



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

**SECOND YEAR FIRST SEMESTER EXAMINATIONS FOR
THE DEGREE OF
BACHELOR OF SCIENCE IN RENEWABLE ENERGY
TECHNOLOGY**

COURSE CODE: RET 241

COURSE TITLE: MECHANICS OF MACHINES

DATE: 19/12/2022

TIME: 8:00 AM – 10:00 AM

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

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QUESTION ONE**[30 marks]**

- (a) Explain any two systems in a vehicle where friction is useful (2 marks)
- (b) Define the following terms and give one example each: (i) : mechanism (ii) Structure (4 marks)
- (c) Differentiate between the following, giving one example of each pair of terms
- (i) Force closed and form closed kinematic pairs
 - (ii) Full and Half kinematic pairs (6 marks)
- (d) Use sketches where applicable to distinguish between the following pairs of terms clearly indicating their differences,
- (i) Binary link and tertiary link (3 marks)
 - (ii) Revolute and Prismatic joint (3 marks)
- (e) A screw jack must raise a load of **500 kg**. The square threads has a pitch of 10 mm and a mean diameter of 50 mm. The coefficient of friction is 0.15. (i) Calculate the force P to both raise and lower the load. Find: (ii) the torque and (ii) the effort applied at the end of a lever length 40 cm and the forward efficiency of the screw jack. (12 marks)

QUESTION TWO**[20 marks]**

- (a) A hoist has a winding drum 0.9m effective diameter and a radius of gyration of 0.35m, the mass of the drum being 100kg. A load of 320kg is to be raised 36m, the mass of the lifting rope being 1kg/m. If the acceleration is 1.8 m/s^2 until a constant velocity of 6m/s is reached, find the (i) starting power and (ii) starting torque and (iii) power just at the end of acceleration.(10 marks)
- (b) A flywheel attached to a shaft has a total mass of 200 kg, and its radius of gyration is 600 mm. If the effect of bearing friction is equivalent to a couple of 100 N-m, calculate the braking torque required to bring the flywheel to rest from a speed of 700 rpm in 10 sec(6 marks)
- (c) A steel cylinder of 500 mm outside and 200 mm inside diameters respectively is set in rotation about its axis. If the cylinder is 900 mm long of density $7,800 \text{ kg/m}^3$, calculate the torque required to give it an angular acceleration of 0.5 rads/s^2 (5 marks)

QUESTION THREE**[20 marks]**

(a) A vehicle has a wheelbase of 3.6 m and is driven along a level road by a torque applied to the **front wheels**. The center of gravity is 0.8 m above the ground level and 1.6 m behind the front wheel axle. The coefficient of friction between the wheels and the road is 0.5. Determine:

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

(ii) the maximum retardation of the vehicle when brakes are applied to **ALL the four wheels**

(9 marks)

(b) A motor-cycle engine gives a torque of 34 Nm at 2000 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 620 mm and the total mass of the machine and rider is 200 kg. 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 180 N, find the road speed and acceleration of the motor-cycle at the above engine speed.

(11 marks)

QUESTION FOUR**[20 marks]**

(a) In a flat belt drive, the tight side tension is 2000 N. The coefficient of friction between the belt and the pulley is 0.3 and the angle of lap of the smaller pulley is 150° . The smaller pulley is the driver and has a radius of 200 mm and rotates at 300 r.p.m. Calculate the tension on the slack side and the power transmitted by the belt. (Velocity of the belt $v = \omega r$ of pulley)

(10 marks)

(b) A machine weighing 1500 N is supported by two chains attached to some point on the machine. One of these chains goes to the eye bolt in the wall and is inclined at 30° to the horizontal and the other goes to the hook in the ceiling and is inclined at 45° to the horizontal. Draw force diagram for the tensions and weight and use **two** methods determine the value of tensions in the two chains. (i) Use Lami's (Sine) Rule and (ii) Components of forces in X -Y directions.

(10 marks)

