



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 (PLANT OPTION)

SET: 2501/311 MECHANICS OF MACHINES

DATE: 4/8/2016

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

Attempt any **THREE** 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. (4 marks)
- (b) Four masses A, B, C and D are carried on a shaft with their centers of mass 150mm, 200mm, 70mm and 60mm respectively from the axis of rotation. The masses are such that $A = 9\text{Kg}$, $B = 18\text{Kg}$, $C = 21\text{Kg}$ and $D = 14\text{Kg}$. The distance of planes of rotation measured from mass A are $B = 3\text{m}$, $C = 5\text{m}$ and $D = 7\text{m}$ respectively. The angular position of B, C and D measured anticlockwise from A are 75° , 160° and 240° 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. Show the position of masses on an end views. (16 marks)

QUESTION TWO

A shaft carries four masses A, B, C and D in this order along its length. The masses at B and C are 18kg and 12.5kg respectively, and each has an eccentricity of 60mm and A and D 80mm. The angle between the masses B and C is 100° and that between B and A is 190° , both are being measured in the anticlockwise direction. The axial distance between A and B is 100mm and that between B and C is 200mm. If the shaft is in complete dynamic balance, determine;

- a) The magnitude of the masses at A and D. (17 marks)
- b) The distance between planes A and D. (2 marks)
- c) The angular position of the mass at D. (1 mark)

QUESTION THREE

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 9.9kgm^2 and that of the engine and flywheel is 0.86kgm^2 . Calculate the value of the gear ratio that will give maximum acceleration up a slope of 1 in 8, with a road resistance of 290N, under maximum torque conditions. (20 marks)

QUESTION FOUR

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 1.25 tonnes, 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. (14 marks)
- (b) The total kinetic energy of the system. (6 marks)