



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS 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 Internal and external forces giving suitable examples in each case (2 marks)
 - ii) Explain any two applications of Shearing in an engineering workshop (2 marks)
 - iii) Discuss the significance of factor of safety in engineering. (3 marks)
 - iv) A circular hole is to be punched in a steel plate 1.5 mm thick. If the punching load is limited to 40kN. Take ultimate shear strength as 90 MN/m^2 . (4 marks)
- b)
 - i) The motion of a particle is given by the equation: $a=t^3-3t^2+5$; where 'a' is the acceleration in m/s^2 and 't' is the time in seconds. When $t=1$, the velocity and displacement of the particle are 6.25m/s and 8.8m respectively. Determine the velocity and displacement of the particle when $t=5$ seconds (8 marks)

- ii) An engine shaft is uniformly accelerated from rest to 60 rpm in 4 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. (4 marks)
- c) i) Explain the significance of carrying out the tensile test for a material. (2 marks)
- ii) With a well labelled diagram, describe the stress strain curve for a mild steel specimen tested to destruction (5 marks)

QUESTION TWO (20MARKS)

- a) A beam is loaded and supported as shown in Figure Q2 (a).
- b) i) Determine the shear forces and bending moments at all the critical points of the beam (6 marks)
- ii) Draw the shear force and bending moment diagrams (6 marks)
- c) i) Calculate the magnitude and position of the maximum bending moment. (5 marks)
- ii) Find the position of the point of contraflexure. (3 marks)

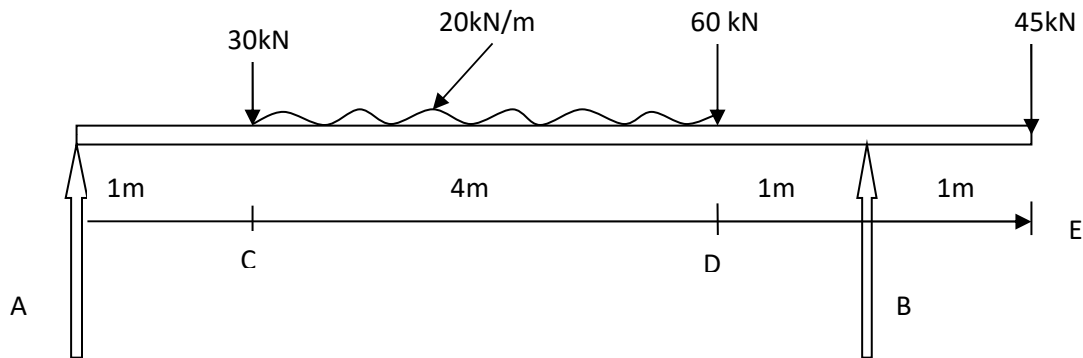


Fig. 2a

QUESTION THREE 20 MARKS

- a) i) Distinguish between centre of gravity and centroid. (2 marks)
- ii) State the two theorems of area moment of inertia. (4 marks)
- b) Determine the area moment of inertia for a triangular section of base b and height h :
 - i) about the base. (4 marks)
 - ii) about a centroidal axis $x-x$ parallel to the base (3 marks)
- c) Determine the moment of inertia of the section shown in Figure Q3(c) about an horizontal axis passing through its centroid. (7 marks)

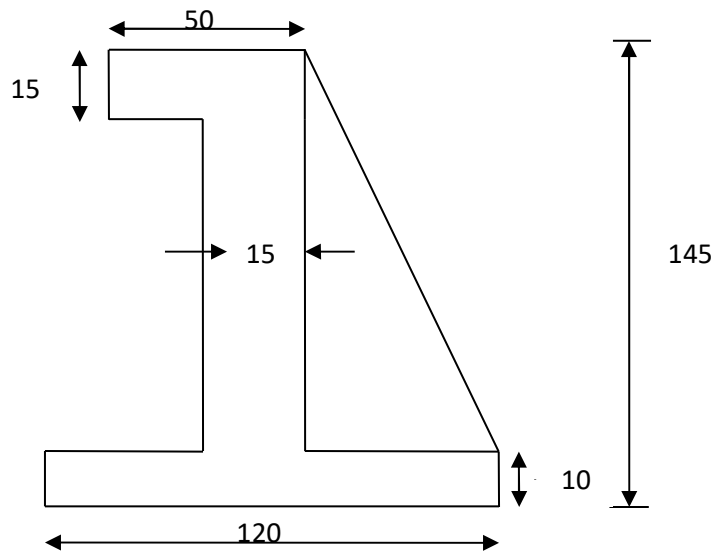


Figure Q3(c)

QUESTION FOUR (20 MARKS)

- 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 and state three assumptions made. (10 marks)
- A rectangular beam of cross section 240mm depth by 120 mm width is subjected to a maximum bending moment of 950kNm. If the Young's Modulus for the material of the beam is 240GN/m², Determine:
 - the maximum stress induced in the beam (2 marks)
 - the stress within a layer 10mm from the outermost fibers of the beam. (2 marks)
 - the radius of curvature of the beam (2 marks)
- A cantilever has a rectangular section 80 mm width and 120mm depth. If the cantilever carries a udl of 3kN/m over the entire length and the bending stress is not to exceed 40 MPa, find the length of the cantilever. (4 marks)

QUESTION FIVE (20 MARKS)

- With the aid of suitable sketches differentiate between:
 - An open and a crossed belt drive (3 marks)
 - a simple and a compound belt drive. (3 marks)
- An engine running at 150 rpm drives a line shaft by means of a belt. The engine pulley is 750mm diameter and the pulley on the line shaft is 450mm diameter. A 900 mm diameter pulley also on the line shaft drives a 150mm diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft when:
 - there is no slip (3 marks)
 - there is a 2% slip at each drive. (4 marks)
- Gears transmit power without slipping. Explain (2 marks)
 - State two advantages and two disadvantages of using Gears in power transmission (2 marks)
 - Describe a suitable application of the rack and pinion gearing mechanism in engineering. (3 marks)