TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

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

EME 2312
MECHANICS OF MACHINES IV

END OF SEMESTER EXAMINATIONS

YEAR 3 SEMESTER 2

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

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

2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. **This paper consists of THREE printed pages.**

Question ONE

A modern tour vehicle has a mass of 1.8 t when unloaded and carries two persons each of mass 70kg together with 200kg of luggage. The maximum output torque from the engine is 200Nm, while the effective windage and rolling resistance at a speed of 100km/h is 620N. In third gear, the ratio of engine speed to back axle speed is 6.43:1 while the effective radius of the road wheels is 350mm. The total moment of inertia of the rotating parts of the engine and the wheels is equivalent to a flywheel of moment of inertia 25kgm^2 at the road wheels. Determine:

(a) The time taken for the vehicle to accelerate from 80km/h to 110km/h at full output torque, on the assumption that the windage and rolling resistance may be assumed constant over this range and that transmission losses may be neglected.

(b) The maximum gradient that this vehicle can climb in this gear, at a steady speed of 100km/h.

(20 marks)

Question TWO

A shaft is supported in two bearings 2.4m apart and projects 0.6m beyond the bearings at each end. The shaft carries three pulleys, one at the middle of its length and the others at each end. The end pulleys have masses of 90kg and 50kg and their centre of mass are at 3.75mm and 5mm respectively from the shaft axis. The centre pulley has a mass of 70kg and its centre of mass is 6.25mm from the shaft axis. If the pulleys are arranged so as to give static balance, determine the dynamics forces produced on the bearings when the shaft rotates at 300rpm. **(20 marks)**

(10 marks)

Question THREE

A shaft 1.3m long carries three unbalanced wheels, A, B and C, spaced at 0, 0.7 and 1.3m from one end respectively. The masses are 8, 10 and 6kg and the eccentricities of the centres of mass are 60, 50 and 40mm respectively. The directions of the eccentricities of B and C relative to A are 60^o and 270^o respectively. The shaft is supported in bearings at X and Y which are 0.2m and 1m from A. Determine:

(a) The forces on the bearings, in magnitude and direction, when the shat rotates at 90 rev/min.

(b) The mass and its angular position that is to be bolted to the wheel C at a radius of 100mm to make the forces on the bearings equal and opposite.

(20 marks)

Question FOUR

A motor vehicle of mass 1.8t travels on a road at a steady speed of 150km/hr. With its engine developing 75kw. Under these conditions, the engine speed is 4200rpm with a direct drive through the gearbox and transmission efficiency of 96%.

The resistance to the motion of the vehicle is given by a relationship of the form $A + 0.284V^{1.86}N$, where V is the speed in km/hr of the vehicle and A is a constant.
If now the vehicle is travelling in second gear up an incline of gradient 1 in 10.5 at a speed of 75km/hr, determine the engine speed and power for a gear ratio of 3.27 at this gear for a transmission efficiency of 91.5%.

(20 marks)

Question FIVE

A car is driven by the rear wheels and when it is stationary, 0.55 of its weight is supported on the rear wheels. The height of the centre of gravity above the road is one-fifth of the wheel base. In a test on a level road it was found that the greatest acceleration obtainable without skidding was $3m/s^2$. Calculate:

(a) The coefficient of friction between the tyres and road
(b) The steepest gradient which the vehicle could climb

(20 marks)