NANYANG TECHNOLOGICAL UNIVERSITY

Teaching, Learning and Pedagogy Division

Reg. No. 200604393R

Course Outline

Academic Year	2018/19	**Semester**	1
Course Coordinator	Chou Siaw Meng / Tan Soon Huat		
Course Code	MA2001		
Course Title	Mechanics of Materials		
Pre-requisites	NIL		
No of AUs	3		
Contact Hours	Lecture: 26 hrs (online) Tutorial: 12 hrs		
Proposal Date	1 May 2018		

Course Aims

The objective is to provide you the fundamental mechanics required for understanding the relations between the loading applied to a body, the material constitution of the body, and the resulting stresses and deformations of the material.

Intended Learning Outcomes (ILO)

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

1) Formulate the relations between loading types and the material response.
2) Perform basic calculations for a body with regards to applied loads, materials, structures, and stresses and deformations.
3) Apply the knowledge gained to engineering design in a creative and systematic manner.
4) Analyse the factors contributing to the deformation and failure of structures.

Course Content

Text Book: Beer, F.P., Johnston, E.R., DeWolf, J.T., Mazurek D. *Mechanics of Materials*, 5th Ed, SI Units, McGraw-Hill, 2009.

Topic
Review of equilibrium and free body diagram **Chap. 1 Introduction – Concept of Stress** 1.1-1.3 Introduction 1.4 Analysis and design 1.5-1.7 Axial stress, shearing stress & bearing stress in connections 1.11 Stress on an oblique plane 1.13 Design considerations
Chap. 2 Stress and Strain – Axial Loading 2.1-2.2 Normal strain under axial loading 2.3 Stress-strain diagram 2.5 Hooke's law; modulus of elasticity 2.6 Elastic versus plastic behavior 2.8 Deformation of mem bers under axial loading 2.11-2.12 Poisson's ratio, generalized Hooke's law 2.14-2.15 Shearing strain, relations among E, ν, and G
Chap. 3 Torsion

3.1-3.3 Deformation of a circular shaft 3.4 Shearing stress 3.5 Angle of twist 3.7 Design of transmission shafts
Chap. 4 Pure Bending 4.1-4.3 Pure Bending 4.4-4.5 Stresses and deformations 4.12 Eccentric axial loading 4.14 General case of eccentric axial loading
Chap. 5 Analysis and Design of Beams for Bending 5.1-5.2 Shear and bending moment diagrams 5.2-5.3 Shear and bending moment diagrams (continue) 5.4 Design of prismatic beams for bending Revision video with examples of past year exam questions
Chap. 6 Shearing Stress in Beams 6.2 Shear on horizontal face of beam 6.3 Determination of shearing stresses in a beam 6.4 Shearing stresses in common types of beams
Chap. 7 Transformations of Stress and Strain 7.1 Introduction 7.2 Transformation of plane stress 7.3 Principal stresses and maximum shearing stress 7.4 Mohr's circle for plane stress 7.6 Maximum out-of-plane shearing stress 7.7 Yield criteria for ductile materials under plane stress 7.8 Fracture criteria for brittle materials under plane stress 7.9 Stresses in thin-walled pressure vessels 7.10 Transformation of plane strain 8.4 Stresses under combined loadings
Chap. 9 Deflection of Beams 9.1 Introduction 9.3 Equation of the elastic curve 9.6 Singularity function
Chap. 10 Columns 10.1 Introduction 10.3 Euler's formula for pin-ended beams 10.4 Extension of Euler's formula

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
Continuous Assessment (CA1) - Online quiz	1, 2	*EAB SLO a, b, c, d	20%	Individual	NA
Continuous Assessment (CA2) - Online quiz	1, 2, 3	EAB SLO a, b, c, d	20%	Individual	
Final Exam (2.5hrs; closed-book)	1, 2, 3, 4	EAB SLO a, b, c, d	60%	Individual	
		Total	100%		

* EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes. The list is below:

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

Formative feedback will be provided to you during the weekly tutorial sessions as well as the outcome of the continuous assessment.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Online lecture	Online lectures provide content knowledge, theory and explanation on each topic in the syllabus with appropriate examples. Solutions to some past years' examination questions are also included.
Tutorial	Tutors provide guidance to solve sample tutorial problems in class. There will be opportunity for students to ask questions.
Additional practice	Problems are selected from McGraw-Hill question bank to provide students with more varied questions for additional practice.

