MACHAKOS UNIVERSITY

University Examinations 2017/2018

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:20/12/2017 **TIME:8:30 – 10:30 AM**

INSTRUCTIONS

This paper consists of *FIVE* questions

Answer question *ONE* (compulsory) and any other *TWO* questions

QUESTION ONE

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. (3 marks)

b) A 10t truck is driven at a steady speed of 40km/h on a level road, against a tractive resistance of 200N/t. The wheels are 1.2m in diameter, the engine runs at 1800rev/min, and the transmission efficiency is 0.85. Calculate the;

i. Engine power

ii. Gear ratio in use.

With the throttle valve fully open and the engine giving three times this power, at the same speed up a 10^0 slope, estimate the;

i. Gear ratio required

ii. Maximum truck speed (17 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 0.15. (10 marks)

QUESTION TWO

A square block lies on a flat floor of a truck. The mass centre lies 0.6m above the track and 0.4 from the left hand edge;

a) Determine the maximum speed at which the truck may travel round a right hand curve of radius 50m banked inwards at an angle of 10^o without the block slipping if the coefficient of friction between the truck floor and block is 0.6. (13 marks)

b) If the block is prevented by a stop from slipping, calculate the maximum truck speed such that the block does not tip outwards when travelling round the same track. (7 marks)

QUESTION THREE

A wagon of mass 14 tonnes is hauled up an incline of 1 in 20 by a rope which is parallel to the incline and is being wound round a 1m diameter drum. The drum is in turn driven through a 40: 1 reduction gear by an electric motor. The frictional resistance to the movement of the wagon is 1.2KN with a gearing efficiency of 85% and the bearing friction at the drum and motor shafts may be neglected. The rotating parts of the drum have a mass of 1.25tonnes, with radius of gyration of 450mm and the rotating parts of the armature shaft have a mass of 110kg with radius of gyration of 125mm.At an instant when the wagon is moving up the slope at 1.8m/s and accelerating at $0.1m/s^2$, determine;

a) The power developed. (13 marks)

b) The kinetic energy of the system. (7 marks)

QUESTION FOUR

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 are 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)

QUESTION FIVE

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)