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(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR**

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

**BACHELOR OF SCIENCE IN MECHANICAL AND
INDUSTRIAL ENGINEERING**

COURSE CODE: MIE 241

COURSE TITLE: MECHANICS OF MACHINES I


DATE: 13/12/2024

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) Give two circumstances where relative slip in friction clutch would be desirable **(3 marks)**
- (ii) Give any **four** causes of imbalance in machine components **(4 marks)**
- (b) Find the length of belt necessary to drive a pulley of 1.2 m diameter, running parallel at a distance of 12 m from the driving pulley of diameter 4.8 m, considering
- (i) belt is open and
- (ii) belt is crossed. **(6 marks)**
- (c) Give the expression of the total angular Kinetic Energy, as the sum of energy of rotation and energy of translation **(2 marks)**
- (d) A steel cylinder 1.4 m long, 84 mm diameter and a density of 7800 kg/m^3 , starts from rest and rolls without slipping with its axis perpendicular to a track of a slope of 15° . Find: -
- (i) the velocity of translation at the instant when the cylinder has rolled 5 m down the slope
- (ii) the kinetic energy of translation **(8 marks)**
- (e) A disc brake rotating at 500 rev/min has three opposing pairs of friction pads pressing on it at an effective radius of 0.15m. Each pad is 50 mm in diameter and the coefficient of friction between the pads and the disc is 0.3. If the pressure on each pad during braking is 500 kN/m^2 . Determine: (i) the frictional torque acting on the brake disc shaft, (ii) the power developed. **(7 marks)**
2. (a) (i) State two main functions of the clutch in an engine of motor vehicle **(2 marks)**
- (ii) A multi-plate clutch is to transmit 12 kW at 1500 rpm. The inner and outer diameters for the plates are to be 100mm and 200mm respectively. The maximum axial force is restricted to 1000N. Assuming constant pressure, calculate the necessary number of pairs of surfaces if $\mu = 0.35$, Find the actual axial force? **(8 marks)**
- (b) Two co-axial rods are connected by a turnbuckle, one rod having a right-handed and the other left-handed V-threads. On both the rods the mean diameter of the thread is 30 mm, the included

angle of its profile is 60° and the pitch is 6 mm. Taking the coefficient of friction between nut and screw to be 0.25, find the torque required to tighten the turnbuckle when the tensile force in the rod is 12 kN **(10 marks)**

3. (a) A laminated belt 8 mm thick and 150 mm wide drives a pulley of 1.2 m diameter at 180 r.p.m. The angle of lap is 190° and mass of the belt material is 1000 kg/m^3 . If the stress in the belt is not to exceed 1.5 N/mm^2 and the coefficient of friction between the belt and the pulley is 0.3, determine the power transmitted when the centrifugal tension is (i) considered, and (ii) neglected. **(10 marks)**

(b) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the masses B, C and D are 60° , 135° and 270° from mass A. Find the magnitude and position of the balancing mass at a radius of 100 mm. **(10 marks)**

4. (a) A centrifugal clutch friction has a driving member consisting of a spider carrying four shoes, which are kept from contact with the clutch case by means of the flat springs until increase of centrifugal force overcomes the resistance of the springs and power is transmitted by friction between the shoes and the case. Determine the necessary mass of each shoe if 22.5 kW is to be transmitted at 750 rev/min with engagement beginning at 75 percent of the running speed. The inside diameter of the drum is 300mm and the radial distance of the center of mass of each shoe from the shaft is 125mm and $\mu = 0.25$ **(10 marks)**

(b) A tilt hammer hinged at O with its head resting on top of the pile B as shown in **Fig.4b** below. The hammer including the arm OA has a mass of 25 kg. Its center of gravity G is 400 mm horizontally from O and its radius of gyration about an axis through G parallel to the axis of the

pin O is 75 mm. The pile has a mass of 135 kg. The hammer is raised through 45° to the horizontal and released. On striking the pile there is no rebound. Find the angular velocity of the hammer immediately before impact and the linear velocity of the pile immediately after impact. Neglect any impulsive resistance offered by the earth into which the pile is driven.

(10 marks)

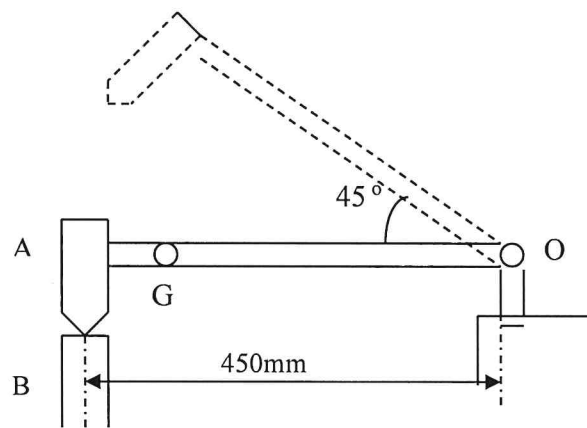


Fig. 4b