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UNIVERSITY EXAMINATIONS 2024/2025

THIRD YEAR FIRST SEMESTER EXAMINATION FOR DEGREE OF BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING AND FOUTH YEAR FIRST SEMESTER FOR DEGREE OF BACHELOR OF EDUCATION TECHNOLOGY IN MECHANICAL ENGINEERING

EMT 3302: MECHANICS OF MACHINES II

DATE: JANUARY 2025 **TIME: 3 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) State five advantages of friction (5 marks)

b) A body of weight 300 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body, while acting at an angle of 25° with the horizontal. (5 marks)

c) State five factors to be considered in a selection of a belt drive (5 marks)

d) The power is transmitted from a pulley of 1 m diameter running at 200 r.p.m. to a pulley of 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 1.4 MPa and 0.5 MPa respectively. The Young's modulus for the material of the belt is 100 MPa (5 marks)

e) List five types of cams (5 marks)

f) Determine the maximum, minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear. (5 marks)

QUESTION TWO (15 MARKS)

A centrifugal clutch is to transmit 15 kW at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is 3/4th of the running speed. The inside radius of the pulley rim is 150 mm and the centre of gravity of the shoe lies at 120 mm from the centre of the spider. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine:

a) Mass of the shoes, and (7 marks)

b) Size of the shoes, if angle subtended by the shoes at the centre of the spider is 60^o and the pressure exerted on the shoes is 0.1 N/mm^2. (8 marks)

QUESTION THREE (15 MARKS)

A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, a motion described below :

a) To raise the valve through 50 mm during 120° rotation of the cam;

b) To keep the valve fully raised through next 30°;

c) To lower the valve during next 60°; and

d) To keep the valve closed during rest of the revolution i.e. 150°;

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm.

Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft.

QUESTION FOUR (15 MARKS)

Show that the length of an open belt drive is given by $L = \pi (r_1 + r_2) + 2x + \frac{(r_1 - r_2)^2}{x}$ where L is the total length of the belt, x is the distance between the centres of two pulleys, r_1 and r_2 are radii of the larger and smaller pulleys respectively as shown in figure Q4.

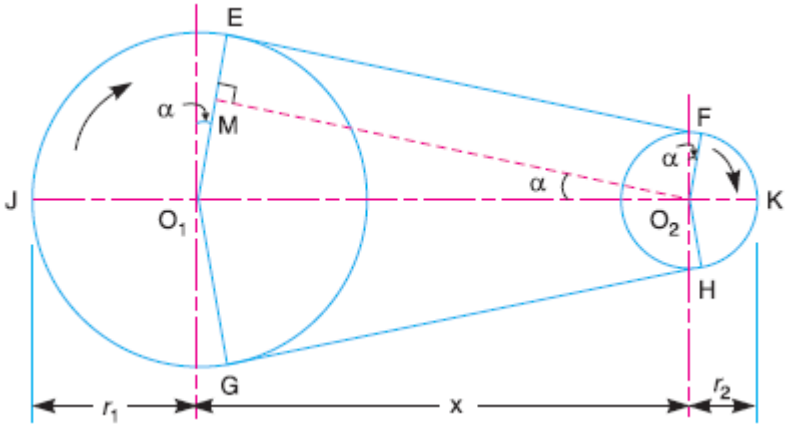

Figure Q4

QUESTION FIVE (15 MARKS)

A block weighing 1500 N, overlying a 10° wedge on a horizontal floor and leaning against a vertical wall, is to be raised by applying a horizontal force to the wedge. Assuming the coefficient of friction between all the surface in contact to be 0.3, determine the minimum horizontal force required to raise the block.