



**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani**  
**Pilani Campus**

**INSTRUCTION DIVISION**  
**FIRST SEMESTER: 2016-2017**  
**Course Handout (Part-II)**

Date: 02/08/2016

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** : **SHUVENDU NARAYAN PATEL**

**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; Axi-symmetric 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, buckling of columns; beam-columns and simple frames, lateral torsion buckling of beams; and introduction to postbuckling of plates.

**2. Scope and Objective:**

This course is basically a mixed course of advanced structural mechanics and stability of structure. This subject deals with the study of stresses and strains in three dimension. The compatibility conditions and equilibrium equations are discussed. Plain strain and plane stress situations are also discussed in this subject. The problems involving axi-symmetric conditions are covered. The yield criterion, plastic potential and flow rules are discussed. Now a days the composite materials are being used in many situations due to their various advantages. The stress-strain relationships of orthotropic and anisotropic materials are involved in this subject. The torsion of circular and non circular sections is discussed. 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 postbuckling characteristic of plates are discussed in this subject.

This subject is covering many advanced topics in structural mechanics and stability of structures. At the end of the semester a student 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 generate the basic ideas of instability of structures. This course is an essential course in structural engineering domain.



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### 3. Text Books and Materials:

- T1. Theory of Elasticity by S. P. Timoshenko and J.N. Goodier, McGraw Hill Higher Education.  
T2. Theory of Elastic Stability, by S. P. Timoshenko and J. Gere, McGraw Hill International Edition.

### 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, Imperial College Press.  
R3: Stability analysis and Design of Structures by M.L. Gambhir, Springer.  
R4: Mechanics of composite materials by R.M. Jones, McGraw-Hill Book Company  
R5: Theory of Plasticity by J. Chakrabarty, Elsevier.

### 5. Course Plan:

Lecture No.	Learning Objective	Topics to be covered	Reference
1-4	Stress and strain in three dimensional domain.	Analysis of stress and strain in three dimensional domain, deviatoric stress and strain; stress and strain invariants, Case studies.	T1-Ch-7
5-6	Compatibility and equilibrium conditions.	Compatibility conditions, equilibrium equations, Case studies.	T1-Ch-8, Sec-84 & 85
7-10	Stress-strain relationship of materials.	Stress-strain relations for anisotropic, orthotropic and isotropic elastic materials, Case studies.	R4-Ch2
11-12	Yield criterion.	Yield criterion, Case studies.	R2-Ch11
13-16	Plain stress and plain strain.	Problems on plane stress and plain strain conditions, Airy stress function, Case studies.	T1-Ch-2
17-19	Axisymmetric problems.	Axisymmetric problems, Case studies.	T1-Ch-12
20-24	Torsion.	Torsion of prismatic bars, circular and non-circular sections; thin-walled sections, membrane and sand-heap analogies, Case studies.	T1-Ch-10
25-26	Plastic potential and flow.	Plastic potential and flow rules, Case studies.	R5-Ch2
27-33	Stability of structures.	Concept of stability of structures and examples of instability, buckling of	T2-Ch-1,2



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		columns; beam-columns and simple frames, Case studies.	
34-36.	Lateral torsional buckling of beams.	Lateral torsional buckling of beams, Case studies.	T2-Ch-6
37-41.	Buckling and Postbuckling response of plates.	Introduction to buckling and postbuckling response of plates. Case studies.	T2-Ch-9

### 6. Evaluation Scheme:

Evaluation Component No	Evaluation Component	Duration	Weightage	Date time and Venue	Nature of component.
1	Mid-Semester Test	1-hour and 30-minutes	25%	<TEST_1>	CB
2	Project, Assignments, Seminars, Take Home Tests, Class Test.		40%	Continuous	OB
3	Comprehensive Examination	3-hours	35%	<TEST_C>	CB

**7. Chamber consultation hour:** To be announced in the 1st class.

**8. Notices:** If any, concerning the course, will be displaced on Notice Board of Dept. of Civil Engg.

**9. Make up policies:** Makeup will be given only to the genuine cases provided prior permission is taken.

**Instructor-in-charge**

**CE G552**



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