MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

SUPPLIMENTARY EXAMINATION

EEE 212: MECHANICS OF MACHINES

DATE: 30/8/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

Answer Question one and any other Two questions.

1. a) Define the following terms
   - i Stress
   - ii Strain (4 marks)

   b) The maximum load in a tensile test on a mild steel specimen is 90 kN. If the test piece is 12 mm diameter and assuming a factor of safety of 3, Determine;
   - i The ultimate tensile stress
   - ii The working stress
   - iii The greatest allowable load on a bar of 30 mm diameter. (9 marks)

   c) i) With the aid of suitable sketches, distinguish between open and closed belt drives, showing clearly the tight and slack sides of each drive.

   ii) A countershaft has a pulley 1400mm diameter keyed to it and it is to have a speed of 250 rev/min. It is to be driven by an electric motor which has a speed of 1200 rpm.

   Determine the diameter of the pulley that should be fitted to the electric motor (10 marks)

d) i) Distinguish between a single gear train and a compound gear train.

ii) A double reduction gearing system is shown in Fig 1d. Gear A is the driver and rotates in the clockwise direction at 1500 rpm. Gears A, B, C and D have 40, 50, 30 and 60 teeth respectively.

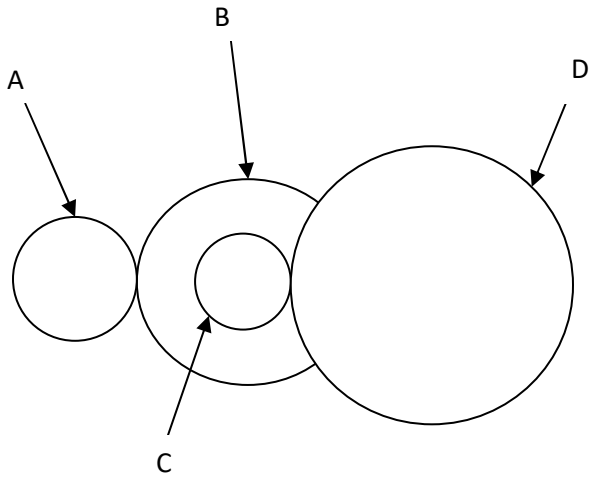

Fig. 1d

For this gearing system, determine;

- the velocity ratio
- the speed and direction of rotation of gear D (7 marks)

2. a) i) Distinguish between moment and momentum

ii) A sphere of mass 360g moving at 8 m/s to the right collides directly with another sphere of mass 230g approaching at 14m/s. If the coefficient of restitution is 0.75, determine the velocity and direction of each after the impact (6 marks)

b) In a car racing competition, car **A** starts from rest and accelerates at 0.4 ms^{-2}. 10 seconds later, car **B** starting at the same point from rest, accelerates at 0.7 ms^{-2} and follows the same path as car **A**.

Determine: i) the time taken for car **B** to overtake **A**

ii) the distance travelled when car **B** overtakes **A** (8 marks)

c) An engine shaft is uniformly accelerated from 10 rpm to 20 rpm in 5 sec. The shaft continues to accelerate at this rate for the next 10 sec. Thereafter, the shaft rotates with uniform speed.

Find the total time taken to complete 500 revolutions. (6 marks)

3. A beam is supported and loaded as shown in Figure 3.

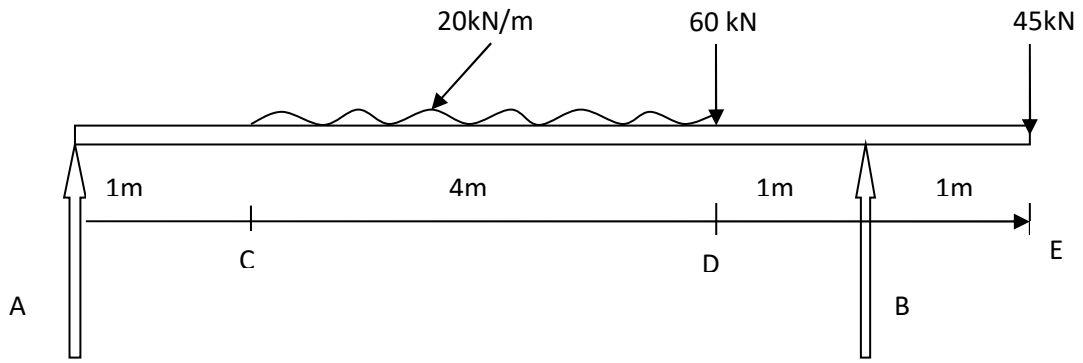

Fig. 3

---

i Determine the shear forces and bending moments at all the critical points of the beam

ii Draw the shear force and bending moment diagrams

iii Calculate the magnitude and position of the maximum bending moment

iv find the position of the point of contraflecture. (20 marks)

4. a) i) Define the term **centroid**

ii) Show that the moment of inertia $\mathbf{I_{xx}}$ of a rectangular section of width **b** and depth **d** about its centroidal axis parallel to the width is given: $I_{xx} = \frac{bd^3}{12}$

(7 marks)

b) State the following theorems of area moment of inertia:

i Perpendicular axes theorem

ii Parallel axes theorem (4 marks)

c) The cross section of a symmetrical I-beam is shown in **Fig.4c**

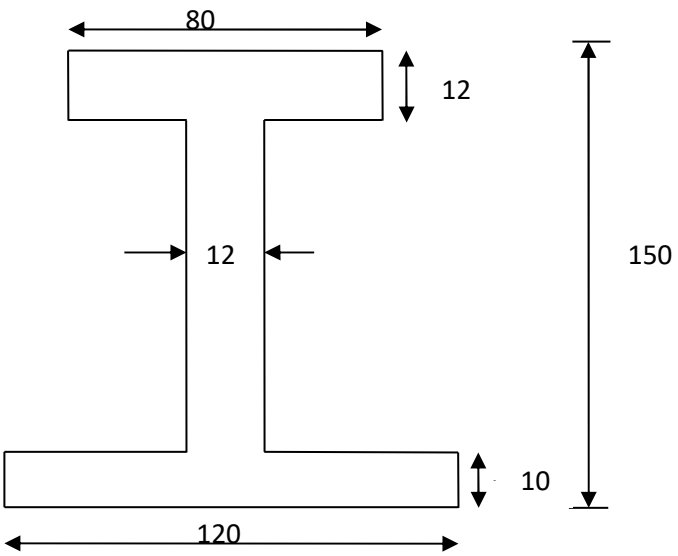

Fig.4c: All dimensions are in mm

Determine for this section:

i The centroid with reference to the base

ii Area moment of inertia of the section about a centroidal axis parallel to the base

(9 marks)

5. a) i) Derive the equation $\frac{M}{I} = \frac{E}{R} = \frac{\sigma}{y}$ for a beam subjected to pure bending, where all the symbols have the usual meaning.

ii) State three assumptions made in (i) above (10 marks)

b) A rectangular beam of cross section 240mm depth by 125 mm width is subjected to a maximum bending moment of 750kNm. If the Youngs Modulus for the material of the beam is 200GN/m^2,

Determine for this beam;

i) The maximum stress induced

ii) The radius of curvature (10 marks)