



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani  
Pilani Campus

**INSTRUCTION DIVISION**  
**FIRST SEMESTER 2018-19**  
**Course Handout (Part II)**

**Date: 02/08/2018**

In addition to Part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

**Course No.** :ME F211/MF F211  
**Course Name** :Mechanics of Solids  
**Instructor-in-charge** :SharadShrivastava  
**Tutorial Instructor** :SharadShrivastava, J.S.Rathore, Rajesh Mishra, Gourav Watts

**1. Course Description:**

Fundamental principles of mechanics; Introduction to the mechanics of deformable bodies; Forces and Moments transmitted by slender members; Stress- Strain; Stress-Strain Temperature relations; Torsion; stresses and deflections due to bending; Stability of equilibrium; Static failure criteria, ductile and brittle material; Dynamic failure criteria.

**2. Scope and Objective:**

- Determination of strength, deformation and stability of structural and machine elements.
- Understand the material properties and Idealization of stress-strain curves.
- Understand different loading conditions and to analyse the results.
- Understand combine load conditions on a body and to analyse the results
- Understand the failure theories.

At the end of the course the student will be in a position to design and analyze simple structural elements, which involve calculation of stress, strain and deformation. This is an essential feature in any design process.

**3. Text Book:**

1. Crandall, Dahl and Lardner, An Introduction to Mechanics of Solids, McGraw-Hill International edition, 1978.

**4. Reference Books:**

1. Mechanics of Materials, Gere and Timshenko. Latest Edition.
2. Mechanics of Materials; F. P. Beer, E. R. Johnston and J. T. DeWolf, Third Edition, 2002, McGraw-Hill International Edition.



**Please Consider Your Environmental Responsibilities**  
**Do Not Print Unless Necessary**



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

3. Introduction to Solid Mechanics by I. H. Shames, 2<sup>nd</sup> Edition, 1980, Prentice Hall of India Private Ltd. New Delhi.
4. Engineering Mechanics of Solids by E. P. Popov, 2nd Edition, PHI, New Delhi.

## 5. Course Plan

Module Number	Lecture session/Tutorial Session.	Reference	Learning Outcome
1.Fundamental principles of mechanics	L1.1. Introduction, principles of mechanics, concept of force & moment, equilibrium conditions	TB Chapter 1	Fundamental principles of mechanics and to an exposition of the requirements of equilibrium
	L 1.2. concept of two & three force members, free body diagram, friction, trusses	TB Chapter 1	
	T1.1. Practice Problems	TB/RB	
2.Introduction to mechanics of deformable bodies	L2.1. Analysis of deformable bodies, uniaxial loading & deformation	TB Chapter 2	To attack problems of applied mechanics by applying three steps. The analysis of truss for both statically indeterminate and determinate conditions will be understood
	L2.2. Statical Determinate Truss	TB Chapter 2	
	L2.3. Problems on trusses	TB Chapter 2	
	L2.4. hoop stresses in thin cylindrical shells	TB Chapter 2	
	L2.5. Castiglione's Theorem	TB Chapter 2	
	L2.6.Problems	TB Chapter 2	
3. Forces & moments transmitted by slender members	T2. Problems on truss structure	TB/RB	
	L3.1. Introduction of forces & moments acting on a section of a member	TB Chapter 3	In this the study of forces and equilibrium requirements will be applied to slender members. The importance of shear force and bending moment variation along the length of slender members will be understood
	L3.2.Shear force and BM diagram	TB Chapter 3	
	L3.3 Problems	TB Chapter 3	
	L3.4 Distributed loads & resultant of distributed loads, Differential equilibrium approach, Singularity functions	TB Chapter 3	
	L3.5. Differential equilibrium approach, Singularity functions	TB Chapter 3	
	T3. Problems	TB/RB	
4. Stress & Strain	L4.1. Introduction, stress, plane	TB Chapter 4	The investigation



