18MT45

Fourth Semester B.E. Degree Examination, June/July 2024
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)
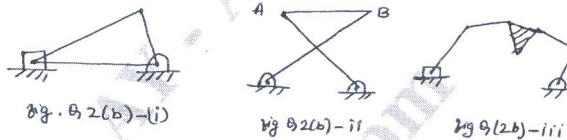   b. Determine the mobility of the mechanism given below :   **(08 Marks)**

Fig. Q2 (b)

Module-2

3 a. A pair of gears 40 and 30 teeth respectively are of 25° involute form. Addendum = 5mm, Module = 2.5mm. If the smaller wheel is the driver and rotate at 1500 rpm, find the velocity of sliding at the point of engagement, at pitch point and at the point of dis-engagement. Also find the length of path of contact and length of arc of contact.   **(10 Marks)**
   b. Two 20° involute spur gears Mesh externally and give a velocity ratio of 3. Module is 3mm and the addendum is equal to 1.1 module. If the pinion rotates at 120rpm, determine :
   i) Minimum number of teeth on each wheel to avoid interference
   ii) Contact ratio.   **(10 Marks)**

OR

4 a. In an epicyclic gear train as shown in Fig.Q4(a), the pitch circle diameter of the annular wheel A is 425mm and the module is 5mm. When the annular wheel is stationary, the spider which carries 3 planet gears P of equal size has to make one revolution for every 6 revolutions of the driving spindle carrying sun wheel S. Determine the number of teeth an all wheels.
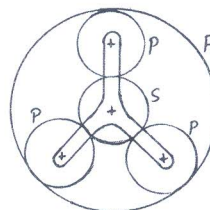

Fig.Q4(a)   **(10 Marks)**

   b. Explain the different types of gear trains with velocity ratio. Give examples for each.
                                                                  (10 Marks)

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. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50kg, 80kg and 70 kg respectively. The masses C and D makes angles of 90° and 195° respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75mm, 100mm, 50mm and 90mm respectively. The plane of rotation of masses B and C are 250mm apart. Determine :

    i) Mass A and its angular position
    ii) Position of planes of A and D. (14 Marks)

  b. Explain balancing of single revolting mass in two different planes for both the mass are on the same side. (06 Marks)

OR

8 a. A shaft routing at 200 rpm drives another shaft at 300rpm and transmits 6kW through a belt. The belt is 100mm side and 10mm thick. The diameter of smaller pulley is 0.5m. The distance between the shaft is 4m. Calculate the stress in the belt if it is,

    i) An open belt drive
    ii) A cross belt drive
    Take $\mu = 0.3$. (10 Marks)

  b. Derive an expression for ratio of driving tensions for flat belt drive. (10 Marks)

Module-5

9 a. Explain with neat sketch effect of gyroscopic couple on a Naval Ship. (10 Marks)

  b. Find the angle of Inclination with respect to the vertical of a two wheeler negotiating a turn given combined mass of vehicle with rider = 250 kg, mass moment of inertia for engine fly wheel = 0.3 kg-m^2, moment of inertia of each road wheel = 1 kg.m^2, speed of engine fly wheel 5 times that of road wheels and in the same direction, height of centre of gravity of rider with vehicle 0.6 m, two wheeler speed 90 km/hr, wheel radius 300 mm and radius of turn 50 m. (10 Marks)

OR

10 a. Define Governor and different types of governors. (06 Marks)
    b. Explain the following terms:
        (i)   Sensitiveness
        (ii)   Governor effort
        (iii) Governor power
        (iv)   Hunting (04 Marks)
    c. The arms of the porter governor are 30 cm long. Upper arms are pivoted to the axis of rotation. Lower arms are attached to the sleeve at a distance of 3.75 cm from the axis. The mass of sleeve is 75 kg. Mass of each ball is 10 kg. Determine the equilibrium speed when the radius of ball is 22.5 cm. What will be the range of speed for this position? If the frictional resistance of the sleeve is 24.5 N. Find also the coefficient of insensitiveness. (10 Marks)

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