

MS2015 – Mechanical Behaviour of Materials

Course Code	MS2015					
Course Title	Mechanical Behaviour of Materials					
Pre-requisites	NIL					
Pre-requisite for	NIL					
No of AUs	3					
Contact Hours	LECTURES	20 hrs	LAMS/TEL (Online Videos and Resources)	6 hrs	TUTORIALS	12 hrs

Course Aims

This course introduces basic concepts and principles behind statics and mechanics, material deformation, fracture, fatigue and creep. Calculations of loads/stresses and macro-mechanical properties will be correlated whenever possible to provide insights into materials fundamentals behind the observed behaviors. The ultimate goal is to enable you to apply these principles in materials design & selection under various mechanical conditions. This course should be taken by early stage materials science and engineering undergraduates as one of the core modules required to acquire fundamental understanding of materials behavior.

Intended Learning Outcomes (ILO)

By the end of the course, you should be able to:

1. Analyze force loading diagrams/pictures and construct Free-Body-Diagrams from them
2. Formulate equations of equilibrium and solve them to determine unknown force components
3. Calculate stresses and strains due to axial loads, torsion and bending
4. Evaluate suitability of materials based on loading, mechanical property and geometric constraints
5. Apply Mohr's Circle for plane stress transformation and to determine principle stresses
6. Determine the deformation field, under elastic regime, under a given state of constraint using the generalized Hooke law in tensorial formation.
7. Determine the intensity and the direction of the principal forces under a given state of constraint and determine the deformation field along the directions of the principal forces, under elastic regime.
8. Predict yield using the Tresca and von Mises yield criteria.
9. Explain the deformation mechanism in the plastic regime, in 1D, including the micro-structural mechanism (dislocation sliding, grain sizes, impurities, etc).
10. Model the deformation mechanism, 1D, using the law presented in the lectures (Ramberg-Osgood, Ludwik, etc models).
11. Know about the experimental techniques to establish the stress-strain curves.
12. Explain the deformation and fracture mechanisms of Creep.
13. Estimate the crack propagation as function of time (be able to solve the equation).
14. Calculate safety factors on stress, life and temperature, stress concentration.
15. Explain the fatigue, fracture and toughness concepts.

Course Content

List of key topics taught

1. Free-Body-Diagrams
2. Two- and three- force members
3. Equations of equilibrium
4. Normal and shear stresses
5. Load-displacement relationship due to axial loads
6. Shear stress due to torsion
7. Normal stress due to bending
8. Stress transformation using Mohr's Circle
9. Introduction of the mathematical concepts needs for the lectures
10. Elasticity
11. Plasticity
12. Viscosity
13. Fatigue and Fracture
14. Crack propagation and Toughness

Reading and References

1. R.C. Hibbeler, Statics and Mechanics of Materials, Pearson
2. W. M. Hosford, Mechanical Behavior of Materials, Cambridge University Press
3. N. E. Dowling, Mechanical Behavior of Materials, Pearson
4. R. W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, John Wiley

Course Policies and Student Responsibilities

You are expected to go through online contents at your own pace before attending face-to-face lectures. Based on the assessment policy in NTU, you are expected to attend all scheduled classes. You are also encouraged to be punctual for class.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.