BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI
HYDERABAD CAMPUS

ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION
FIRST SEMESTER: 2022-2023
Course Handout (Part-II)

Date: 20/08/2022

In addition to Part-I (General Handout for all course appended to the Time Table) this portion gives further specific details regarding the course.

Course No. **:** CE G552
Course Name **:** *Advanced Structural Mechanics and Stability*
Instructor-in-Charge **:** CHANDU PARIMI

1. Course Description:

Analysis of stress and strain in three dimensional domain, deviatoric stress and strain; stress and strain invariants, compatibility conditions, equilibrium equations; stress-strain relations for anisotropic, orthotropic and isotropic elastic materials; yield criterion; plastic potential and flow rules. Problems on plane stress and plain strain conditions, Airy stress function; Axisymmetric problems; torsion of prismatic bars, circular and non-circular sections; thin-walled sections, membrane and sand-heap analogies, concept of stability of structures and examples of instability. Stability of structures with one and two degree of freedom, buckling of columns; beam-columns and simple frames, lateral torsional buckling of beams; and introduction to post-buckling analysis of plates.

2. Scope and Objective:

This course is basically a mixed course of advanced structural mechanics and stability of structures. This subject deals with the study of stresses and strains in three dimensions along with a slight introduction to the tensor notation. The compatibility conditions and equilibrium equations are discussed. Plain strain and plane stress situations are also discussed in this subject. The problems involving axisymmetric conditions are also covered. Theory of plasticity is covered through the concepts of yield criteria, plastic potential and flow rules. Nowadays, composite materials are being used in many situations due to their various advantages. The stress-strain relationships of orthotropic and anisotropic materials are discussed. The behavior of circular and non-circular sections under torsional load is studied. The concept of stability of structures is discussed. The buckling of column, beam-column and simple frames are covered. The torsional buckling problem of beams and post-buckling characteristic of plates are discussed in this course.

This course is also covering many advanced topics in structural mechanics and stability of structures. At the end of the semester, students will be in a position to understand and analyze stresses and strains in 3-D domain. One will get the introduction of composite materials and their stress-strain relationships. The student will also understand the basic ideas of instability of structures. This course is an essential subject in structural engineering domain.

3. Text Books:

T1. Theory of Elastic Stability by S. P. Timoshenko and J. Gere, Tata McGraw Hill Education private limited, 2010.
T2. Theory of Elasticity by S. P. Timoshenko and J. N. Goodier, Tata McGraw Hill Education private limited.

4. Reference Books:

R1: Fundamentals of Structural Stability by G.J. Simitses and D.H. Hodges, Elsevier.
R2: Mechanics of Solids and Structures by D.W.A. Rees, World Scientific Publishing Company, Imperial College Press.
R3: Stability Analysis and Design of Structures by M.L. Gambhir, Springers, 2004.
R4: Theory of Plasticity by J. Chakrabarty, Elsevier.
R5. Mechanics of Composite Materials by R.M. Jones, Taylor & Francis, CRC Press.
R6. Introduction to the Mechanics of a Continuous Medium by L. E. Malvern, Prentice Hall Inc.
R7. Stability of Structures by Z. P. Bazant and L. Cedolin, Dover Publications Inc.

5. Course Plan:

Lecture No.	Learning Objective	Topics to be covered	Reference
1-4	Stress and strain in three dimensional domain	Vectors and Tensors ,Analysis of stress and strain in three dimensional domain, deviatoric stress and strain, stress and strain invariants, Case studies.	T2-Ch-7 And R6-Ch-2
5-6	Compatibility and equilibrium conditions	Compatibility conditions, equilibrium equations, Case studies.	T2-Ch-8, Sec-84 & 85
7-10	Stress-strain relationship of materials	Stress-strain relations for anisotropic, orthotropic and isotropic elastic materials, Case studies.	R5-Ch2
11-12	Yield criterion	Yield criterion, Case studies.	R2-Ch11
13-16	PLANE stress and plane	Problems on plane stress and plane strain	T2-Ch-2

	strain	conditions, Airy stress function, Case studies.	
17-19	Axisymmetric problems	Axisymmetric problems, Case studies.	T2-Ch-12
20-24	Torsion	Torsion of prismatic bars, circular and non-circular sections, thin-walled sections, membrane and sand-heap analogies, Case studies.	T2-Ch-10
25-26	Plastic potential and flow	Plastic potential and flow rules, Case studies.	R4-Ch2
27-33	Stability of structures	Concept of stability of structures and examples of instability, Stability of structures with one and two degree of freedom, buckling of columns, beam-columns and simple frames, Case studies.	T1-Ch-1,2
34-36.	Torsional buckling of beams	Lateral torsional buckling of beams, Case studies.	T1-Ch-5,6
37-41.	Buckling and Post-buckling response of plates	Introduction to buckling and post-buckling response of plates, Case studies.	T1-Ch-9

6. Evaluation Scheme:

Sl. No	Evaluation Component	Duration	Weightage	Date & Time	Nature of component.
1	Test	90 MIN	25%	02/11 1.30 - 3.00PM	CB
3	Assignments		30%	Continuous	OB
4	Seminar		15%		OB
5	Comprehensive Examination	3 hours	30%	23/12 FN	OB

7. Chamber consultation hour: one hour after every class

8. Notices: All concerning notices will be displayed on Civil Engineering Notice Board only.

9. Make up policies: Make-up would be granted only for genuine cases with **prior permission**.

10. Academic honesty and academic integrity Policy: Academic honesty and integrity are to be

maintained by all students throughout and no academic dishonesty is acceptable.

Instructor-in-charge
CE G552