TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION) (DMPL III)
DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOTIVE OPTION) (DAE III)

EME 2202
MECHANICS OF MACHINES I

END OF SEMESTER EXAMINATIONS

YEAR 2 SEMESTER 1

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
   - Answer Booklet
   - Scientific Calculator
   - Drawing Instruments

2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. Maximum marks for each part of question are as indicated.
5. **This paper consists of THREE printed pages.**

Question ONE

(a) Determine the centroidal moment of inertia I_x and I_y for the L-shaped section in Figure 1.

(13 marks)

(b) Get the radius of gyration with respect to the X axis through the centroid of Figure 2 of the T-Section. **(7 marks)**

Question TWO

(a) For a particle moving in a circular part; define the following terms:

(i) Tangential acceleration
(ii) Radial acceleration

(2 marks)

(b) A horizontal bar 1.5m long and of small cross-section rotates about the vertical axis through one end. It accelerates uniformly from 1200 r.p.m. to 1800r.p.m. in an interval of 5 seconds. Determine:

(i) The initial and final linear velocity at start and end of interval.
(ii) The normal acceleration at mid-point after 5S.
(iii) The tangential acceleration at mid-point of bar after 5s.

(6 marks)

(c) A motor running at 2600rev/min is suddenly switched off and decelerates uniformly to rest after 10s. Determine:

(i) The angular deceleration
(ii) Number of rotations made before coming to rest

(7 marks)

(d) A train passes station A with velocity of 80km/hr and acceleration $3m/s^2$. After 30s it passes a signal which instructs the driver to slow down to a halt. The train then decelerates at $2.4m/s^2$ until it stops. Determine:

(i) The total time taken from station A to the end of motion
(ii) The total distance covered in (i).

(7 marks)

Question THREE

(a) A mass of 300kg is allowed to fall vertically through 1m on to the top of a pile of mass 500kg. Assume that the falling mass and pile remain in contact after impact and that the pile is moved 150mm at each blow. Determine:

(i) The energy lost in the blow
(ii) Their common velocity after impact
(iii) The average resistance against the pile

(15 marks)

(b) A telecommunications satellite has a moment of inertia of $82kgm^2$ when it is its final configuration with its solar panels extended. It is required to rotate at a rate of 0.5reve/s in this configuration. When the satellite is still in the cargo bay of a shuttle vehicle and the panels are still folded away, it has a moment of inertia of $6.8kgm^2$. Determine the rotational speed that it should be accelerated to before being released and unfolded.

(5 marks)

Question FOUR

A flywheel is constructed as shown in Figure 3. By considering it as a number of discs, both real and imaginary determine:

(i) Its moment of inertia
(ii) The time it will take to reach a speed of 4800rpm if the torque to give a uniform acceleration is 1300Nm. Take density of material as $8200kg/m^3$

(20 marks)

Question FIVE

(a) From first principles shown that angular momentum is given by:
Angular momentum = I_ω **(7 marks)**

(b) A haulage rope winds on a drum of radius 500mm, the free end being attached to a truck. The truck has a mass of 600kg and is initially at rest. The drum is equivalent to a mass of 1260kg with a radius of gyration 460mm. The rim speed of the drum is 0.75m/s before the rope tightens. By considering the change in linear momentum of the truck and the angular momentum of the drum, determine:

(i) The speed of the truck when the motion becomes steady.
(ii) The energy lost to the system.

(13 marks)