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15MA42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
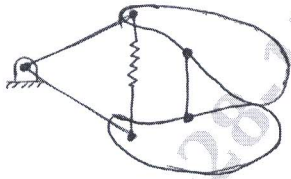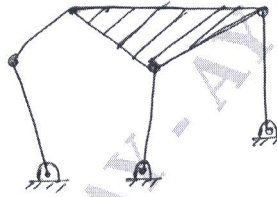## Theory of Machines

Time: 3 hrs.

Max. Marks: 80

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

Module-1

1   a. Define the following :
        (i) Machine and Mechanism,   (ii) Link and Kinematic pair,   (iii) Kinematic chain of
        kinematic mechanism.   **(06 Marks)**
     b. Calculate the degrees of freedom of mechanisms

         (i)   (ii)   (iii)   **(06 Marks)**
     c. Explain any two inversions of Single Slider Crank mechanism.   **(04 Marks)**

OR

2   a. Explain any two inversions of four bar chain.   **(04 Marks)**
     b. Sketch and explain Whitworth Quick Return Mechanism.   **(06 Marks)**
     c. Sketch and explain Geneva Wheel.   **(06 Marks)**

Module-2

3   In a four bar mechanism, the crank AB rotates at 40 rad/sec. The length of the links are
     crank AB = 200mm, coupler link BC = 400mm, rocker link CD = 450mm and fixed link
     AD = 600mm. When the link AB is at right angle to AD, determine the velocity and
     acceleration of :
     (i) The mid-point of the link BC.
     (ii) A point on the link CD 150mm, from the pin connecting the link CD and AD.
        [Graphical Method]   **(16 Marks)**

OR

4   In slider crank mechanism, the crank radius is 100mm and length of connecting rod is
     500mm. The crank is rotating in counter-clockwise direction at an angular velocity of
     15 rad/sec and angular acceleration of 115 rad/sec^2. Find the acceleration of piston and
     angular acceleration of connecting rod when the crank is at 60° from I.D.C. [Analytical
     method].   **(16 Marks)**

Module-3

5   a. Derive the expression for length of path contact and arc contact for a pair of involute gear in
        contact.   **(10 Marks)**
     b. Two gear having 40 and 50 involute teeth respectively are in mesh. The module of gears is
        10mm and angle of obliquity is 20°. The line of contact on each side of the pitch point is two
        third of maximum possible length. Find length of path of contact and contact ratio. **(06 Marks)**

OR

6   An epicyclic gear train shown in Fig.Q6. The internal gear D has 90 teeth and the sun gear A has 40 teeth. The two planet gears B and C are identical and they are attached to an arm as shown. How many revolutions does arm makes
   (i) When 'A' makes one revolution in clockwise and 'D' make 1/2 revolutions in opposite sense.
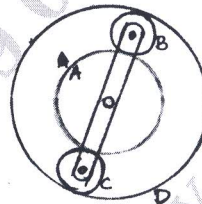   (ii) When 'A' makes 1 revolution clockwise and 'D' remains stationary [Tabular Method].

Fig.Q6   (16 Marks)

Module-4

7   a. Explain different types of friction.   (06 Marks)
   b. Derive an expression for frictional Torque in flat pivot bearing for both the conditions.
                                                                                          (10 Marks)

OR

8   a. Derive an expression for ratio of tension in V-belt drive.   (06 Marks)
   b. A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of groove is 30°. The cross-sectional area of each belt is 750 mm^2 and μ = 0.12. The density of belt material is 1.2 Mg/m^3 and maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys 300mm diameter rotating at 1500 rpm. Find also the shaft speed in rpm at which the power transmitted would be maximum.   (10 Marks)

Module-5

9   a. Draw the profile of a cam operating a roller reciprocating follower and with the following data:
   Minimum radius of cam = 15mm, Lift = 30mm, Roller diameter = 15mm, The cam lift the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of the cam rotation with UARM followed by a dwell for remaining period. If the cam rotates at a uniform speed of 150 rpm, calculate the maximum velocity and acceleration during the decent period.   (16 Marks)

OR

10 a. Derive an expression for maximum velocity of the follower, when the roller has contact with straight flanks.   (06 Marks)
   b. In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30mm and the roller radius is 17.5mm. The angle of ascent is 75° and the total lift is 17.5mm. The speed of the cam shaft is 600 rpm. Calculate
   (i) Principal dimensions of the cam; (ii) The acceleration of the follower at the beginning of the lift, where the straight flank mergers into the circular nose. Assume there is no dwell.
                                                                                          (10 Marks)

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