



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

MECHANICAL SCIENCE

DATE: 15/12/2020

TIME: 8:30 – 11:30 AM

INSTRUCTIONS TO CANDIDATES

- *This paper consists of FIVE questions*
- *Answer all questions*

1. (a) (i) Define the following as applied to properties of materials.
 - (I) Stress
 - (II) Ultimate strength/ Tensile strength
- (ii) A member of an aircraft frame is required to carry an axial load of 10 kN. The ultimate strength of the material is 400 MN/m^2 and factor of safety of 8 is to be considered. The member is to be made of hollow circular bar, whose outside diameter is twice the inside diameter. Determine the minimum diameters required.
- (iii) State any **two** factors which influence the choice of the value of factor of safety in engineering design. (10 marks)
- (b) (i) Define the following terms:
 - (I) Energy;
 - (II) Power.
- (ii) A vehicle wheel has a mass of 40 kg, a mean diameter of 600 mm and a radius of gyration of 250 mm. If the vehicle travels at 80 km/hr, determine the kinetic energy of each wheel. (8 marks)
- (c) State any **two** factors which affect the power transmitted by a:

(i) Belt drive

(ii) Clutch.

(2

marks)

2. (a) (i) State the law of conservation of linear momentum.
(ii) A truck of mass 10 tonnes, travelling at 80 km/hr, collides head on with a van of mass 3 tonnes, travelling at 60 km/hr. After collision, the two vehicles move together. Determine the energy loss due to the impact. (11

marks)

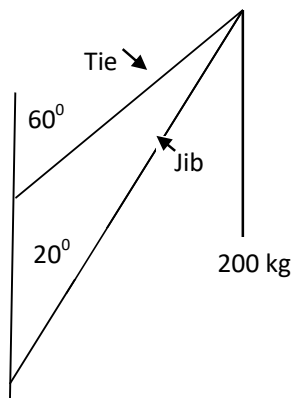
- (b) (i) List **two** factors which affect the value of gauge pressure at any point inside a fluid.
(ii) An oil tank measures 10 m x 8 m x 4 m high. The tank is filled with oil of density 880 kg/m^3 . Determine the thrust exerted on the vertical surface of the tank.
(iii) Name any **two** devices which may be used to measure the gauge pressure of a fluid flowing through a pipe. (9 marks)

3. (a) Define the following:
i. Potential energy'
ii. Kinetic energy. (5 marks)
(b) A drop hammer is allowed to fall from rest through a height of 6 m on to a forging. Find the downward velocity of the hammer when it strikes the forging. If the mass of the hammer is 500 kg what is the work done by the forging and baseplate in bringing the hammer to rest in a distance of 50mm? (10

marks)

- (c) Derive the expression for kinetic energy. (5 marks)

4. (a) A jib crane carries a load of 200 kg as shown. Use Lamis theorem to determine the forces acting in the jib and tie (7 marks)



- (b) Horizontal steel beam of uniform cross-section 4 m long rests on two Supports, one at the end of beam and the other at a distance of 1 m from the other end of the beam. The mass of the beam is 80 kg. Calculate the outward reactions at the supports.
- (13 marks)

5. (a) define the following terms

- i) Polygon of forces
- ii) Resultant of force
- iii) Equilibrium

(6 marks)

(b) The following horizontal forces act at a point:-

50N in direction due east

80N in direction due south

30N in direction 20° north of west.

Calculate the values and direction of the fourth force necessary to maintain equilibrium.

(14 marks)