COURSE CONTENT

Academic Year	2023-24	Semester	2
Course Coordinator			
Course Code	CV1011		
Course Title	Mechanics of Materials		
Pre-requisites	NIL		
No of AUs	4		
Contact Hours	Total: 52 Hours (Lecture: 39 hours; Tutorial: 13 hours)		
Proposal Date	12 Sep 2023		

Course Aims

This course aims to equip you with the basic knowledge of:

1. forces and stress/strain in simple structures under static equilibrium
2. stress/strain for members under axial, bending, shear, torsion and their combination
3. column buckling

The topics covered in this course provide essential technical basis for the analysis and design of civil structures.

Course Learning Outcomes (Course LO)

Upon successful completion of the course, you should be able to:

1. determine forces and their resultants in static equilibrium in 1D, 2D and 3D situations, using scalar and vector approaches
2. determine the forces in a simple structure under external loads; and present them in appropriate form
3. determine the geometric properties of shapes in elementary and composite forms and apply to the context of distributed loads and section properties
4. recall the basic mechanical properties of materials
5. determine the stress and strain in a member under axial load, torsion, bending, shear and their combination; and their relevance to design
6. transform plane stress (strain) components from one orientation to another, and determine their principal/maximum values
7. determine the buckling load of simple columns

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1	Forces and vectors	2	1
2	System of forces and resultants	2	
3	Equilibrium of a body	2	1
4	Geometric properties and distributed loads	3	1
5	Internal forces	3	1

6	Stress and strain	2	
7	Mechanical properties of materials	2	1
8	Axially loaded members	2	1
9	Torsion	3	1
10	Bending stress in beams	3	1
11	Shear stress in beams	3	1
12	Combined stresses	2	1
13	Stress (strain) transformation	6	2
14	Column buckling	4	1
	Total:	39	13

Assessment

Components	Course LO tested	Related programme SLO or graduate attributes	weighting	Team/ Individual	Assessment rubrics
1. Final Examination	All	EAB SLOs (a), (b)	60%	Individual	
2. Continuous Assessment 1 : Quiz 1	1-7	EAB SLOs (a), (b)	20%	Individual	
3. Continuous Assessment 2 : Quiz 2	8-14	EAB SLOs (a), (b)	20%	Individual	
Total			100%		

*CEE SLOs = Student Learning Outcome For Civil Engineering Programme (Per BEng Civil Engineering Accreditation)

Related Programme LO or Graduate Attributes

a. **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems;

b. **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences;

c. **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d. **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Formative feedback

1. Feedback will be through the dissemination of your performance in quiz and review of quiz questions in class/tutorial.

2. You are encouraged to discuss questions during or outside lectures and tutorials based on individual needs.

Learning and Teaching approach

Approach	Theory and method are introduced and formulated based on physics and mathematics in an engineering context, reinforced and illustrated through examples
Lectures	Weekly lectures provide students with specific knowledge and techniques to achieve learning outcomes
Tutorials	Weekly tutorials enable students to apply the knowledge to solve structured problems. Students are encouraged to explore alternative approaches and techniques

Textbooks/References:

Hibbeler, R.C., Statics and Mechanics of Materials, SI Edition, Pearson – Prentice Hall, 2004.
Gere, J.M., Timoshenko, S.P., Mechanics of Materials, Stanley Thornes, 1999.
Beer, F.P., Johnston, E.R., Mechanics of Materials, McGraw-Hill, 2015.

Course Policies and Student Responsibilities

The standing university policy governing student responsibilities shall apply. No special policy for this course.

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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. If you are uncertain of the definitions of any of these terms, you should go to the Academic Integrity Handbook for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email

Planned Weekly Schedule

Week	Topics	Course LO	Activities
1	Introduction, force and moment, couple, equivalent system, static equilibrium, free body diagram, basic member types	1,2	Lectures & Tutorial
2	Centroid of a system of particles and continuum, elementary and composite bodies, resultant of distributed force, moment of area of basic and composite shapes, parallel axis theorem	3	Lectures & Tutorial
3	Internal forces in structures, shear and bending moment diagram, relationship between load, shear and bending moment	1,2	Lectures & Tutorial
4	Vector approach, vector addition of forces, position vectors, dot product, cross product, moment about an axis	1,2	Lectures & Tutorial
5	Stress in average and local sense, axial stress, shear stress, allowable stress, design of simple connections, deformation and strain	4,5	Lectures & Tutorial
6	Tension and compression test, stress-strain diagram, stress-strain behaviour of ductile and brittle materials, Hooke's law, strain energy	4,5	Lectures & Tutorial
7	Poisson's ratio, shear stress-strain diagram Axially loaded members, principle of superposition, statistically indeterminate axially loaded members, thermal stress	4,5 5	Lectures & Tutorial

8	Circular shaft under torsion, shear stress and twist angle	5	Lectures & Tutorial
9	Normal stress in beams under bending, curvature	5	Lectures & Tutorial
10	Shear stress in beams under bending, wide-flange sections	5	Lectures & Tutorial
11	Combined stresses Stress transformation, introduction	5 6	Lectures & Tutorial
12	Principal stress, maximum shear, Mohr circle	6	Lectures & Tutorial
13	Buckling behaviour, Euler's equation, critical load	7	Lectures & Tutorial