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	:	**MEX4335/MEX3271 Applied Mechanics and Strength of Materials**
Academic Year	:	2015/16
Date	:	14th December 2016
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 **not more than THREE** from each section.

SECTION A

Question No.01:

a) Briefly explain with relevant sketches the different types of beams and different types of loads acting on a beam. ***(05 marks)***

b)

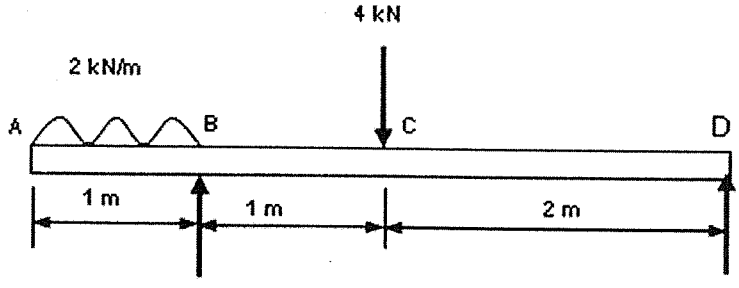


Fig. Q1

A beam ABCD 4m long, simply supported at A and D, is over hanging by 1m to the left of support at B and carries loads as shown in Fig.Q1

I. Determine the reaction forces at B and D.
II. Draw the shear force and bending moment diagrams for the beam.
III. Determine maximum bending moment of the beam and its position.

(15 marks)

Question No.02:

The stresses acting on three mutually perpendicular planes at a point in an elastic material are 72 N/mm^2 tensile and 28 N/mm^2 shear on plane 1, 14 N/mm^2 compressive and 28 N/mm^2 complementary shear on plane 2, and no stress on plane 3.
Use Mohr's circle diagram to show the stress components on different planes and thus calculate

I. The principal stress ***(09 marks)***

II. The maximum shear stress ***(03 marks)***

III. The position of the planes on which there is no normal stress ***(04 marks)***

IV. The principal strains ***(04 marks)***

Take Modulus of elasticity (E) = 200x10^2 N/mm^2 and Poisson's ratio (υ) = 0.3.

Question No.03:

(a) Draw the typical stress–strain curve for a mild steel and indicate the Elastic region, Plastic region, Yield strength and the Ultimate strength

(05 marks)

(b)

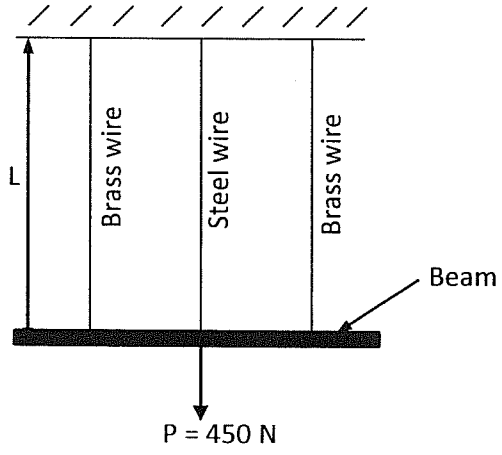


Fig.Q3

– A beam weighing 450N is held in a horizontal position by three vertical wires. Two of them are similar with one attached to each end of the beam, and the third to the middle of its length as shown in Fig.Q3. Each outer wire is of brass and has diameter 1.25 mm. The centeral wire is of steel and has diameter 0.625 mm. The beam is rigid, and wires were of the same length and unstressed before the beam is attached. If the Young's Modulus of the brass is 86 GN/m^2 and for steel 210 GN/m^2, detremine the stresses induced in the wires.

(15 marks)

Question No.04:

(a) Prove that the second moment of area of a triangle having a base '*b*' and height '*h*', about an axis along the base is $bh^3/12$. Hence show that a square section has the same second moment of area about a centroidal axis parallel to a side of the square.

