18MT45

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Theory of Machines

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1   a. Define the following :
        (i)   Kinematic link   (ii)   Structure
        (iii) Inversion of mechanism   (iv)   Grubler's criterion for plane mechanisms
                                                                                (08 Marks)

    b. With a neat sketch, explain
        (i)   Crank and Lever mechanism.   (ii)   Elliptical trammels.
        (iii)   Scotch yoke mechanism   **(12 Marks)**

OR

2   a. With a neat sketch, explain whitworth quick return motion mechanism with an equation.
                                                                                (12 Marks)
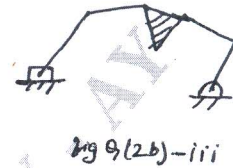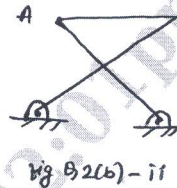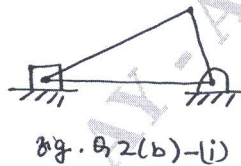
    b. Determine the mobility of the mechanism given below :   **(08 Marks)**

Fig. Q2 (b)

Module-2

3   a. Define Gears and explain the law of gearing.   **(08 Marks)**

    b. A pair of gears having 40 and 20 teeth respectively are rotating in mesh, the speed of the smaller being 2000 rpm. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact.   **(12 Marks)**

OR

4   a. Define gear trains. Explain in brief different types of gear trains.   **(10 Marks)**

    b. Two spur gears A and B of an epicyclic gear train is shown in below Fig. Q4 (b) have 24 and 30 teeth respectively. The arm rotates at 100 rpm clockwise direction. Find the speed of gear box its own axis where gear axis fixed. If inseted of being fixed the wheel A rotates at 200 rpm in counter clockwise direction, what will be the speed of B.   **(10 Marks)**
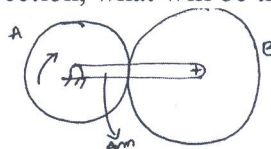

Fig. Q4 (b)

Module-3

5   A cam with 3 cm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as defined below :

    (i)   Follower to move outward through 3 cm during 120° of cam rotation with SHM.

    (ii)   Dwell for the next 60°

    (iii) Follower to return to its starting position during the next 90° with VARM

    (iv) Dwell for the remaining period.

Draw the cam profile (i) follower axis passes through cam axis.   **(20 Marks)**

OR

6   A vertical spindle supplied with a plane horizontal face at its lower end is actuated by a cam keyed to a uniformly rotating shaft. The spindle is raised through a distance of 30 mm in one fourth, remains at rest in one fourth, is lowered in one third and remains at rest for the remainder of a complete revolution. Draw the profile assuming the least radius of the cam profile as 25 mm and that the spindle moves with uniform acceleration and retardation on both during ascent and descent. However during descent deceleration period is half the acceleration period. The axis of the spindle passes through cam axis. The cam rotates in anti clockwise direction.   **(20 Marks)**

Module-4

7   A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and resolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the panes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular position.   **(20 Marks)**

OR

8   A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.   **(20 Marks)**

Module-5

9 a. Derive an expression for ratio of tensions in flat belt drive.   **(08 Marks)**

    b. A pulley is driven by a flat belt running at a speed of 600 m per minute. If coefficient of friction between belt and pulley is 0.3, angle of contact is 160° and maximum tension is 7000 N, find the power transmitted by the belt.   **(04 Marks)**

    c. Analyze the stability of a two wheel vehicle taking left turn. Derive the necessary equations.   **(08 Marks)**

OR

10 a. Derive an expression for the height of the Porter governor taking into consideration the force of friction at the sleeve.   **(10 Marks)**

    b. A Porter governor has all four arms 30 mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35 mm from axis. The mass of each ball is 7 kg and the load on the sleeve is 540 N. Determine the equilibrium speed for the two extreme radii of 200 mm and 260 mm of rotation of governor balls.   **(10 Marks)**

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