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MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: **ECC 104**

COURSE TITLE: **APPLIED MECHANICS**

DATE: 27/04/2022 **TIME:** 15:00 -17:00

INSTRUCTIONS TO CANDIDATES
This paper contains **FOUR** Questions
Answer **question ONE (1)** and any **OTHER TWO** questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

1. (a) (i) Differentiate between the following terms: (i) Kinetics (ii) kinematics (4 marks)
(ii) Explain where friction is NOT desired in engineering applications (2 marks)

(iii) Give two advantages of flat belt compared to other power drives (2 marks

(b) (i) (a) Give examples application of hoists in domestic or industrial (2 marks)
(ii) Explain what causes "overhauling or reversing of a Screw Jack" (2 marks)

(c) A block of weight 100 N is kept in position on a plane inclined at 30° to the horizontal by a horizontal force P. The coefficient of friction of the surface of the inclined plane is 0.25, determine the minimum magnitude of the force P (8 marks)

(d) A screw Jack with V-threads with an included angle of 30° is used to lift a load of 1000 N. The screw has 100 threads per metre. If the coefficient of friction is 0.6 and the mean diameter is 60 mm, determine; (i) the torque required at the thread (ii) the effort required at the end of a lever used to turn the nut, with effective length of 35cm. (10 marks)

2. (a) A vehicle has a wheel base of 2.8 m with a center of gravity 0.86 m above the ground and 1.2 m behind the front axle. The coefficient of friction between the tyre and the ground is 0.4. Calculate; (i) The maximum acceleration when vehicle is driven on **front** wheel only

(ii) The maximum deceleration when brakes are applied to all the **four** wheels (10 marks)

(b) A mass of 500 kg falling 400 mm is used to drive a pile of mass 300 kg into the ground. Assuming there is no rebound; find the common velocity of the mass and pile at the end of the blow and the loss of kinetic energy. Calculate the average resistance if the pile and the mass penetrate the ground up to 80 mm (10 marks)

3. (a) (i) State Newton's second Law of motion (2 marks)
(ii) A flywheel together with its shaft has a total mass of 250 kg and its radius of gyration is 800 mm. If the effect of bearing friction is equivalent to a couple of 100 Nm, calculate the braking torque required to bring the flywheel to rest from a speed of 700 rev/min in 10 seconds (6 marks)

(b) A motor-cycle engine gives a torque of 24 Nm at 200 rev/min. The moment of inertia of each road wheel is 1.2 kg m^2 and that of the engine parts is 0.1 kg m^2. The effective diameter of the rear wheel is 620mm and the total mass of the machine and rider is 180kg. If the speed reduction between engine and rear wheel is 9:1 and the combined effect of rolling resistance and windage is assumed to be 200N, find the road speed and acceleration of the motor-cycle at the above engine speed (12 marks)

4. (a) (i) State two main reasons for using idler pulley in a belt drive (2 marks)

(ii) The tight side tension in a flat belt drive is 1800 N. The coefficient of friction between the belt and the pulley is 0.25 and the angle of lap of the smaller pulley is 145°. The smaller pulley has a radius of 200 mm and rotates at 400 rev/min. Find: - (i) the slack side tension and (ii) Power transmitted by the belt. (Ignore centrifugal effects) (8 marks)

(b) A ball is tossed upwards with a velocity of 10 m/s from a window located 20 m above the ground. Determine (i) the highest elevation reached by the ball above the ground (ii) the time taken to reach that elevation (iii) the velocity of the ball just as it hits the ground (iii) the corresponding time taken during free fall (iii) the total time taken by the ball (10 marks)