(06 marks)

(b) Fig.Q4 shows an unsymmetrical I-section. Determine the second moment of area about the axes X-X passing through its center of gravity (C.G).

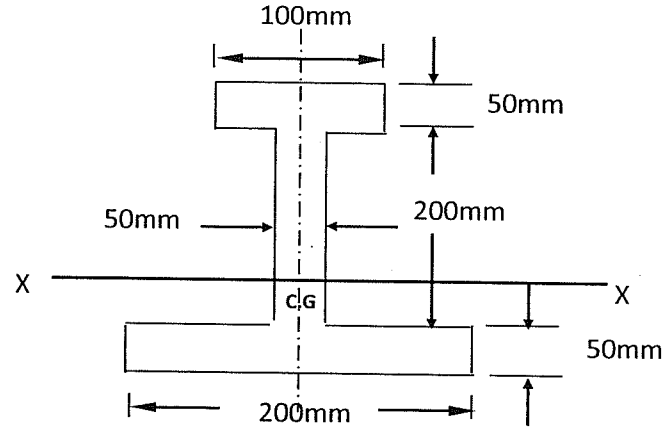


Fig.Q4

(14 marks)

SECTION B

Question No.05:

a) Establish a formula for the maximum torque transmitted by a single plate clutch of external and internal radii r_1 and r_2 respectively. The limiting coefficient of friction is μ and the axial spring load is **W**. Assume that the pressure intensity on the contact faces is uniform.

(08 marks)

b) A single plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is limited to 70 kN/m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of friction is 0.25, determine

I. The inner and outer radii of the plate and the mean radius
II. The width of the friction lining.

(12 marks)

Question No.06:

A rotating shaft carries four masses, **A, B, C** and **D**, rigidly attached to the shaft. The center of masses are at 30 mm, 36mm, 39 mm and 33 mm respectively from the axis of rotation. **A, C** and **D** are 7.5 kg, 5 kg and 4 kg respectively and the axial distance between **A** and **B** is 400 mm and that between **B** and **C** is 500 mm. The eccentricities of **A** and **C** are at 90^0 to one another. Determine,

I. the angles between **A, B** and **D**. ***(10 marks)***

II. the axial distance between the planes of revolution of **C** and **D**. ***(06 marks)***

III. the mass **B**. ***(04 marks)***

Question No.07:

a) Explain

i. the meaning and the usage of a Turning Moment Diagram.

(04 marks)

ii. the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels.

(04 marks)

b) The turning moment diagram of a petrol engine is drawn to the following scales: Turning moment, 1 mm = 5 Nm; crank angle 1mm = 1^0.
The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, and 270 mm^2. The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. determine the coefficient of fluctuation of speed when the engine runs at 1800 r.p.m.

(12 marks)

Question No.08:

An epicyclic gear consists of three wheels ***A, B*** and ***C*** as shown in Fig.Q8. The gear ***A*** has 72 internal teeth and gear ***C*** has 32 external teeth. The gear ***B*** meshes with both ***A*** and ***C*** and is carried on an arm ***EF*** which rotates about the center of ***A*** at 18 r.p.m. if the gear a is fixed, determine the speed of gears ***B*** and ***C***.

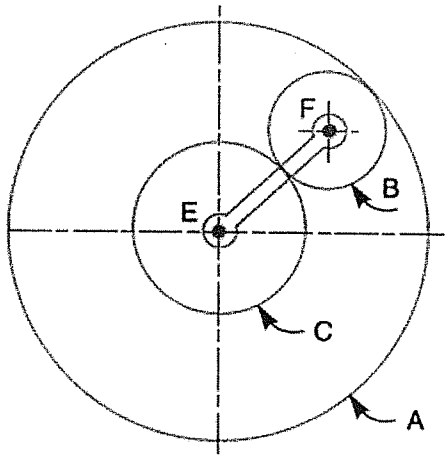


Fig.Q8

(20 marks)

END