NPTEL Syllabus Template

Course Title	**Stability aspects of structural steel design: Concepts and applications**
Discipline	Civil Engineering
Duration of course 4/8/12 weeks (10/20/30 hours @2.5 hrs/week)	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 10 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.	Yes. Advanced Structural mechanics (CE6110) Advanced Structural Steel Design (CE6232) IIT Hyderabad
The time frame of when you would want to offer the course: (Jan 2024/July 2024)	January 2025
Will it map to any course in the AICTE model curriculum? LINK to AICTE Curriculum LINK 1 LINK 2 LINK 3 LINK 4	Yes
Will it map onto any of the NPTEL domains? LINK to Domain page: https://nptel.ac.in/noc/Domain/	No

Name of the Instructor(s)	Prof. Mahendrakumar Madhavan Ph.D., P.E., F. SEI., FICE., F. ASCE	
Department	Civil Engineering	
Institute	IIT Hyderabad	
Email ID	mkm@ce.iith.ac.in	
Mobile Phone Number	+91 9490782690	
Website of Instructor	https://sites.google.com/view/iithmkmsteelsite/home	

Intended audience	UG Civil Engineering students (3rd year and above) /PG Structural Engineering /Industry Person
Is it a core/elective course?	Core
Is it a UG/PG/PhD level course?	PG
Is this course relevant for GATE exam preparation?	Yes
Which degrees would it apply to? (BE/ME/MS/BSc/MSc/PhD etc)	ME
What are the next set of courses that can be taken by students who complete this?	Design of Steel Bridges, Design of Plates and Shells structures
Pre-requisites in terms of educational qualification of participants, or if any other courses should be done before this course can be taken	Basic Design of Steel Structures
Industry recognition of this course – List of companies/industry that will recognize/value this online course	TATA Steel SAIL JSW JSPL L&T Kirby Industry Pennar Industry Zamil TATA BlueScope
Will the final certification exam be– paper/pen type or computer based - both are proctored	Paper and Pen 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?	No
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	Name : **Prof. Leroy Gardner** Dept. : Department of Civil and Environmental Engineering Institute : Imperial College London, UK Email : leroy.gardner@imperial.ac.uk Name : **Prof Gregory J Hancock** Dept. : School of Civil Engineering Institute : The University of Sydney, Australia Email : gregory.hancock@sydney.edu.au
List of reference materials/books	1. "*Steel structures design and Behavior*" by **Salmon & Johnson.** 2. "Principles of structural stability theory" by

	Alexander Chajes. 3. "Structural stability – Theory and Implementation" by **Chen and Liu.** 4. "Design of steel structures" by **Edwin Gaylord & Charles Gaylord.** 5. IS 800:2007 GENERAL CONSTRUCTION IN STEEL - CODE OF PRACTICE

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

1. Introduce the course in about 4-5 lines

Structural stability and the design of steel structures are commonly perceived as distinct fields in structural engineering. However, the core philosophy behind the development of design provisions available in IS 800:2007 can be directly traced back to the fundamental understanding of structural stability. This course seeks to bridge the gap between these two domains by formulating stability equations based on fundamental principles. The course commences with simple spring bar models, introducing stability concepts, and then progresses to one-dimensional members like columns, beams, and beam-columns. Additionally, it covers two-dimensional elements such as plates, directly applicable to designing long-span structures like plate girders. Upon completing this course, students are expected to confidently navigate global steel design standards. The course structure will ensure that students gain a profound understanding of the origin of design provisions. This will enable them to comfortably apply the concepts learned to design safe and stable steel structures with an inherent understanding of the limitations and their applicability. Upon completing this course, students are expected to confidently navigate global steel design standards. The course's emphasis on tracing these standards back to fundamental principles in structural stability will significantly enhance the understanding of the students, equipping them to be industry-ready on a global scale.

