



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

EEE 212: MECHANICS OF MACHINES

DATE: 2/8/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

1.
 - a) Distinguish between stress and strain as used in engineering (4 marks)
 - b) A mild steel rod, 12mm diameter is subjected to a maximum tensile load of 90 kN. Assuming a factor of safety of 2.5, Determine;
 - i. the working stress
 - ii. the ultimate tensile stress
 - iii. the greatest allowable load on a bar of 30 mm diameter. (10 marks)
 - c)
 - i) With the aid of suitable sketches, distinguish between a flat and a V-belt and state an application for each
 - ii) A countershaft has a pulley 1200mm diameter keyed to it and it is to have a speed of 1200 rev/min. It is to be driven by an electric motor which has a speed of 2000 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 2000 at rpm. Gears A, B, C and D have 40, 50, 30 and 60 teeth respectively.

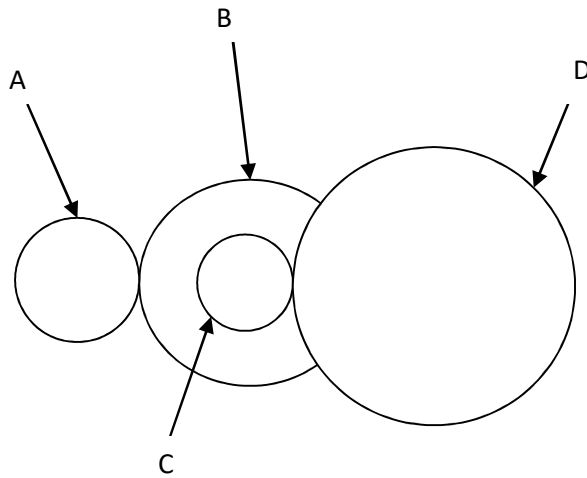


Fig. 1d

For this gearing system, determine;

- the velocity ratio
 - the speed and direction of rotation of gear D (6 marks)
2. A beam is supported and loaded as shown in Figure 3.

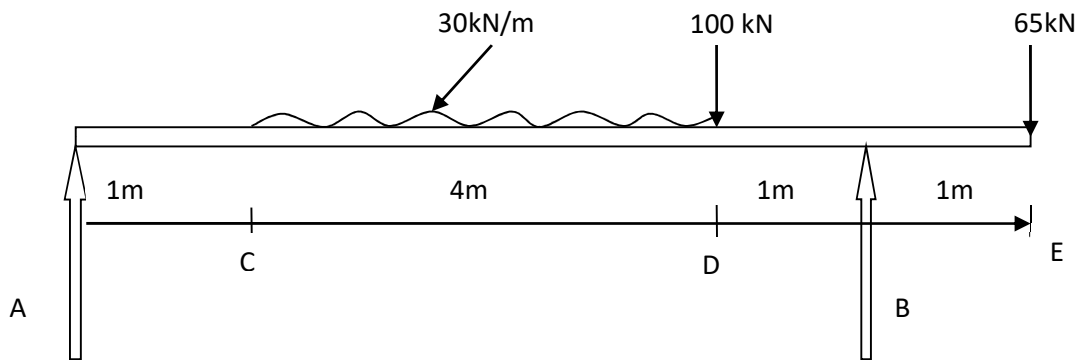


Fig. 3

- 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 contraflexure. (20 marks)

3. a) i) Distinguish between Inertia and momentum
- ii) A sphere of mass 3.5kg moving at 7 m/s to the right collides directly with another sphere of mass 2.6kg approaching at 12m/s. If the coefficient of restitution is 0.78, 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 0.5 ms^{-2} . 10 seconds later, car **B** starting at the same point from rest, accelerates at 0.8 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 15 rpm to 20 rpm in 3 sec. The shaft continues to accelerate at this rate for the next 8 sec. Thereafter, the shaft rotates with uniform speed.

Find the total time taken to complete 800 revolutions. (6 marks)

4. 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 200 GN/m^2 ,

Determine for this beam;

- i. the maximum stress induced
- ii. the radius of curvature
- iii. the stress at a distance 55 mm from the top surface. (10 marks)

5. a) i) Distinguish between the terms **centre of gravity** and **centroid**
- ii) Show that the moment of inertia 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**

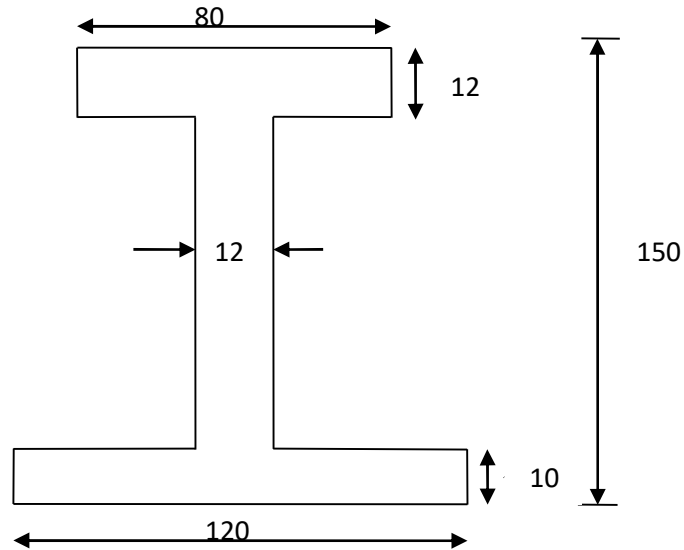


Fig.4c: All dimensions are in mm

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)