The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX3271/MEX4335 Applied Mechanics and Strength of Materials**
Academic Year	:	2014/15
Date	:	19th September 2015
Time	:	0930hrs – 1230hrs
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 8 questions. All questions carry equal marks.
3. Answer any 5 questions selecting **at least TWO** from each section.

SECTION- A

Question No.01:

a) Define the terms stress and strain.

b) A simply supported beam ABCD, 6 m long, is overhanging by 1.5 m and carries appoint load and uniformly distributed load as shown in Fig.Q1.

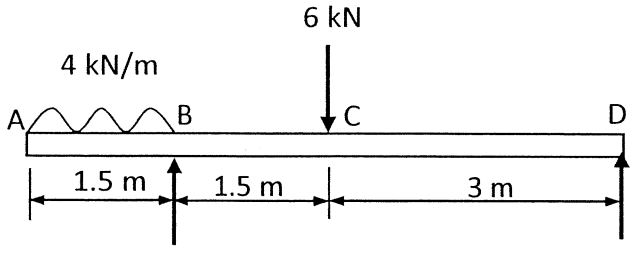


Fig.Q1

Draw the shear force and bending moment diagrams for the beam and locate the point of contra flexure.

Question No.02:

a) Derive an expression for the stresses (σ_θ, τ_θ) on an oblique plane of a rectangular body, when the body is subjected to tensile stresses in x and y directions as shown in Fig.Q2.

b) Determine the magnitudes of σ_θ, τ_θ, when $\theta = 0^0$, 45^0 and 90^0

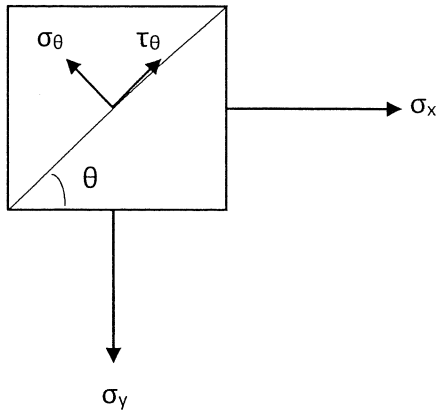


Fig.Q2

c) A structural member is loaded in such a manner that at a particular point in the member, the stresses in a in two dimensional stress system are found to be;

$\sigma_x = +400 \ \ N/mm^2$, $\sigma_y = +300 \ \ N/mm^2$ and $\tau_{xy} = +200 \ \ N/mm^2$.

i) Draw the Mohr's circle for the point representing all the given stresses.

ii) Determine the magnitude and the directions of principal stresses.

iii) Find the magnitude of the maximum shear stress.

Question No.03:

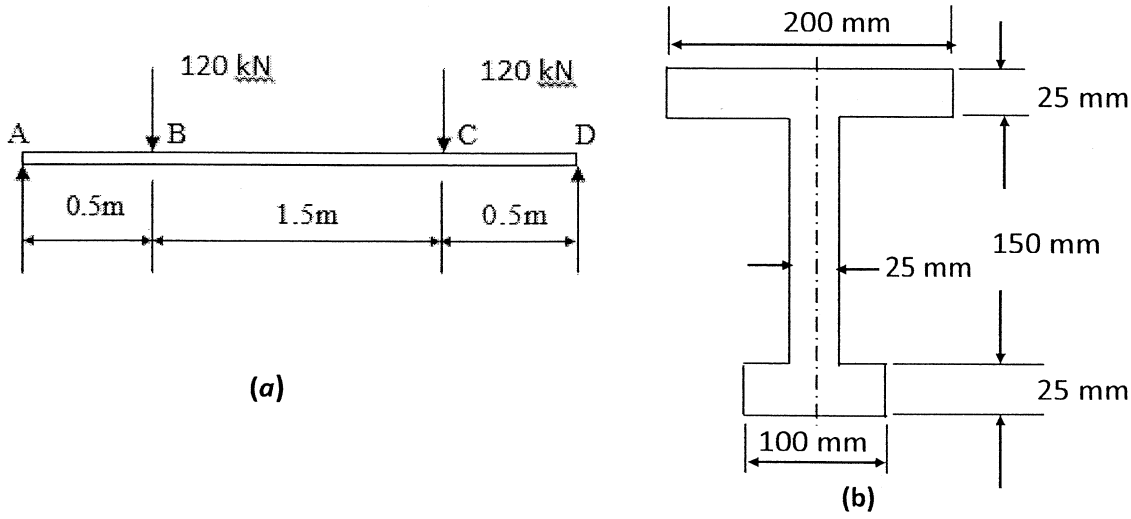


Fig.Q3

Fig.Q3(*a*) shows a simply supported beam carrying two vertical forces while Fig.Q3(*b*) shows the cross section of the beam.

Determine,

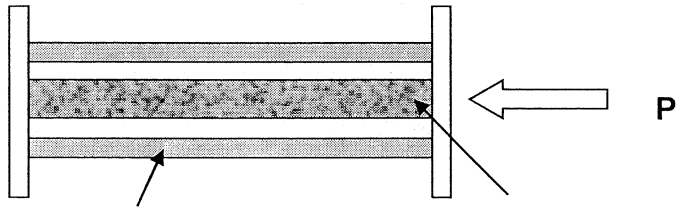
i) the position of the neutral axis from the base of the cross section given in Fig.Q3(*b*).

ii) the second moment of area about the neutral axis.

iii) the maximum tensile and compressive stresses within the portion BC of the beam.

Question No.04:

a) Fig.Q4 shows a compound bar of length **L**, made up of a rod (r) placed inside a sleeve (s) which are made of different materials. The ends are connected and restrained so that they elongate together. If a load **P** is acting on the compound bar what would be the loads taken by each component?



