MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING

MED – PR 205: MECHANICS OF MACHINES II

DATE: 26/7/2019 **TIME: 8.30-10.30 AM**

INSTRUCTIONS:

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 self-propelled truck of total mass 25 tones 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 the;

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

QUESTION THREE

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

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)