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:

- Take $g = 9.81 m/s^2$
- 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) A stone is dropped from the top of a tower 20 m high. Determine:

i) the time of fall;

ii) its velocity on striking the ground at the foot of the tower.

(8 marks)

(b) 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)

(c) 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)

Question2

(a) A force P acts on a body at an angle θ to a horizontal line OX. P, together with a pull of 1.5KN at 30^o to and below, OX, has the same effect as a force of 5KN at 45^o to, and above, OX. Determine the magnitude of P and the angle θ.

(8 marks)

(b) 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)

Question3

(a) i) 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)

(b) 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.

(12 marks)

Question4

(a) 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 $g = 9.81m/s^2$.

ii) Explain the following terms in mechanical engineering science

i. Mass

ii. Conservation of linear momentum

iii. Centrifugal force

(12 marks)

(b) A body moves in a circular path of radius 10m. In an interval of 0.5s the radius from the centre of the circle to the body sweeps out an angle of 18^o Determine the average angular velocity and the average linear speed of the body.

(8 marks)

Question5

(a) A ladder leans aganist a perfectly smooth vertical wall at an angle of 30^o to the horizontal. Aload of 800 N is placed three-quarters of the way up the ladder. If the ladder rests on a rough horizontal surface which prevents slipping, Determine the magnitude and direction of the reaction between the ladder and the ground.

(10 marks)

(b) A flywheel was uniformly accelerated from rest. After two minutes the speed was 30 rev/min. Determine the number of revolutions made by the flywheel in attaining a speed of 120 rev/min.

(10 marks)