Sleeve (s)

Cross sectional area – A_s

Modulus of elasticity - E_s

Rod (r)

Cross sectional area – A_r

Modulus of elasticity – E_r

Fig.Q4

b) A concrete column of cross – sectional area 500mm x 500mm is reinforced by four longitudinal 50 mm diameter round steel bars placed at each corner. If the column carries a compressive load of 400 kN and the modulus of elasticity of steel is 15 times that of concrete, determine:

i) the individual loads carried by steel and concrete.

ii) the compressive stress produced in the concrete and steel bars.

SECTION- B

Question No.05:

Three rotating masses A=14 kg, B=11 kg, and C=21 kg, are carried on a horizontal shaft with their centers of masses loaded at 275 mm, 400 mm, and 150 mm respectively, away from the shaft axis. The angular positions of B and C are 60^0 and 135^0 respectively from A measured in the same direction. The distance between the planes of rotation of A and B is 1.35 m and between those of A and C is 3.6 m, with B and C being on the same side of A.

Two balancing masses are required to be fitted, each with its center of mass 225 mm from the shaft axis, and in planes midway between those of A and B and of B and C in order to make the given system of rotating masses dynamically balanced. Determine the magnitude and angular position of each balancing masses with respect to A.

Question No.06:

a) Explain with a neat sketch the "sun and planet wheel" of the simplest epicyclic gear system.

b)

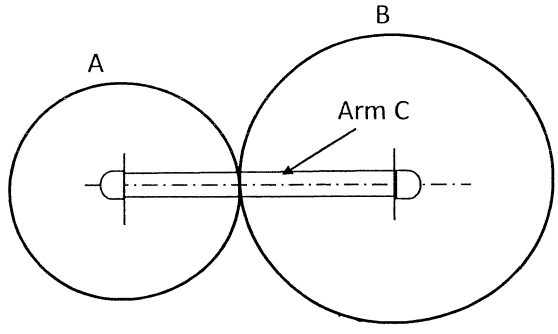


Fig.Q6

In an epicyclic gear train shown in Fig.Q6, an arm carries two gears **A** and **B** having 24 and 32 teeth respectively. If the arm rotates at 160 rev/min. in the anticlockwise direction about the center of the gear **A** which is fixed, determine the speed of rotation of gear **B**.

c) If the gear **A**, instead of being fixed, makes 320 rev/min in the clockwise direction, what will be the speed of rotation of gear **B**?

Question No.07:

The mechanical system shown in Fig.Q7 has a rotating drum with moment of inertia 'I' kgm^2. A spring of stiffness 'k' N/m is attached to the drum at the radius 'r' m and a weight of mass 'M' kg is attached to the drum by an inelastic string wound around the drum at its outer radius 'R' m.

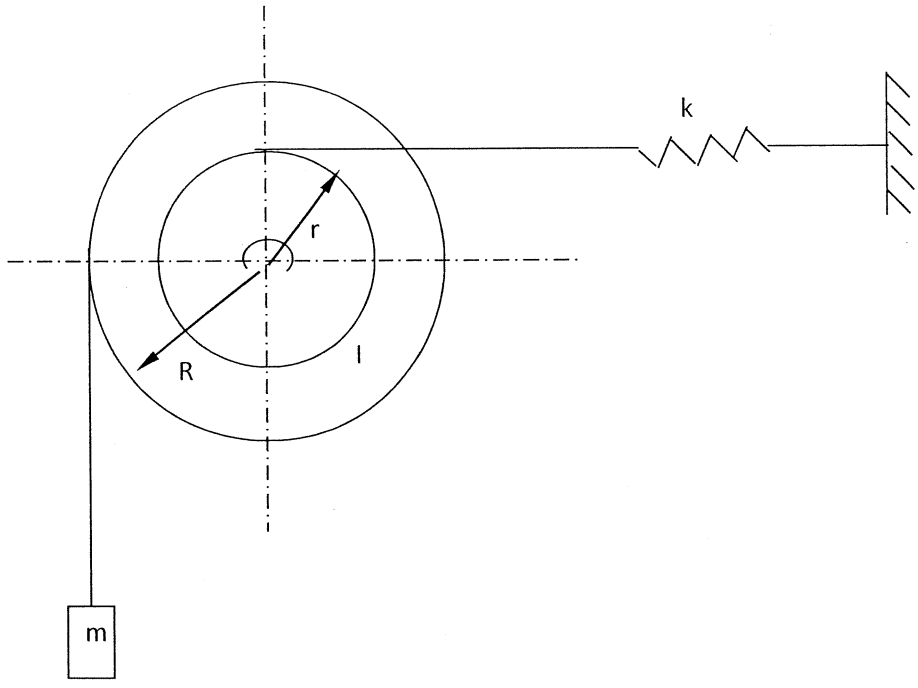


Fig.Q7

For small oscillations of the drum around its axis, show that the frequency of vibration of the system is,

$$N = \frac{1}{2\pi}\sqrt{\frac{kr^2}{I+mR^2}} \text{ cycles per second}$$

Question No.08:

a) If ***I*** is the moment of inertia and **ω** is the mean speed of a flywheel, prove that the maximum fluctuation of energy can be expressed as

$$E_{\max} = \frac{K_s I \varpi^2}{100}$$

Where K_s is the coefficient of fluctuation of speed expressed as a percentage.

b) An engine runs at 150 rev/min and a curve of the turning moment plotted on a crank angle base showed the following areas alternatively above and below the mean turning moment line

780, 400, 520, 620, 260,340 and 420 mm^2

The scales used were 1mm = 500 Nm and 1mm = 1° crank angle

If the total fluctuation of speed is limited to 1. 2 % of the mean speed, determine the required mass of the flywheel. The radius of gyration is 0.5mm.

END