TECHNICAL UNIVERSITY OF MOMBASA

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

SPECIAL/SUPPLEMENTARY UNIVERSITY EXAMINATIONS 2015/2016

SECOND YEAR SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION
FOR THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
(BSME)

EMG 2207: ENGINEERING MECHANICS II (DYNAMICS)

SERIES: AUGUST 2016

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES:

1. You should have the following for this examination:-
   - Answer Booklet
   - Scientific Calculator
2. This paper consists of FIVE Questions
3. Question ONE is COMPULSORY
4. Attempt any other TWO Questions
5. Question ONE carries 30 Marks and the other FOUR questions carry 20 Marks each
6. All symbols have their usual meaning unless specified otherwise

QUESTION ONE: (COMPULSORY: 30 Marks)

a) A particle moves along a straight line with acceleration a=5t-30, where a is in m/s^2 and t is in seconds. At t=0, the position of particle is -6m and it has a velocity of 4m/s. Determine:

i) The expression for velocity and position in terms of t;

ii) The times at which the velocity is zero and their corresponding positions from the origin; and

iii) The maximum velocity.   (11 Marks)

b) The elevator in a mine vertical shaft weighs 18kN and requires 30 seconds to descend 100 m from rest until it stops at the bottom. The velocity of the elevator is 5 m/s except during starting and stopping periods. If the tension in the cable supporting the elevator is 13.5 kN during start, what is its value during stop, assuming constant deceleration?   (14 Marks)

c) A block of weight 10 N has an initial velocity of 10 m/s down an inclined plane making an angle of 30° with horizontal. If the coefficient of friction between the plane and the block is 0.3, what is the velocity of the block after moving a distance 70m? Use work-energy principle. (5 Marks)

QUESTION TWO: (20 Marks)

a) An automobile with a rear wheel drive has a wheel base (b) of 3m and weight (w) 60kN. The center of gravity is 1m above the pavement (h) and 1.2m ahead of rear wheel (l). The coefficient of friction between the wheel and pavement is 0.6. Determine the maximum acceleration the automobile could have when moving along a level road and the force exerted by the rear wheel on the pavement (reaction R_r).

If it is changed to a front wheel drive, find the acceleration and hence, state which is more efficient.

What is the possible acceleration on a four wheel drive? (10 Marks)

b) A truck has a wheel base of 4.4m and weighs 68kN, 75% being on the rear axle. Its center of gravity is 1m above the ground and is brought to rest from a speed of 60 km/h. If it is provided with four-wheel brakes and the coefficient of friction between the tyres and the road is 0.6, at what distance it will come to rest and the time elapsed?

What is the braking effort at each wheel, assuming equal brake torques? Determine the reactions on the front and rear wheels and the weight shift due to braking. (10 Marks)

QUESTION THREE: (20 Marks)

a) If an aeroplane travels a distance of 6000 km at a constant speed in 12 hours, calculate:

i) Its speed in m/s; (2 Marks)

ii) The number of kilometers travelled in 20 minutes, and; (2 marks)

iii) The time taken to travel 100 km. (2 Marks)

b) A cricket ball is thrown vertically upwards at a velocity of 20 m/s. Calculate:

i) The time taken to reach maximum height; and (2 Marks)

ii) The maximum height attained. (2 Marks)

Assume g=9.81 m/s^2 and the air resistance to be negligible.

c) A diesel engine pulling a train along a level track has its oil supply cut off when the train is travelling at 60 km/h. It is observed that the speed falls to 40 km/h after the train has travelled a distance of 1200 m. The mass of the engine and carriage is 80 Mg. Assuming the retardation to be uniform, calculate the total force resisting motion.

(4 Marks)

d) A lift has an upward acceleration of 0.981 m/s². What pressure will a man weighing 660 N exert on the floor of the lift? (2 Marks)

What pressure would he exert if the lift has an acceleration of 0.981 m/s² downwards?

(2 Marks)

What upward acceleration would be required to cause the man to exert a pressure of 750 N on the floor? (2 Marks)

QUESTION FOUR: (20 Marks)

a) In a circus, a motor cyclist moves inside a spherical cage of radius 3m. The motor cycle and the man together weigh is 7.3 kN. Find the minimum velocity the motor cyclist should maintain at the highest point of the cage to be in contact with the cage?

(5 Marks)

b) A pilot weighing 800 N flies a small plane in a vertical loop of 100m radius. The pilot experiences weightlessness at the highest elevation and an apparent weight of 2700 N at the lowest elevation. Find the speed of flight at the two elevations. (5 Marks)

c) A horizontal drum of 1m diameter of a belt drive carries the belt over the upper half circumference. It transmits a power of 10 kW at 200 rpm clockwise. If the coefficient of friction between the belt and the rope is 0.25, calculate the tensions on the two sides of the belt. If the weight of the drum is 300 N, determine the reactions on the bearing. Assume the belt of negligible weight. (7 Marks)

d) Find the kinetic energy stored in a flywheel of a rolling engine if it is rotating at 100 rpm. The mass of the wheel is 25 tons and radius of gyration 3m. (3 Marks)

QUESTION FIVE: (20 Marks)

a) An electric motor has to lift a body having a mass of 50 kg by means of a rope wound round a drum having a diameter of 1.2m. Calculate:

i) The torque to be exerted, and

ii) The work done when the drum makes 30 revolutions. (5 Marks)

b) A pulley is 800 mm in diameter and the difference in tension on the two sides of the driving belt is 2000 N. If the speed of the pulley is 300 rev/min, what is the work done in 5 minutes?   (5 Marks)

c) A stone released from an elevator moving up at a speed of 5 m/s, reaches the bottom of the shaft in 3 seconds.

i) How high was the elevator when the stone was released?

ii) With what speed does the stone reach the bottom of the shaft?   (6 Marks)

d) A bomb dropped from an aeroplane rising vertically with uniform velocity reaches the ground in 7 seconds. What is the height of the plane when the bomb reaches the ground?   (4 Marks)