

POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION
DECEMBER 2011 SESSION

JJ310 : STRENGTH OF MATERIALS

DATE : 30 APRIL 2012 (MONDAY)
DURATION : 2 HOURS (11.15 AM - 1.15 PM)

This paper consists of **TWELVE (12)** pages including the front page.
Section A: Objective (25 questions – answer all)
Section B: Structured (4 questions – answer 3)

CONFIDENTIAL
DO NOT OPEN THIS QUESTION PAPER UNTIL INSTRUCTED BY
THE CHIEF INVIGILATOR

(CLO stated at the end of each question is referring to the learning outcome of the topic assessed. The CLO stated is only for lectures' references.)

SECTION A

OBJECTIVE (25 marks)

Instructions: This section consists of 25 objective questions. Answer all questions in the answers booklet.

1. Tension is[CLO1]
 - A. a force that tends to stretch materials
 - B. a force that tends to squeeze or crush materials
 - C. a force that tends to slide one face of materials
 - D. a force that tends to push materials

2. Stress is the[CLO1]
 - A. ratio of lateral dimension over horizontal dimension
 - B. ratio of applied force over the longitudinal dimension
 - C. ratio of the applied force to cross-sectional area of material
 - D. ratio of cross-sectional area to applied forces

3. The unit of strain is: [CLO1]
 - A. Pascals
 - B. Metres
 - C. Dimension-less
 - D. Newtons

6. What is ultimate stress? [CLO1]
- A. When a specimen is loaded beyond the elastic limit.
 - B. The maximum stress up to which a material can exhibit the property of elasticity.
 - C. Stress due to the load put upon the materials.
 - D. Stress corresponding to the ultimate load put upon the materials.
7. The ratio $\frac{\text{stress}}{\text{strain}}$ is called[CLO1]
- A. Modulus of rigidity
 - B. Modulus of plasticity
 - C. Modulus of ductility
 - D. Modulus of elasticity
8. Factor of safety is defined as? [CLO1]
- A. The ratio of transverse contraction strain to longitudinal extension strain
 - B. The component of stress coplanar with a material cross section
 - C. The ratio of the maximum stress allowed and the actual stress
 - D. The ratio of the actual stress and the maximum stress allowed
9. A wire is stretched 3mm by a force of 150N. Assuming the elastic limit is not exceeded, the force that will stretch the wire 5mm is: [CLO1]
- A. 150N
 - B. 250N
 - C. 90N
 - D. 450N
10. A round bar with a cross sectional area of 100mm^2 has a tensile force of 100kN applied to it. The stress in the round bar is: [CLO1]
- A. 1MPa
 - B. 1GPa
 - C. 1kPa
 - D. 100MPa

15. Composite bar is [CLO1]
- i. A bar that consist of 2 or more bars.
 - ii. A bar made of different materials.
 - iii. Two or more welded bars.
 - iv. A bar that can expand and compress.
- A. i only
 - B. i, ii, and iii
 - C. ii, iii and iv
 - D. All above

16. Using Table 1, determine the shear force and bending moment shown below. [CLO1]

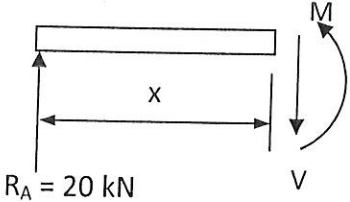
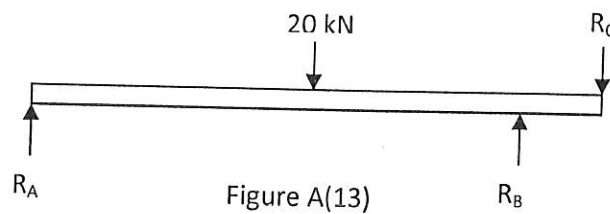
Range	Free body diagram	Shear Force and Bending Moment
$0 \leq x \leq 0.5$		$V = ?$ $M = ?$

Table 1

- A. $V = 20, M = 20x$
- B. $V = 20x, M = 20x$
- C. $V = 20x^2, M = 20x^2$
- D. $V = 20x, M = 20$

18. In bending moments equation, $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$, M is[CLO1]
- maximum bending moment
 - bending moment
 - second moment of area
 - Young Modulus

19. The equilibrium of the forces from Figure A is [CLO1]



- $R_A + 20 \text{ kN} + R_B + R_C = 0$
 - $R_A - 20 \text{ kN} - R_B - R_C = 0$
 - $R_A + R_B - 20 \text{ kN} - R_C = 0$
 - $20 \text{ kN} - R_B + R_C = 0$
20. A beam with a rectangular cross section of 40mm deep. It is made from metal with a modulus of elasticity of 205GPa. The maximum tensile stress in the beam must not exceed 350MPa. What is the radius of curvature? [CLO1]
- 11.71 m
 - 11.71 mm
 - 117.1mm
 - 1.171 m

25. $\frac{\tau}{R} = \frac{G\theta}{L} = \frac{T}{J}$ is the torsion equation. What is τ ? [CLO1]

- A. Shear stress
- B. Shear strain
- C. Second moment of area
- D. Torsion

QUESTION 3

A cantilever beam as shown in Figure B(3) is 4 m long with flexural stiffness (EI) of 20 MNm^2 . It has a point load of 1 kN at the free end. Calculate the slope and deflection at the free end. [CLO2]

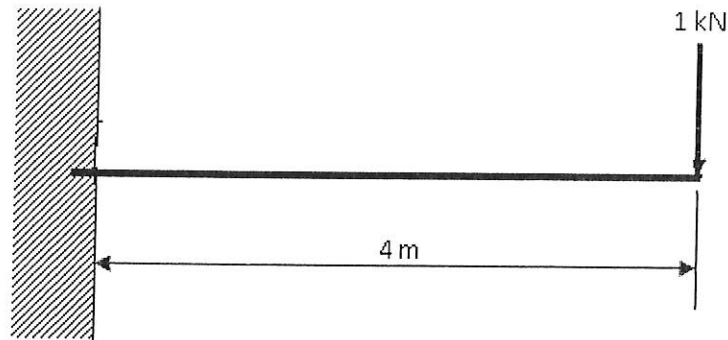


Figure B(3)

(25 marks)

QUESTION 4

- (a) A 50 mm diameter shaft and 0.7 m long is subjected to a torque of 1200 Nm. Calculate the shear stress and the angle of twist. Given $G = 90 \text{ GPa}$. [CLO1]
(7 marks)
- (b) A hollow shaft with a 50 mm external diameter and 30 mm internal diameter and 0.7 m long is subjected to a torque of 1200 Nm. Calculate the shear stress and the angle of twist. Given $G = 90 \text{ GPa}$ [CLO1]
(7 marks)
- (c) A steel shaft 5 m long, having a diameter of 50 mm, is to transmit power at a rotational speed of 600 rev/min. If the maximum shear stress is limited to 60 MN/m^2 . Determine the following.
- The maximum power that can be transmitted [CLO1]
 - The corresponding angle of twist [CLO1]
- Assume the modulus of rigidity for steel is 80 GN/m^2 .

(11 marks)