MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

MED – PR 205: MECHANICS OF MACHINES II

DATE: 6/6/2017 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS

-Section A is compulsory

-Attempt any TWO other questions from section B

SECTION A (COMPULSORY)

QUESTION ONE

a) A vehicle of mass 1500kg reaches a speed of 50km/h from rest in a distance of 60m up the 10% incline with constant acceleration. The centre of mass of the vehicle is 600mm above the track and is equidistant between the wheel base of 3000mm.If the coefficient of friction between the wheels and the road is 0.8, calculate the;

i. Tractive effort under the rear driving wheels.

ii. Normal force under each pair of wheels. (10 marks)

b) Four masses A, B, C and D are rigidly attached to a shaft which rotates at 8rev/s. The masses are all in the same plane. The masses and radii of rotation, together with their relative angular positions measured in the anticlockwise direction are;

A= 1kg, 1.2m, 0^o B = 2kg, 0.6m, 30^o C= 3kg, 0.3m, 120^o D= 4kg, 0.15m, 165^o

i. Find the resultant out-of-balance force on the shaft

ii. Determine the magnitude and position of the balance mass required at 0.6m radius (10 marks)

c) A uniform cylinder of radius 40mm is released from rest on an incline of 30^o .Find the acceleration of the centre if the coefficient of friction is 0.3. (10 marks)

SECTION B

QUESTION TWO

A motor vehicle of mass 1620kg and 640mm road wheels effective diameter runs at a uniform speed. The engine develops a maximum torque of 265Nm and the transmission efficiency is 86%.The total moment of inertia of the wheels and axle is 9.9kgm² and that of the engine and flywheel is 0.86kgm².Calculate the value of the gear ratio that will give maximum acceleration up a slope of 1in8, with a road resistance of 290N, under maximum torque conditions. (20 marks)

QUESTION THREE (20 MARKS)

An electric motor drives a winding drum of mean diameter 1.8m and moment of inertia of 110kgm^2 via a speed reduction gear drive of ratio 40:1.A cable runs round the drum, carrying a load of 5.5 tonnes on one end and a balancing mass of 3.5tonnes on the other end. If the moment of inertia of the motor shaft is 6kgm^2 and the transmission efficiency is 94%. At an instant when the upward velocity and acceleration of the load is 2.5m/s and 4.2m/s^2 respectively, determine;

a) The power generated by the motor. (17 marks)

b) The total kinetic energy of the system. (3 marks)

QUESTION FOUR (20 MARKS)

a) i. State **TWO** conditions necessary for complete dynamic balance for a shaft carrying several masses

ii. State any **FOUR** effects of unbalanced forces in a machine having Several rotating parts. (4 marks)

b) Four masses A, B, C and D are carried on a shaft with their centres of mass 150mm, 200mm, 70mm and 60mm respectively from the axis of rotation. The masses are such that A = 9Kg, B = 18Kg, C = 21Kg and D =14Kg.The distance of planes of rotation measured from mass A are B =3m, C =5m and D =7m respectively. The angular position of B, C and D measured anticlockwise from A are 75^0, 160^0 and 240^0 respectively. Two balance masses are fitted as follows: One mid-way between A and B, whose centre of mass from the shaft axis is 110mm, and the other is fitted mid-way between C and D whose centre of mass from the shaft axis is 90mm.Determine the value of the balance masses and their angular positions With respect to mass A and show the positions of masses on an end view. (16 marks)

QUESTION FIVE (20 MARKS)

A solid ball of radius r, having an angular velocity ω and no translational velocity is placed on a rough inclined plane of angle θ to the horizontal and released so that it moves up the plane. The axis of rotation is parallel to the plane and the coefficient of friction is μ;

a) i Describe the initial motion of the ball;

ii Show that the distance S, through which the ball subsequently rolls without slipping up the plane is given by:

$$S = \frac{14\,\omega^2 r^2}{5g\sin\theta}\left[\frac{\mu\cos\theta - \sin\theta}{7\mu\cos\theta - 2\sin\theta}\right]^2$$

(17 marks)

b) If the ball in (a) is 200mm diameter and rotates at 360rev/min before released on a plane inclined at 26^0 to the horizontal, determine the distance it rolls up the plane without slipping if $\mu = 0.2$ (3 marks)