University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology Honours Degree
Level 4 (Semester I) Examination, June/July 2023
Academic year 2021/2022

Course Unit: ENT4132 Mechanics of Machine (Written) **Duration: 2 hours**

- All symbols have their usual meanings.
- Answer all **Four (04)** questions.
- Calculators are allowed for this examination.
- You should show all the necessary calculations on your answer sheet.

1)

a) Define what does it mean by degrees of freedom of a mechanism?

(2 marks)

b) Draw a schematic diagram of the following lower pairs and identify the number of degrees of freedom of each pair?

I. Spherical Pair
II. Plane Pair
III. Cylindrical Pair
IV. Revolute Pair
V. Prismatic Pair

(5 marks)

c) Find the number of joints and degrees of freedom of the following mechanism (Figure 1). (Clue: take multiple joints and sliding joints into account when the number of joints are calculated. Consider that all the joints are mechanically equivalent)

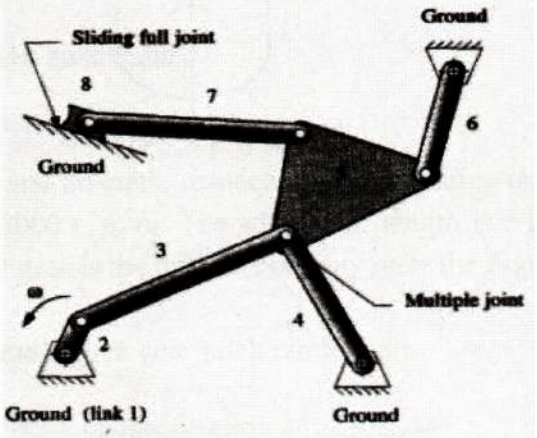

Figure 1

(4 marks)

d) If a revolving rotor is unbalanced, explain the reason for that, in terms of the rotor's centre of mass and the rotation axis.

(2 marks)

e) State two types of balancing and briefly explain them.

(3 marks)

f) State whether the following rotating shafts are balanced or not using the provided information in each figure and explain the reason for your answer?

I.

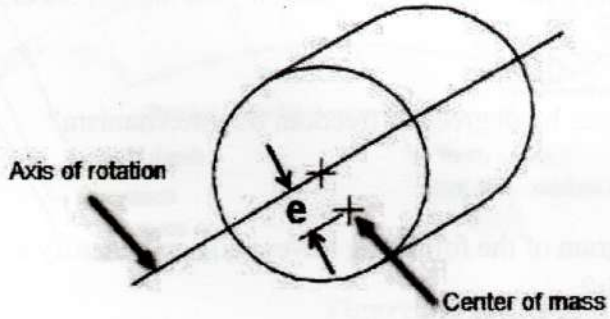

Figure 2

II.

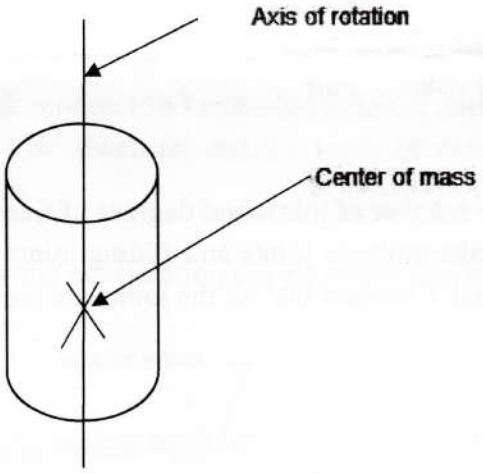

Figure 3

III.

