MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

MED-PR 107: MECHANICS OF MACHINES I

DATE: **TIME:**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

1. a) Define kinematics of a particle (2 marks)

   b) A vehicle moves in a straight line such that for a short time its velocity is defined by $V = (3t3+2t^2)$ m/s. Where t is in seconds. Determine its position and acceleration when t = 3 seconds, t = 0 when s = 0 (16 marks)

   c) i) Derive an expression from first principles for the relationship between linear impulse and momentum of a body. (7 marks)

   ii) A machine gun of mass 25 kg fires a bullet of mass 30 gram with a velocity of 250 m/s .Find the velocity which the machine gun will recoil. (5 marks)

2. a) Define the following quantities

   i. Momentum

   ii. Impulse (2 marks)

   b) A 4mg truck "A" travelling at 18m/s runs into the back of another 6mg lorry "B" travelling at 7m/s in the same direction. Find the momentum of each vehicle before impact assuming the vehicles remain locked together. (18 marks)

3. a) Derive from the first principles expression for centripetal acceleration of a particle moving with uniform angular velocity

$$a = w^2r \quad \text{or} \quad v^2/r$$ (10 marks)

b) A centrifugal clutch is designed just to engage when the centre's of gravity of the rotating weights are 200 mm from centre's of rotation. The speed at engagement is 1440 rev/min. If the revolving masses are each 0.5 Kg. Calculate the spring stiffness required for an extension of 20 mm when the masses move from the rest to the engaged position. (10 marks)

4. a) An 18 tonne truck has a maximum of 36km/h on a truck for which resistance to motion is 250N/t. The engine exerts a pull of 6 kN. What is the momentum at maximum speed? Find the time taken to reach full speed from rest. (10 marks)

b) Using theorem of parallel axes show that

$I_0 = I_G + mh^2$

Where, I_o = moment of inertia about O

I_G = moment of inertia of a body about an axis through the centre of mass G

h = distance between O and G (10 marks)

5. a) A ball bearing is dropped on a rigid hard surface from height, h. It rebounds to height, h1. Find the co-efficient of restitution if, h= 800mm and h1 = 650mm (7 marks)

b) The two buffers at one end of a truck each require a force of 0.7 MN/m of compression and engage with similar buffers on the truck which it overtakes on a straight horizontal track. The truck has a mass of 10 tonnes and its initial speed is 1.8 m/s, while the second truck has a mass of 15 tonnes with initial speed 0.6 m/s, in the same direction.

i. Find the common speed when moving together during impact

ii. The kinetic energy then lost to the system and the compression of each buffer spring to store this

iii. The velocity of each truck on separation if only half of the energy store in the springs is returned. (13 marks)