MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

SUPPLEMENTARY EXAMINATION

MED – PR 205: MECHANICS OF MACHINES II

DATE: 3/8/2016 **TIME: 2.00-4.00 PM**

INSTRUCTIONS:

-Section A is compulsory

-Attempt any **TWO** other questions from section B

SECTION A (COMPULSORY) - 30 MARKS

1 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) 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;

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

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

SECTION B

2 a) Three 15kg rotating masses at radii 125mm set at 120^o to each other attached to a shaft. The masses are equally spaced along the shaft with a pitch of 250mm. The shaft is supported on two bearings symmetrically arranged with respect to the masses and is 850mm apart.

Determine the dynamical loads on the bearings for a speed of 500rev/min. (11 marks)

b) The shaft is to be balanced by means of a mass at a radius of 187.5mm in the plane of mass 1 and another mass at a radius of 250mm attached to a flywheel situated 225mm beyond the bearing adjacent to mass 3.Determine the magnitude of these balance masses and their angular positions relative to mass 1. (9 marks)

3 A self propelled truck of total mass 25 tonnes and a wheel diameter 750mm, runs on a track for which the resistance is 180N/t. The engine develops 60KW at its maximum speed of 2400rpm and drives the axle through a gear box. Determine;

(a) The time to reach full speed from rest on the level track. If the gear reduction ratio is 10:1, assuming the engine torque to be constant and a gearing efficiency of 94%. (13 marks)

(b) The gear ratio required to give an acceleration of 0.15m/s on an up gradient of 1 in70, assuming a gearing efficiency of 90%. (7 marks)

4 In an epicyclic gear train, the output shaft is connected to the Annulus which has 72 internal teeth and the input shaft is keyed to the sun wheel which has 32 external teeth.

The planet messes with both the sun and the annulus, and is carried on an arm which rotates about the centre of the annulus at 18 rev/min.If 1.85KW is supplied to the sun rotating at 58.5rev/min clockwise,determine:

(a) The speed of the planet and the annulus (14 marks)

(b) The fixing torque required on the annulus assuming 80% efficiency (6 marks)

(c)

5 Show that for a solid homogeneous cylinder of radius r, resting on a plane whose angle of inclination Θ, may be varied. The coefficient of friction μ, between the cylinder and the plane is 0.2.For the cylinder to just slip before rolling when first released:

(a) Show that:

$$\tan \Theta = \mu \left\{ r^2 + \frac{k^2}{k^2} \right\}$$

Where k = radius of gyration. (13marks)

and hence determine the:

(b) Value of Θ for the condition; (3 marks)

(c) Acceleration of the cylinder under the same conditions (4 marks)