TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION 2013/2014

SECOND YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2207 : ENGINEERING MECHANICS II (DYNAMICS)

TIME: 2 HOURS **SERIES:** DECEMBER, 2013

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
   - Answer Booklet
   - Scientific Calculator

2. This paper has **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. All symbols have their usual meaning unless specified otherwise.
6. Use clear and neat sketches.
7. This paper consists of **FOUR** ***Printed pages.***

Q.1 (a) A shot putter tosses a shot upwards at 40 degrees to the horizontal from a height of 1.8m above the ground as shown in Figure Q.1(a). If the shot lands 15m way, 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) Two blocks A of mass 16kg 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 Q.1(b). 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)**

Q.2 (b) A bullet of mass 30g is fired into a body of mass 10kg which is suspended by a string 0.8m long. Due to this impact, the body swings through an angle of 30 degrees. Find the velocity of the bullet just before impact. **(6 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.2(c) w.r.t. x-axis. **(6 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.2(d). Calculate the time elapsed to hit the target and its horizontal distance. **(5 marks)**

Q.3 (a) An automobile with a rear wheel drive has a wheel base (b) of 3m and weight (w) 60kN. The c.o.g is 1m above the pavement (h) and 1.2m ahead of rear wheel (l). The coefficient of friction μ 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 c.o.g. is 1m above the ground and is brought to rest from a speed of 60kmph. 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)**

Q.4 (a) A radar equipped police car notes a burglar's car travelling at 110kmph. The police car starts pursuit 30 sec after the observation and accelerates to 160kmph in 20 sec. Assuming the speeds are maintained on a straight road how far from the observation post will the chase end, and after what time?

(b) A train weighing 4000KN reaches a speed of 30kmph in 20sec after starting from rest. What is the force exerted by the engine.

(5 marks)

(c) A stone is dropped into water and the splash is heard after 3 seconds. Find the depth of the water, if the velocity of sound is 350m/s. **(7 marks)**

Q.5 (a) Two blocks weighing 400kN and 500kN are hug at the two ends of an inelastic light string passing over a smooth pulley of 400mm diameter. Determine:

(i) Acceleration of the blocks and pulley
(ii) The tension in the string

If at the end of 5 sec the string breaks, how much higher the 400kN block will go?

(10 marks)

(b) Two blocks A and B weighing 100KN and 300kN, respectively are connected by a light inextensible string passing over a light frictionless pulley as shown in Figure Q5(b). Assuming the coefficient of friction under block A as 0.2, determine the acceleration of the blocks and tension in the string. **(10 marks)**