**Please Consider Your Environmental Responsibilities**  
**Do Not Print Unless Necessary**



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani  
Pilani Campus

	stress, equilibrium of an element in plane stress,		of three basic principles will be applied to the localized behavior of the materials at a point within a deformable body. Concept of stress and strain and its variation at a point in different planes will be understood.
	L4.2. Mohr circle representation of a plane stress, general state of stress	TB Chapter 4	
	L4.3 Problems	TB Chapter 4	
	L4.4 Analysis of deformations, strain components, relation between strain & displacement	TB Chapter 4	
	L4.5. Strain component associated with arbitrary set of axis, Mohr circle representation of plane strain, general state of strain	TB Chapter 4	
	L4.6.Problems	TB Chapter 4	
	T4 Problems	TB/RB	
5. Stress-Strain-Temperature relations	L5.1. Introduction, tensile test, idealization of stress strain curve,	TB Chapter 5	The relation between stress and strain will be studied. Also their relation with temperature will be analysed. Different material properties and yielding criterion for ductile materials will be understood.
	L5.2. elastic stress strain relation, Thermal strain,	TB Chapter 5	
	L5.3. complete equations of elasticity, strain energy in a elastic body	TB Chapter 5	
	L5.4. criteria of initial yielding	TB Chapter 5	
	L5.5 Problems	TB Chapter 5	
	T5.Problems	TB/RB	
6. Torsion	L6.1. Introduction, geometry of deformation of a twisted circular shaft, stress strain relations, ,	TB Chapter 6	In this chapter student will apply the fundamental principles to consider the problem of twisting. The stress developed due to torsion will be analysed and corresponding deformation will also be understood.
	L6.2 equilibrium requirements, stresses & deformations in twisted elastic circular shaft	TB Chapter 6	
	L6.3. torsion of elastic hollow circular shaft,	TB Chapter 6	
	L6.4, combined stresses, strain energy due to torsion, yielding in torsion	TB Chapter 6	
	L6.5.Problems	TB Chapter 6	
	T6. Problems	TB/RB	
7.Stresses due to bending	L7.1.Introduction, deformation in	TB Chapter 7	Here the slender



**Please Consider Your Environmental Responsibilities**  
**Do Not Print Unless Necessary**



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

	pure bending, stress-strain relations, equilibrium requirements,		member subjected to transverse loading would be analysed. The stresses and deformation would be analysed .
	L7.2 stresses & deformations in pure bending.	TB Chapter 7	
	L7.3. Stresses due to shear force and bending moment,	TB Chapter 7	
	L7.4. combined stresses, strain energy due to bending, yielding in bending	TB Chapter 7	
	L7.5.Problems	TB Chapter 7	
	T7.Problems	TB/RB	
8. Deflections due to bending	L8.1.Introduction, moment-curvature-relations, integration of moment-curvature relations, Numerical problems	TB Chapter 8	The deflection of slender members which transmit bending moments would be analysed, which would be helpful while designing high speed machinery with close tolerances, leaf springs etc.
	L8.2. superposition, Load-deflection	TB Chapter 8	
	L8.3 differential equation, Energy Methods, Problems	TB Chapter 8	
	T8.Problems	TB/RB	
9. Stability of equilibrium buckling	L9.1 Introduction, elastic stability, examples of instability,	TB Chapter 9	In this chapter student will analyse the body when it is deviated from equilibrium conditions.The analysis of columns would be done to predict the stability of structure.
	L9.2 elastic stability of flexible columns	TB Chapter 9	
	L9.3Problems	TB Chapter 9	

**6. Evaluation Scheme:**

EC	Evaluation	Duration	Weightage	Date, Time & Venue	Nature of
----	------------	----------	-----------	--------------------	-----------



**Please Consider Your Environmental Responsibilities**  
**Do Not Print Unless Necessary**



BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani  
Pilani Campus

No.	Component				Component
1.	Mid sem. Exam.	1.5 Hrs	30% (60)	10/10 2:00 - 3:30 PM	CB
2	Tutorial	--	20%(40)		OB
3	Quiz		10%(20)		CB
3.	Compre. Exam.	3 Hrs	40%(80)	5/12 FN	CB+OB

7. **Tutorial :** Will be announced in the class. There will be total 6 evaluative tutorial. 3 will be conducted before midsem (out of which best 2 will be considered) and 3 will be conducted after midsem (again out of which best 2 will be considered). **There will be no makeup in any circumstances for evaluative tutorials.**
8. There will be 1 quiz exam most probably in the last week of November after the completion of course. **There will be no makeup in any circumstances for Quiz exam**
9. **Chamber Consultation Hour:** Will be announced by instructors individually in the class.
10. **Make up Policy:** Make-up will be granted only to genuine cases. For cases related to illness, proper documentary evidence is essential. Prior permission is necessary if student is out of station on the test date.
11. **Notices:** Notice, if any, concerning the course will be displayed on the Notice Board of Mechanical Engineering Department.

**Instructor-in-charge**  
**ME F211/ MF F211**



Please Consider Your Environmental Responsibilities  
Do Not Print Unless Necessary