(University of Choice)

# MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

## MAIN CAMPUS

## UNIVERSITY EXAMINATIONS
## SECOND YEAR 2021/2022 ACADEMIC YEAR

## SUPPLEMENTARY/SPECIAL EXAMINATIONS

## FOR THE DEGREE

## OF

## BACHELOR OF TECHNOLOGY EDUCATION

## (MECHANICAL)

**COURSE CODE:** TEM 441

**COURSE TITLE:** MECHANICS OF MACHINES I

**DATE:** 4/10/2022 **TIME:** 12.00 PM - 2.00 PM

*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) Explain two situations where friction is applied in engineering practice(2 marks)

   (ii) State three advantages of belt drive over direct drive (3 marks)

   (b) (i) Explain three situations where hoists are applied in everyday life (3 marks)

   (ii) What is a screw jack?. Explain the principle on which it works (4 marks)

   (c) A screw jack has a thread with a pitch of 5 mm and diameter 25 mm. The coefficient of friction is 0.25. Calculate the efficiency when a load is raised, and the effort needed to raise a load of 6 kN with a handle 500 mm long. (8 marks)

   (d) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 r.p.m. The coefficient of friction between the belt and pulley is 0·25, angle of lap 160° and the maximum tension in the belt is 2·5 kN. (10 marks)

2. (a) A mass of 600 kg falling 0.3 m is used to drive a pile of mass 400 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. (8 marks)

   (b) The engine of a car rotates at 12 times the speed of the road wheels, which are 660mm in diameter. The mass of the car is 900kg. The engine flywheel mass is 10kg and its radius of gyration is 125mm. The resistance to motion of the car is 270N. Calculate the engine torque and power required to accelerate the car at 0.6m/s2 when traveling on a level road at 6m/s. efficiency of power transmission may be taken as 85% and the inertia of the rotating parts may be neglected. (12 marks)

3. (a) A motor vehicle has a wheel base of 2.8 m and its center of gravity is 0.6 m above ground-level and is equidistant from the axles. The coefficient of friction between tyres and the road is 0.6. Determine: -

   (i) the maximum acceleration of the vehicle if the wheels are not to slip

   (iii) the deceleration when brakes are applied to all the four wheels (10 marks)

   (b) A hoist has a winding drum of mass 120 kg, a diameter of 1.5 m and a radius of gyration of 0.6 m. A load of 400 kg is to be raised 50 m high using a lifting rope whose mass is 2 kg/m. If the acceleration is 1.6 m/s$^2$ until a constant velocity of 4 m/s is reached, find: (i) the power just at the end of acceleration period (ii) Power at the starting point (iii) Starting torque (10 marks)

4. (a) A heavy disc is attached to a shaft supported on frictionless bearings has a mass of is 200 kg and a radius of gyration of 600 mm. A constant torque of 900 Nm is applied to rotate the disc from rest, determine the moment of inertia, angular acceleration and the speed of the flywheel and kinetic energy after 10 seconds. (6 marks)

(b) A motor vehicle has a mass of 2000 kg, and the moment of inertia of each pair of road wheels and rear axle is together 7.8 kg $m^2$. The engine rotates at 2800 rev/min and the moment of inertia of the engine parts is 1.2 $kgm^2$. The affective diameter of the road wheels is 500 mm. Find the acceleration on the level at an instant when the engine output torque is 100 Nm and the overall speed reduction ratio is 9. Calculate also the road speed in km/hr. Take the air and road resistance at 200 N at this speed, and the transmission efficiency as 90% (8 marks)

(c)Three forces $F_1$, $F_2$, and $F_3$ are acting on a body as shown in fig. 4 and the body is in equilibrium. If the magnitude of force $F_3$ is 250N, find the magnitudes of forces $F_1$ and $F_2$ (6 marks)

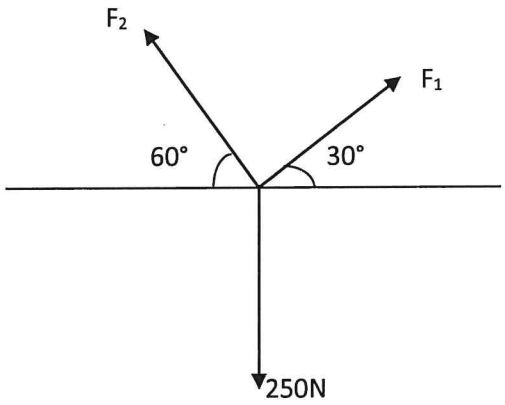


**Fig. 4**