Reading and References

Text Book: Beer, F.P., Johnston, E.R., DeWolf, J.T., Mazurek D. *Mechanics of Materials*, 5th Ed, SI Units, McGraw-Hill, 2009.

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct. The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of your mental health and wellbeing. These policies and codes concerning students can be found in the following link:
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

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.

Course Instructors

Instructor	Office Location	Phone	Email
Chou Siaw Meng	N3.2-02-71	67904958	msmchou@ntu.edu.sg
Tan Soon Huat	N3.2-02-01	67904837	mshtan@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	LAMs	Tutorial
1	Review of equilibrium and free body diagram **Chap. 1 Introduction – Concept of Stress** 1.1-1.3 Introduction 1.4 Analysis and design 1.5-1.7 Axial stress, shearing stress & bearing stress in connections	a, b, c	Week 1	No tutorial in wk 1
2	1.11 Stress on an oblique plane 1.13 Design considerations **Chap. 2 Stress and Strain – Axial Loading** 2.1-2.2 Normal strain under axial loading 2.3 Stress-strain diagram 2.5 Hooke's law; modulus of elasticity 2.6 Elastic versus plastic behavior 2.8 Deformation of members under axial loading 2.11-2.12 Poisson's ratio, generalized Hooke's law	a, b, c	Week 2	Revision on Statics and Chap 1
3	2.14-2.15 Shearing strain, relations among E, ν, and G **Chap. 3 Torsion** 3.1-3.3 Deformation of a circular shaft 3.4 Shearing stress	a, b, c	Week 3	Chap 1
4	3.5 Angle of twist 3.7 Design of transmission shafts **Chap. 4 Pure Bending** 4.1-4.3 Pure Bending 4.4-4.5 Stresses and deformations	a, b, c	Week 4	Chap 2
5	4.12 Eccentric axial loading 4.14 General case of eccentric axial loading **Chap. 5 Analysis and Design of Beams for Bending** 5.1-5.2 Shear and bending moment diagrams	a, b, c	Week 5	Chap 3
6	5.2-5.3 Shear and bending moment diagrams (continue) 5.4 Design of prismatic beams for bending	a, b, c	Week 6	Chap 4
7a 7b	Revision video with examples of past year exam questions **Chap. 6 Shearing Stress in Beams** 6.2 Shear on horizontal face of beam 6.3 Determination of shearing stresses in a beam	a, b, c	Week 7a Week 7b	Chap 4/5
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8	continue on 6.3 Determination of shearing stresses in a beam 6.4 Shearing stresses in common types of beams **Chap. 7 Transformations of Stress and Strain** 7.1 Introduction 7.2 Transformation of plane stress 7.3 Principal stresses and maximum shearing stress	a, b, c, d, e	Week 8 Online CA1 (Chap 1 to 4)	Chap 5
9	continue on 7.3 Principal stresses and maximum shearing stress 7.4 Mohr's circle for plane stress 7.6 Maximum out-of-plane shearing stress	a, b, c, d, e	Week 9	Chap 6
10	7.7 Yield criteria for ductile materials under plane stress 7.8 Fracture criteria for brittle materials under plane stress 7.9 Stresses in thin-walled pressure vessels Worked Examples	a, b, c, d, e	Week 10	Chap 7 (part 1)
11	7.10 Transformation of plane strain 8.4 Stresses under combined loadings **Chap. 9 Deflection of Beams** 9.1 Introduction 9.3 Equation of the elastic curve	a, b, c, d, e	Week 11	Chap 7 (part 2)
12	9.6 Singularity function **Chap. 10 Columns** 10.1 Introduction 10.3 Euler's formula for pin-ended beams 10.4 Extension of Euler's formula	a, b, c, d, e	Week 12 Online CA2 (Chap 5 to 7)	Chap 9
13	-		-	Chap 9/10