational qualification of participants, if any other courses should be done before this can be done	Basic course on concrete materials, reinforced concrete design, and advanced reinforced concrete design

Industry recognition of this course – List of companies/industries that will recognize/value this online course	L&T Constructions India, Shapoorji Palonji Construction Limited, Tata Consulting Engineers Limited, Tata Projects Limited, Engineers India Limited, All practicing structural engineers
Will the final certification exam be– paper/pen or computer-based - both are proctored	Both paper and computer-based
Will the course require use of any software such as Matlab or any programming language, etc or any other tool? If yes, does it have a Linux based compiler available or if licensed, can we get the educational license for the same?	Excel is sufficient. MATLAB can also be used if available. Educational licenses for MATLAB are available. Free versions of CSI SAFE will be used for analysis and design of post-tensioned slabs
Names of 2 reviewers for the course (can be from other institutes – will be used if we need any additional inputs on the course) – Name, Dept, email id, Institute	Dr Amlan Sengupta, Professor, Civil Engineering, IIT Madras, amlan@iitm.ac.in Dr Vasant Matsagar, Professor, Civil Engineering, IIT Delhi, matsagar@civil.iitd.ac.in Dr Devdas Menon, Professor, Civil Engineering, IIT Madras, dmenon@iitm.ac.in
List of reference materials/books/	**Books/ References:** **Textbook:** ● N. Krishna Raju, Prestressed Concrete, McGraw-Hill Education; 6th edition, 2018. **Reference Books** ● Edward G. Nawy, Prestressed Concrete – A fundamental approach, 5th Edition, Prentice-Hall, 2005 ● M.K. Hurst "Prestressed Concrete Design", Publisher-Taylor and Francis, 2017. Pages: 280, eBook ISBN9781315274447 ● Michael P. Collins and Denis Mitchell, Prestressed Concrete Structures, 3rd Edition, 1991, Prentice Hall. ● TY Lin and NH Burns, Design of Prestressed Concrete Structures, 3rd edition, Paperback : 646 pages, ISBN-10 : 9812531173, Wiley. **Codes and Standards:** 1. **IS 1343: 2012** — Prestressed Concrete - Code of Practice 2. **IS 875 (Parts 1-5): 1987** — Code of practice for design loads (other than earthquake) for buildings and structures (second revision) 3. IRC 112: Code of Practice for Concrete Road Bridges, 2020, Published by Indian Road Congress, New Delhi. 4. IRC 6: Standard Specifications and Code of Practice for Road Bridges, 2017, Published by Indian Road Congress, New Delhi. 5. Indian Railway Standards guidelines for design of bridges **NPTEL course:** **PRESTRESSED CONCRETE STRUCTURES, Dr. Amlan K. Sengupta,** **https://archive.nptel.ac.in/courses/105/106/105106118/**

Course Outline (add/delete more weeks/modules as required - depending on the course)

Module 1: Introduction: (3 hour)

1-1 (45 minutes): History of Prestressed Reinforced Concrete, Need for prestressing, , advantages of prestressed concrete.

1-2 (45 minutes): Types of prestressing, Systems and devices.

1-3: (45 minutes): Review of short and long-term behavior of concrete and prestressing steel,

1-4: (45 minutes): Production process of prestressing strand, Types and mechanical properties of prestressing steel

Module 2: Losses in prestress (3 hours)

Losses in prestress – losses due to pre-tensioning and post-tensioning
2-1 (1 hour): Immediate losses: elastic shortening, anchorage slip, Friction losses
2-2 (1 hour): Time dependent losses: Relaxation of steel, Shrinkage and creep
2-3 (1 hour): Code provisions for considering losses.

Module 3: Analysis of members under Axial load (1 hour)

Analysis at transfer, Analysis at service, and analysis at ultimate loads. Load-displacement behaviour, Comparison of load-displacement behaviour of Reinforced concrete and prestressed concrete.

Module 4: Analysis and design for flexure (6 hours)

4-1 (1 hour): Analysis: At service loads: Stress concept, C-line/ Force concept, Load balancing concept

4-2 (2 hour): Moment-curvature analysis of prestressed concrete members, Layer by layer approach for moment-curvature analysis, Effect of various parameters on $M-\phi$ $M-\phi$ behaviour

4-3 (1 hour): Kern point, pressure line, cracking moment, Control of crack widths, Camber and deflection, Stress analysis of flexural members

4-4 (2 hour): flexural design of statically determinate beams (type 1 and 2), Magnel's graphical method, Composite construction, Detailing requirements

Module 5: Analysis and design for shear and torsion (3 hours)

5-1 (1.5 hours): Analysis and design for shear, Failure modes, Shear resistance mechanism, Effect of prestress on shear behaviour, Code provisions, Design for shear.

