MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SPECIAL/SUPPLIMENTARY EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING

MED – PR 205: MECHANICS OF MACHINES II

DATE: 19/01/2021 **TIME: 8.30-10.30 AM**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE

a) 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)

b) A 10 tonne truck is driven at a steady speed of 40Km/h on a level road against a tractive resistance of 200N/tonne. The wheels are 1.2m in diameter, the engine runs at 1800rev/min and the transmission efficiency is 0.85.Calculate the engine power and the gear ratio in use. (10 marks)

c) A metal block 300kg is lifted by means of a rope which is wound several times round a drum and which then supports a balance mass of 210kg.As the block raises, the balance mass falls. The drum has a diameter of 2.2m, a radius of gyration of 830mm and its mass is 140kg.The frictional resistance to the movement of the block is 310N and that to the movement of the balance mass is 290N.The frictional torque on drum shaft is 180Nm.At an instant when the block has an upward velocity of 3.5m/s and an acceleration of $2.2m/s^2$, calculate the power required. (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. (14 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. (6 marks)

QUESTION THREE

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 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 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 1.25tonnes, 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. (14 marks)

b) The total kinetic energy of the system. (6 marks)

QUESTION FIVE

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)