TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MEDICAL ENGINEERING

DIPLOMA IN MEDICAL ENGINEERING

DME/Sept 2015/S-FT

EME 2152
MECHANICAL ENGINEERING SCIENCE

2 hrs

INSTRUCTIONS TO CANDIDATES:

- This paper consists of **FIVE** questions

- Answer question **ONE COMPULSORY** and Attempt any Other **TWO**

- This paper consists of 3 printed pages

Question1

(COMPULSARY)

(a) Four forces act at a point as follows;

    i) 1KN due E:

    ii) 4KN at 45 N of E:

    iii) 3kN due N:

    iv) 5kN 50 S of W

Determinne the magnitude and direction of the resultant force

(8 marks)

(b) A rectangular block of iron,weighing 200N, rests on a rough horizontal floor. If the coefficient of friction between the metal and the floor is 0.5, Determine the force required to drag the block a long the floor with uniform velocity when

    i) the force is applied horizontally;

    ii) the force act sat an angle of 30° upwards from the horizontal;

(12 marks)

(c) A train travels between two stations A and D, 15 km apart, in 24 minutes. The train accelerates uniformly from rest at A, then travels at constant speed for 12 minutes, finally retarding uniformly to stop at D. Determine the value of the uniform velocity in km per hour. If the time taken for the acceleration is twice the time for the deceleration, find the time taken in each case.

(10 marks)

Question2

(a)   i) Define the following terms;

      i. Polygon of forces theorem

      ii. Triangle of forces theorem

  ii) Show
$$v = \omega r$$

(6 marks)

(b)   i) A piston moves from rest to a speed of 5m/s in one twenty-fifth of a second. Determine the average acceleration and the distance travelled.

  ii) A force of 930 N acts on a pillar in a direction due N. Aforce of 300N on the same pillar acts 30o W of N. Determine the magnitude and direction of the resultant force

(14 marks)

Question3

(a) A motor car is travelling at 60 km/h when the brakes are applied and the car is brought to rest with uniform retardation in 40 m. If the outside diameter of the wheels is 50 cm Determine:

   i) the linear velocity before the brakes were applied

   ii) the corresponding angular velocity of the wheels

   iii) the linear retardation of the car, and

   iv) the corresponding angular retardation of the wheels

(12 marks)

(b)   i) A forging hammer of mass 1,300 kg falls freely from a height of 5 m on to a steel ingot. Determine the momentum of the hammer at the moment of impact. Take $g = 9.81 m/s^2$.

   ii) A ball-bearing of mass 100 g, rolling down a groove at a velocity of 500 cm/s, squarely strikes a stationary ball-bearing of mass 50g. The velocity of the first ball-bearing after impact is 200 cm/s in the direction of its motion before impact. Determine the velocity of the second ball.

(8 marks)

Question4

(a) A rectangular block of iron, weighing 200 N, rests on a rough horizontal floor. If the coefficient of friction between the metal and the floor is 0.5, Determine the force required to drag the block along the floor with uniform velocity when (i) the force is applied horizontally, and (ii) the force acts at an angle of 30° upwards from the horizontal.

(14 marks)

(b) A machine is used to raise a load of 120 N, and it is found that an effort of 24 N is required. At the same time as the load moves 3 in. the effort moves 18 in. Determine;

   i) the mechanical advantage,

   ii) the velocity ratio,

   iii) the efficiency of the machine.

(6 marks)

Question5

(a) A block of steel, of mass 500 kg, rests on a rough surface inclined at 10° to the horizontal. If the coefficient of sliding friction between the block and the surface is 0.25 find the magnitude of the force which, when applied parallel to the inclined surface, is necessary (i) to push the block up the incline, and (ii) to push the block down the incline.

(14 marks)

(b) Explain the following terms in mechanical engineering science

i) Mass
ii) Conservation of linear momentum
iii) Centrifugal force

(6 marks)