5-2 (1.5 hours): Analysis and design for torsion, Types of torsion, Skew bending theory, Cracking torque-plasticity theory, Thin-walled tube anology, Space truss analogy, Code provisions, Design for torsion.

Module 6: Design for Bond and Anchorage zones (3 hours)

6-1 (1 hour): Anchorage zone stresses for post-tensioned members; Stress distribution in end block;
6-2 (1 hour): design of anchorage zone; Transfer of prestress in pre-tensioned members;
6-3 (1 hour): Design of prestress members for bond and bearing.

Module7: Analysis and Design of Continuous Beams (3 hours)

7-1 (1 hour): Analysis and design of statically indeterminate structures - continuous beams.
7-2 (1 hour): Advantages of continuous members; Disadvantages of continuity in prestressing;
7-3 (1 hour): determination of cable profile, concepts of linear transformation and concordance.

Module 8: Composite Construction (3 hours)

8-1 (1 hour): Introduction to Composite construction with precast prestressed members, types of composite construction.
8-2 (1 hour): Analysis of stresses; prestressed beams and cast in-situ reinforced concrete slab, Flexural and shear strength of composite sections.
8-3 (1 hour): Analysis and design of composite sections.

Module 9: Connections (3 hours)

9-1 (1 hour): Basics of connections; Reinforced concrete bearing in composite members.
9-2 (1 hour): Dapped-End beam connections; Reinforced concrete brackets and corbels.
9-3 (1 hour): Design for connections in precast prestressed concrete elements.

Module 10: Design of post-tensioned slabs (6 hours)

10-1 (1.5 hours): Introduction to post-tensioned slabs; Analysis and design considerations of post-tensioned slabs; Factors influencing in choosing slab thickness; Corrosion protection of unbonded tendons; load balancing; Distribution of tendons in Two-way slabs.
10-2 (1.5 hours): Equivalent frame method; Stress checks and control of cracking; Considerations for Edge and Corner panels.
10-3 (1.5 hours): Flexural capacity of PT slabs; Shear design of PT slabs; Calculation of deflections of slabs; Example on the design of post-tensioned Flat Plate.
10-4 (1.5 hours): Modeling aspects of post-tensioned slabs

Module 11: Applications of prestressing with Case Studies: (3 hours)

11-1 (1 hour): Application in bridges with real world case studies
11-2 (1 hour): Application of post-tensioning in buildings: Case Study on design of PT slab
11-3 (1 hour): Application in strengthening with real world case studies

FOR GETTING THE INTRODUCTORY COURSE PAGE READY – TO OPEN FOR ENROLLMENTS

1. Introduce the course in about 4-5 lines

It is an intensive course covering material aspects of prestressed concrete, specifications, analysis, and design of prestressed reinforced concrete (PSC) components using the limit state method. The focus will be given to the background and mechanics of the code provisions and their limitations. Particularly, the students will learn advanced topics related to the behaviour and design of prestressed concrete. The advanced topics include flexural behaviour of prestressed concrete, analysis and design for shear and torsion. Special topics will also include the design of post-tensioned slabs, analysis and design of composite sections, and connections for prestressed concrete elements. Finally, a design project will be given to bridge the theory and practice.

2. Photograph of instructor

3. About the instructor

Dr Suriya Prakash is currently a Professor in the Department of Civil Engineering at IIT Hyderabad. Before joining IIT Hyderabad, he worked as a design engineer at Structural Group Inc., Baltimore, USA. He received his PhD from Missouri University of Science and Technology, the USA, in 2009. He obtained his M.S degree specializing in Structural Engineering from IIT Madras in 2005. His research interests include understanding reinforced and prestressed concrete behaviour, precast systems for affordable housing, and repair and rehabilitation of structures. He has sixteen years of research and teaching experience, guided 8 Ph.Ds., published more than 80 research papers in internationally reputed journals and presented more than 50 papers in national and international conferences. He is also serving as the associate editor for the ASCE Journal of bridge engineering and on the editorial board of ASCE Journal of Composites for Construction and Indian Concrete Journal. He is a member of various professional bodies, including ACI, ASCE, ICI, IIBE and ASTR. He is also an executive member of the Indian Institution of Bridge Engineers. He has received many accolades, including prestigious Ramanujan fellowship from the Government of India, DAAD-DUO fellowship and teaching excellence awards from IIT Hyderabad.

4. Two-minute introductory video about the course