2. Photograph of instructor(s)

3. About the instructor(s)

Mahendrakumar Madhavan is a Professor in the Department of Civil Engineering, Indian Institute of Technology (IIT) Hyderabad, India. Prof. Madhavan teaches at both undergraduate and postgraduate levels, provides industry training by conducting short courses and seminars, assists practicing structural engineers by offering consultancy services, and leads the structural steel research group at IITH with the goal of enabling sustainable construction practices at home in India and around the globe. He obtained his Ph.D. from the University of Alabama at Birmingham, USA, and a Masters's Degree from The National University of Singapore, Singapore. Prior to joining IIT Hyderabad, Prof. Madhavan worked as a Structural Engineer at Alabama Power Company, Birmingham, and is a Registered Professional Engineer (PE) in the State of Alabama USA.

Prof. Madhavan's principal research interests lie in the area of physical testing of structural members and systems, numerical modeling through the use of commercially available finite element packages, and the development of new design methods for steel-intensive structures. He has published more than 60 peer-reviewed internationally reputed journals and is the Chair of the "American Society of Civil

Engineers (ASCE) Structural Engineering Institute (SEI) Structural Members Committee on Metals" and a member of “ASCE SEI Cold-Formed Steel Members Committee". He is an Editorial board member of the Journal of Structures and is an Associate Editor for ASCE Journal of Structural Engineering. Prof. Madhavan is a Fellow of the American Society of Civil Engineers (ASCE), USA, a Fellow of the Institution of Civil Engineers (ICE), London, and is also the first Indian to be elected as a Fellow of ASCE’s Structural Engineering Institute (SEI).

Weekly Course Plan			
Weeks		Topics	Assignments
Week 1	:	**Introduction to stability:** Concepts of stability, Types of stability, Methods of analyses in stability, Small deflection theory, Large deflection theory, Spring bar models	Online
Week 2	:	**Columns:** Classical column theory, Pin-Ended columns, End-restrained Columns, Eccentrically loaded columns, Secant’s formula	Online
Week 3	:	**Imperfections in columns:** Initially crooked columns, Effect of residual stresses, Experimental stub-column stress-strain curve, Perry-Robertson Formula	Online
Week 4	:	**Design curves for steel columns:** Design equation as per IS:800, Column research council curve, Structural stability research council, Single column curve as per AISC, Design curves as per Eurocode	Online
Week 5	:	**Members under subjected to torsional loading:** Types of torsion - St. Venant torsion and Warping torsion, Torsional and Flexural-Torsional buckling of columns – The three critical loads of members, Tutorial problem	Online
Week 6	:	**Members under subjected to transverse loading:** Elastic critical moment for simply supported beams subjected to uniform bending moment – With closed (Rectangular section) and open cross-sections (I-section); With different loading conditions {Unequal end moments, Central concentrated load}, Generic solution of M_{cr} for a generic loading case	Online
Week 7	:	**Members under subjected to transverse loading (Cont.):** Elastic critical moment for beams - With different support conditions {Effective length factors for Lateral Torsional Buckling of Cantilever beams, Fixed beams}, M_{cr} equation for continuous beams, Beam with generic support conditions	Online
Week 8	:	**Design of beams:** Based on Structural Stability Research Council Approach, Tutorial problem on laterally unsupported beam	Online
Week 9		**Plated structures:** Introduction to stability of plates- Strength of plates under uniform edge compression -Shear buckling equations-Post	Online

		critical methods-Tension field method	
Week 10		**Design of Plate Girder:** Introduction - Elements of Plate Girder – General Considerations-Stiffeners-Design Procedure-Tutorial problem	Online
Week 11		**Members under combined Axial load and Moments:** Beam Column with Concentrated and Distributed Lateral Load; Effect of Axial Load on Bending Stiffness-Slope-Deflection Equation- Moment magnification factors	Online
Week 12		Behaviour of Beam-column - Nominal Strength-Instability in the Plane of Bending - Interaction Equation- Code design procedures- Design of Beam Column (Tutorial Problem)	Online

TA Details			
	:	Teaching Assistant 1	Teaching Assistant 2
Name	:	Karmugilan P	Hareesh Sirigiri
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Currently pursuing degree	:	Ph.D.	Ph.D.