



MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EEE212: 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

QUESTION ONE(COMPULSORY) (30 MARKS)

- a) i) Distinguish between stress and strain (2 marks)
- ii) Explain briefly any two Shearing applications in Engineering (3 marks)
- iii) Describe the tensile test for a mild steel specimen tested to destruction (2 marks)
- iv) Explain the critical parts of a typical stress strain graph for the test in (ii) above (6 marks)
- b) The maximum load in a tensile test on a mild steel specimen is 120 kN. If the test piece is 15 mm diameter and assuming a factor of safety of 2.5, Determine;
- i) the ultimate tensile stress (2 marks)
- ii) the working stress (2 marks)
- iii) the greatest allowable load on a bar of 30 mm diameter. (2 marks)

- c) A steel bar of diameter 40mm is turned down to 20mm diameter for a half of its length. Determine the ratio of the extensions in the two parts due to axial loading. (5 marks)
- d) A circular hole of diameter 50mm is to be punched out of a 2mm thick metal plate. The ultimate shear stress for the plate material is 500 MPa. Determine:
- i) The minimum force required on the punch (3 marks)
 - ii) The compressive stress on the punch at this load (2 marks)

QUESTION TWO (20 MARKS)

- a) With the aid of suitable sketches, distinguish between open and crossed belt drives, showing clearly the tight and slack sides of each drive. (4 marks)
- b) An engine shaft running at 120 rpm is required to drive a machine shaft by means of a belt. The pulley on the engine shaft is 2m diameter and that of the machine shaft is 1m diameter. If the belt thickness is 5mm, find the speed of the machine shaft when:
- i) there is no slip (3 marks)
 - ii) there is a 3% slip (3 marks)
- c)
 - i) Gears transmit power without slipping. Explain (2 marks)
 - ii) State two advantages and two disadvantages of using Gears in power transmission (2 marks)
 - iii) Distinguish between a simple gear train and a compound gear train. (2 marks)
- d) A double reduction gearing system is shown in Fig Q2d. Gear A is the driver and rotates in the clockwise direction at 2000 rpm. Gears A, B, C and D have 40, 50, 20 and 60 teeth respectively. Determine; the velocity ratio, the speed and direction of rotation of gear D (4 marks)

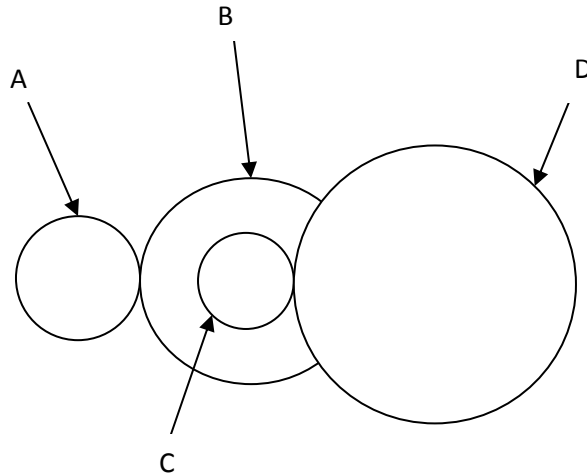


Figure. Q2d

QUESTION THREE- (20 MARKS)

- a) Distinguish between the following as used in beams:
- i) *Simply supported beam and a Cantilever*
 - ii) *A point load and a Distributed* (4 marks)
- b) A beam is supported and loaded as shown in Fig Q3b

