TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2207: ENGINEERING MECHANICS II

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MARCH 2014

TIME: 2 HOURS

INSTRUCTIONS:

- This paper consists of **FIVE** questions.
- Answer any **THREE** questions. All questions carry **EQUA**L marks.
- All symbols have their usual meaning unless specified otherwise. Use clear and neat sketches.

This paper consists of Two printed pages

QUESTION 1

a) A particle moves along a straight line with acceleration $a = 10t - 20$, where a is in m/s^2 and t is in seconds. At $t = 0$, the position of the particle is -5m and it has a velocity of 7m/s. determine:
   i) The expressions for velocity and positions in terms of t
   ii) The times at which the velocity is zero and their corresponding positions from the origin
   iii) The maximum velocity. **(9 marks)**

b) The cheetah can run as fast as 75kmph. If you assume that the animal's acceleration is constant and that it reaches top speed in 4 seconds, what distance can it cover in 10 seconds? **(5 marks)**

c) The greatest ocean depth yet discovered is in the Marianas Trench in the Western Pacific ocean. A steal ball released at the surface requires 64 minutes to reach the bottom. The ball's downward

acceleration is a = 0.9g-CV, where g is the acceleration due to gravity at sea level and the constant C = 3.02s^{-1}. What is the depth of the Marianas Trench in kilometers. **(6 marks)**

QUESTION 2

a) A gas turbine starts rotating from rest at $t = 0$ and has angular acceleration $\alpha = 6t \ \ rad/s^2$ for 3 seconds. It hen slows down with constant angular deceleration $\alpha = -3 rad/s^2$ until it stops:
   i) What maximum angular velocity does it attain? **(3 marks)**
   ii) Through what total angle does it turn? **(3 marks)**

b) The rotor of an electric generator is rotating at 200rpm (revolutions per minute) when the motor is turned off. Due to frictional effects, the angular deceleration of the rotor after it is turned off is $\alpha = -0.01\omega \ \ rad/s^2$, where ω is the angular velocity rad/s. how many revolutions does the rotor turn after the motor is turned off? **(7 marks)**

c) The pressure on a horizontal shaft bearing is 50kN. The shaft of diameter 160mm rotates at 50rpm. If the coefficient of friction at the bearing is 0.05, what power is lost in overcoming friction? **(6 marks)**

QUESTION 3

a) A uniform ladder of length 20m rests against a vertical wall making an angle of 45^0. The coefficient of friction between the ladder and the wall is $1/3$ and that between ladder and ground is ½ . if a man whose weight is one half of that of the ladder, ascends the ladder how high he will be when the ladder slips. **(7 marks)**

b) A bomb dropped from an aeroplane rising vertically with uniform velocity reaches the ground in 5 seconds. What is the height of the place when the bomb reaches the ground. **(6 marks)**

QUESTION 4

a) Two blocks A of mass 116kg and B of mass 8kg are connected by a light rope which passes around a pair of frictionless pulleys of negligible mass as shown in figure 4 (a) . Block A is acted upon by a 200N force. The coefficient of kinetic friction between block A and the horizontal surface is 0.4. if the system is released from rest, determine the velocity of the two blocks when block A has moved 3m to the left. Use the method of work-energy principle. **(9 marks)**

b) State the parallel axis theorem. Illustrate your answer with a neat sketch. **(3 marks)**

c) Determine the moment of inertia and the radius of gyration of the shaded area as shown in Figure Q 4 (c) with respect to x-axis. **(8 marks)**

QUESTION 5

a) A shot putter toses a shot upwards at 40 degrees to the horizontal from a height of 1.8m above the ground as shown in Figure .5 (a). if the shot lands 15m away, determine:

i) The initial speed of the shot

ii) The maximum height attained by the shot

iii) The distance from the shot putter to the position where maximum height occurs.

iv) The final velocity of the shot just before hitting the ground. **(11 marks)**

b) A soldier fires a bullet at a velocity of 80m/s at an angle of 30 degrees upwards to strike a target 50m lower than his position, as shown in figure Q.5 (b), calculate:

i) The maximum height to which the bullet will rise, the horizontal range and the times elapsed,

ii) The times elapsed to hit the target and its horizontal distance

iii) The velocity with which it will hit the target and it direction. **(9 marks)**