



MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

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

SUPPLEMENTARY EXAMINATION

EEE 212: MECHANICS OF MACHINES

DATE:

TIME:

INSTRUCTIONS:

1. This examination contains FIVE questions. Question ONE (1) is compulsory and carries 30 marks. All the other questions carry 20 marks each.
2. Answer question ONE and any other TWO questions
 1. a) Define the following terms
 - i) stress
 - ii) strain (3 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 25 mm diameter. (10 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 1200mm diameter keyed to it and it is to have a speed of 200 rev/min. It is to be driven by an electric motor which has a speed of 1000 rpm. Determine the diameter of the pulley that should be fitted to the electric motor (10 marks)

Examination Irregularity is punishable by expulsion

- 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 1800 rpm. Gears A, B, C and D have 30, 40, 20 and 50 teeth respectively.

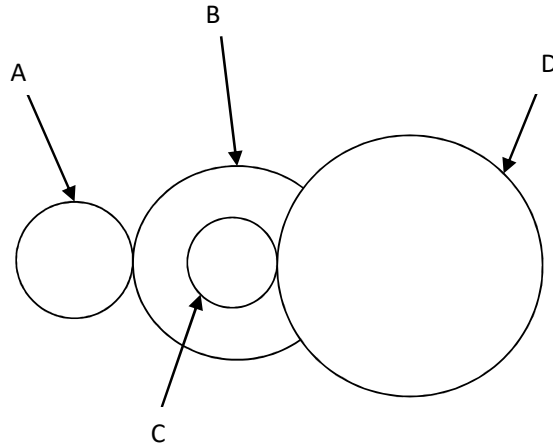


Fig. 1d

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 0.8, 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 0.45 ms^{-2} . 5 seconds later, car **B** starting at the same point from rest, accelerates at 0.75 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 18 rpm in 4 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 400 revolutions. (6 marks)

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

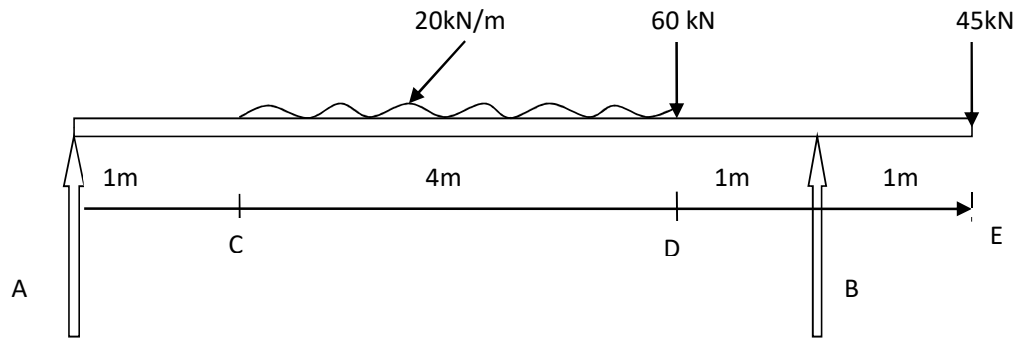


Fig. 3

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- 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)
4. 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**

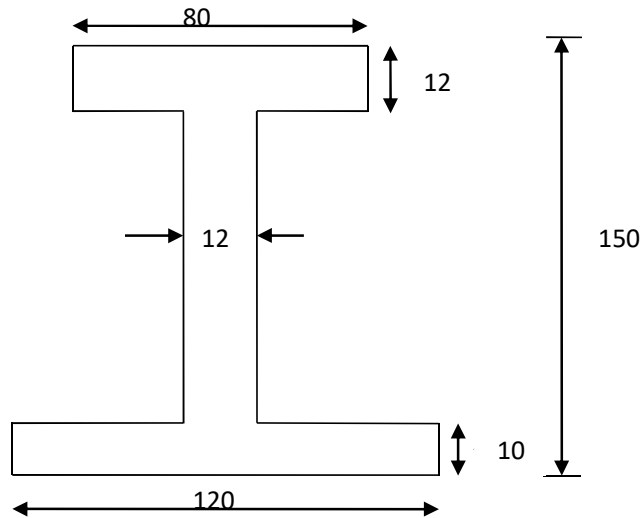


Fig.4c: All dimensions are in mm

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)

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/m²,

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)

(8 marks)