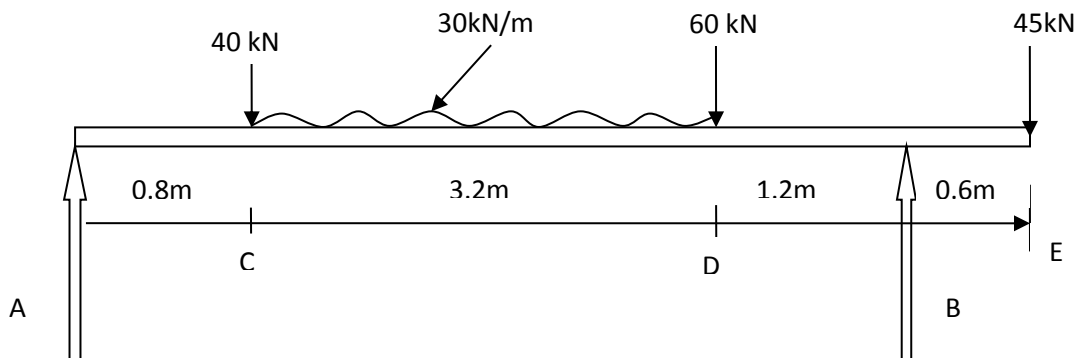


Figure. Q3b

- i) Determine the shear forces and bending moments at all the critical points of the beam (4 marks)
- ii) Draw the shear force and bending moment Diagrams for the beam (4 marks)
- iii) Determine the Magnitude and position of the maximum bending moment (4 marks)

- iv) Locate the position of the point of contraflexure. (4 marks)

QUESTION FOUR- (20 MARKS)

- a) Distinguish between centre of gravity and centroid (2 marks)

- b) The cross section of a model commemoration plaque is shown in **Fig.Q4b**

Determine :

- i) the centroid of this section with reference to the base: (3 marks)
- ii) the moment of inertia of the section about the centroidal axis parallel to the base. (5 marks)
- c) A rectangular beam of cross section 240 mm depth by 125 mm width is subjected to a maximum bending moment of 750 kNm. If the Youngs Modulus for the material of the beam is 210GN/m^2 , Determine for this beam;
- i) the maximum stress induced (3 marks)
- ii) the radius of curvature: (2 marks)
- d) A cantilever beam 0.5 m long carries a single point load, W at its free end. The beam is of hollow cross section of 90mm and 70 mm outside and inside diameters respectively. If the bending stress in the cantilever is not to exceed 65MN/m^2 , Determine the load 'W' (5 marks)

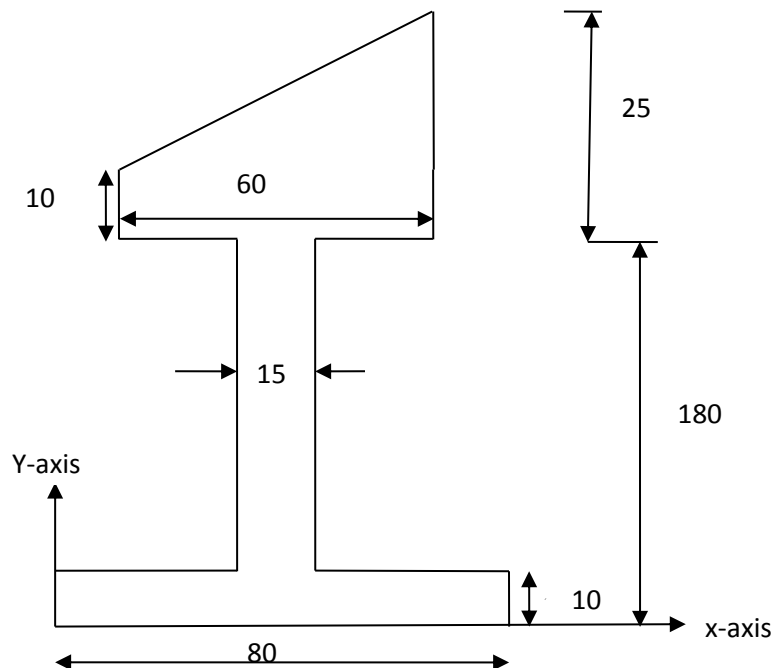


Figure Q4b: All dimensions are in mm

QUESTION FIVE - (20 MARKS)

- a) 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** (4 marks)
 - ii) the distance travelled when car **B** overtakes **A** (3 marks)
- b) An engine shaft is uniformly accelerated from rest to 20 rpm in 15 sec. The shaft continues to accelerate at this rate for the next 30 sec. Thereafter, the shaft rotates with uniform speed. Find the total time taken to complete 1000 revolutions. (6 marks)
- c)
 - i) State Newtons Second law of motion (2 marks)
 - ii) Show from Newton's second law of motion that : $F=ma$ where the symbols have their usual meaning. (2 marks)
 - iii) A wagon of mass 50 tonnes, starting from rest travels 30m along a horizontal track and strikes a bumper stopper. Determine the velocity with which the wagon strikes the stopper. (3 marks)