

602



(University of Choice)

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

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF EDUCATION TECHNOLOGY

(MECHANICAL OPTION)

COURSE CODE: TEM 441

COURSE TITLE: MECHANICS OF MACHINES I

DATE: 11/12/2023

TIME: 12:00 PM – 2:00 PM

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **FOUR** questions
2. Answer Question **ONE (Compulsory)** and any other **TWO** Questions
3. All symbols have their usual meaning

TIME: 2 Hours

MMUST observes **ZERO** tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over

QUESTION ONE**[30 marks]**

- a) Define the following terms **(3 marks)**
- i. Limiting force of friction
 - ii. Angle of friction
 - iii. Helix angle
- b) The theory of uniform pressure and theory of uniform wear are usually applied in designing friction clutches. You are to design a friction clutch to be used in your final year project, which of the two assumptions will you make use of while designing the friction clutch. Why? **(3 marks)**
- c) Clearly explain the difference between greasy friction and film friction **(4 marks)**
- d) You are designing a belt drive system for your final year project. State five factors and considerations you would take into account when selecting the appropriate belt drive for your specific application. **(4 marks)**
- e) Show that for an ideal screw jack, the efficiency is independent of the weight lifted **(5 marks)**
- f) Find the speed of a shaft which is driven with the help of a belt by an engine running at 200 rpm. The diameter of the engine pulley is 51 cm and that of shaft is 30 cm. If the thickness of the belt is 10mm, then find the speed of the shaft. **(3 marks)**
- g) Sketch and briefly explain the internal expanding shoe brake. **(4 marks)**
- h) Define 'angular velocity' and 'linear acceleration'. Do they have any relation between them? **(2 marks)**
- i) State the difference between forced vibration and damped vibrations. **(2 marks)**

QUESTION TWO**[20 marks]**

- a) A shaft of 100 mm diameter and 1 metre long is fixed at one end and other end carries a flywheel of mass 1 tonne. Taking Young's modulus for the shaft material as 200 GN/m^2 , find the natural frequency of longitudinal and transverse vibrations. **(8 marks)**
- b) Determine the external and internal radii of the friction plate of a single clutch if maximum torque transmitted is 90 Nm. The external radius of the friction plate is 1.5 times the internal radius and the maximum intensity of pressure at any point of contact surface should not exceed $0.8 \times 10^5 \text{ N/m}^2$. Take both sides of the plate as effective and co-efficient of friction .s 0.3. Assume uniform wear. Also calculate the axial force exerted by the springs. **(12 marks)**

QUESTION THREE**[20 marks]**

- a) A screw jack has a square thread of mean diameter 6 cm and pitch 0.8 cm. The co-efficient of friction at the screw thread is 0.09. A load of 3 kN is to be lifted through 12 cm. Determine the torque required and the work done in lifting the load through 12 cm. Find the efficiency of the jack also. **(15 marks)**
- b) The radius of gyration of a flywheel, which weighs 6 kN, is 50 cm. If the wheel starts from rest and attains a speed of 200 r.p.m. in 2 minutes, determine the average torque exerted on the flywheel. **(5 marks)**

QUESTION FOUR**[20 marks]**

- a) There are four unbalanced masses m_1 , m_2 , m_3 and m_4 of 200 kg; 300 kg, 240 kg and 260 kg respectively rotating in the same plane at radii of rotation 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively. The corresponding angles between the successive masses are 45° , 75° , 120° . Find the position and magnitude of the balancing mass m_b required, if its radius r_b of rotation is 0.2 m. **(8 marks)**
- b) Sketch and name the different types of friction clutches **(9 marks)**
- c) Why is balancing of rotating parts necessary for high-speed engines? **(3 marks)**

