Course Syllabus

offered by Department of Physics and Materials Science
with effect from Semester A 2015 / 16

Part I Course Overview

Course Title:	**Mechanics of Solids**
Course Code:	**AP2104**
Course Duration:	**One semester**
Credit Units:	**3**
Level:	**B2**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	***AP1201 General Physics I**
Precursors: *(Course Code and Title)*	**MA1200 Calculus and Basic Linear Algebra I** **MA1300 Enhanced Calculus and Linear Algebra I** **MA1201 Calculus and Basic Linear Algebra II** **MA1301 Enhanced Calculus and Linear Algebra II**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

* This pre-requisite requirement is waived for Advanced Standing I students (admitted in 2014/15 and thereafter) and Advanced Standing II students (admitted in 2013/14 and thereafter).

Part II Course Details

1. Abstract

This course will provide students with sufficient knowledge in mechanics of solids so that they can proceed to the intermediate and more advanced course in the BEng Materials Engineering programme. Stress-strain analysis of materials in the linear elastic regime of simple engineering structures under axial, torsional, shear and bending loads will be introduced.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs#	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Describe the contributions of some historical figures in the development of Solid Mechanics		√		
2.	Describe the stress and strain components at a point.			√	
3.	Solve problems involving simple engineering structures subjected to axial, torsional, bending and/or transverse loads.			√	
4.	Perform transformation of stress and strain under plane stress conditions and construct Mohr's Circle.			√	
5.	Apply solid mechanics knowledge to solve structural design problems			√	
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

 # Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5		
Lecture / Tutorial	Explain the key concepts in Mechanics of solids in an interactive manner	√	√	√	√	√		32
Laboratory	To demonstrate some of the key topics learned in Lecture/Tutorial by experimentation			√		√		12
Total(hrs)								44

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4	5			
Continuous Assessment: 40 %								
Tests	√	√	√	√	√		20%	There will be two 1-hour tests, each carries 10%
Lab reports			√		√		15%	Students need to complete a number of experiments that demonstrate the principles discussed in lectures/tutorials
Assignments	√	√	√	√	√		5%	Take home assignments
Examination: 60% (duration: 2 hours)								
** The weightings should add up to 100%.*							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Adequate (C+, C, C-)	Marginal (D)	Failure (F)
1. Tests	Able to solve numerical problems, and demonstrate the understanding of basic principles	High	Significant	Moderate	Basic	Not even reaching the marginal level
2. Lab reports	Ability to explain the methodology and results from experiments	High	Significant	Moderate	Basic	Not even reaching the marginal level
3. Assignments	Able to solve numerical problems, and demonstrate the understanding of basic principles	High	Significant	Moderate	Basic	Not even reaching the marginal level
4. Examination	Able to solve numerical problems, and demonstrate the understanding of basic principles	High	Significant	Moderate	Basic	Not even reaching the marginal level

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

- Historical development; and engineering examples (1 hour)
- Concept of stress (4 hours)

  Forces and stresses. Axial loading. Normal stress. Shearing stress. Bearing stress in connections. Thermal stress. Analysis of simple structures. Stress on an oblique plane under axial loading. Stress under general loading conditions. Components of stress. Ultimate and allowable stress. Factor of safety.
- Axial loading (4 hours)

  Normal strain under axial loading. Stress-strain diagram. True stress and true strain. Hooke's law. Modulus of elasticity. Deformation of members under axial loading. Statically indeterminate problems. Problems involving temperature changes. Poisson's ratio. Multiaxial loading. Generalized Hooke's law. Dilation. Bulk modulus. Shearing strain. Relationship between modulus of elasticity, Poisson's ratio and modulus of rigidity. Stress and strain distribution under axial loading. Saint-Venant's Principle. Stress concentrations.
- Torsion (4 hours)

  Stresses and deformations in circular shafts in the elastic range. Angle of twist. Statically indeterminate shafts.
- Shear and bending-moment diagrams (4 hours)

  Sign conventions for shearing force and bending moment. Determination of shear and bending-moment diagrams for beams under concentrated and/or distributed loads. Relations among load, shear and bending moment.
- Pure bending (2 hours)

  Stresses and deformations in prismatic members in pure bending in the elastic range. Deformations in a transverse cross section.
- Transverse loading (2 hours)

  Transverse loading of prismatic members. Basic assumption regarding the distribution of normal stresses. Determination of the shear in a horizontal plane. Determination of the shearing stresses in beams.
- Stress and failure analysis (4 hours)

  Transformation of plane stress. Principle stresses. Maximum shearing stress. Mohr's circle for plane stress, yield criteria. (von Mises, Tresca).
- Introduction to structural design (1 hour)

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	**Engineering Mechanics 2 Mechanics of Materials,** Dietmar Gross, Werner Hauger**,** Jörg Schröder, Wolfgang A. Wall, Javier Bonet, Springer 2011 (online access from SpringerLink).

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	David H. Allen, "Introduction to the Mechanics of deformable solids : bars and beam", Springer 2013 (online access from SpringerLink).