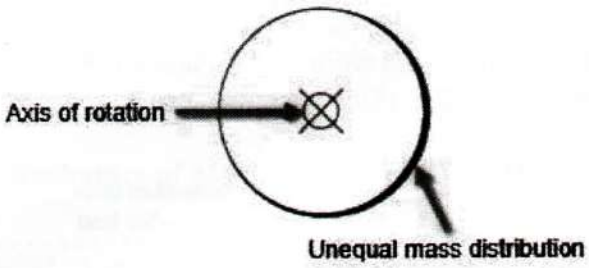

Figure 4

(9 marks)

2)

a) Derive the following formula for the length of a cross-belt drive. The terms d_1, d_2, x, and L are the diameter of the larger pulley, the diameter of the smaller pulley, the distance between the centres of two pulleys, and the total length of the belt respectively.

$$L = \frac{\pi}{2}(d_1 + d_2) + \frac{(d_1+d_2)^2}{4x} + 2x$$

(10 marks)

b) A crossed belt connects two pulleys, one 450 mm diameter and the other 200 mm diameter, on parallel shafts 1.95 m apart.

I. Find the length of the belt required and the angle of contact between the belt and each pulley.

(7 marks)

II. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25?

(8 marks)

3)

a) Write three applications of gear trains.

(3 marks)

b) A pair of gears with 40 and 20 teeth, respectively, are rotating in mesh, with the speed of the smaller gear being 2000 r. p. m. The addendum length is 5 mm and the module is 5 mm. Consider, the small gear is the driver. You may refer the Figure 5 for the terminology of gears.

I. Find the driver and driven gear pitch circle radii.

(4 marks)

II. Find the radii of the addendum circle of each gear.

(4 marks)

III. Find the angular velocity of each gear.

(4 marks)

IV. Find the velocity of the gear at the point of contact of the gears.

(4 marks)

V. Find the gear ratio of the gear train.

(4 marks)

VI. State for what purpose the above mention gear train can be used.

(2 marks)

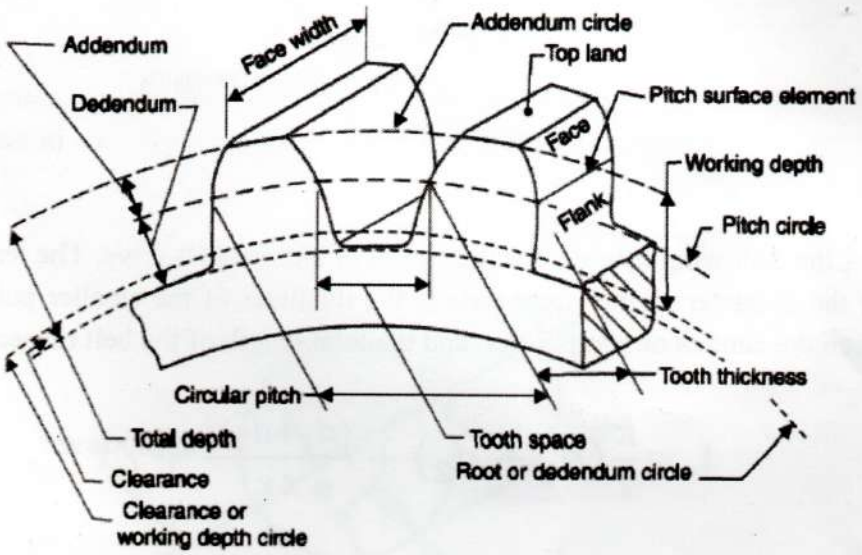

Figure 5

4)

a) State 3 standard follower motions used to design cam profiles.

(3 marks)

b) A disc cam is to give simple harmonic motion to a knife edge follower during an out stroke of 50 mm. The angle of ascent is 120^0 dwell 60 and the angle of descent is 90^0. The minimum radius of the cam is 50 mm.

I. Calculate the maximum velocity and acceleration during ascent and descent when the camshaft revolves at 240 r. p. m.

(8 marks)

II. Draw the corresponding displacement diagram to design the cam profile.

(4 marks)

III. Draw the profile of the cam when the axis of the follower passes through the axis of the camshaft.

(10 marks)

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