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P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belgaum)
Fourth Semester, B.E. - Mechanical Engineering
Semester End Examination; June - 2016
Kinematics of Machines

Time: 3 hrs *Max. Marks: 100*

Note: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.
   ii) Assume suitable data for missing details.

UNIT - I

1 a. Explain :

   i) Screw pair 2

   ii) Super Structure

 b. Determine the number of degrees of freedom for the kinematic chain shown in Fig. Q 16.
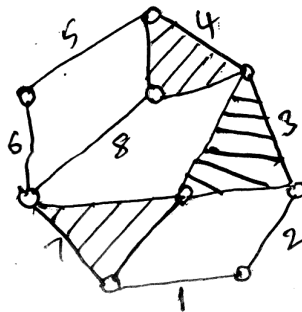
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Fig. Q16.

 c. Sketch and explain the following inversions :

   i) Crank and slotted lever quick return, motion mechanism 14

   ii) Elliptical trammel.

2 a. Sketch and explain Whitworth quick return motions mechanism. 7

 b. Sketch and explain the intermittent motions, mechanism which converts one revolution of a driving member to $1/4^{th}$ revolution of a driven member. 6

 c. Sketch and explain a steering gear mechanism which has turning pairs. Also determine angle α using trigonometry. 7
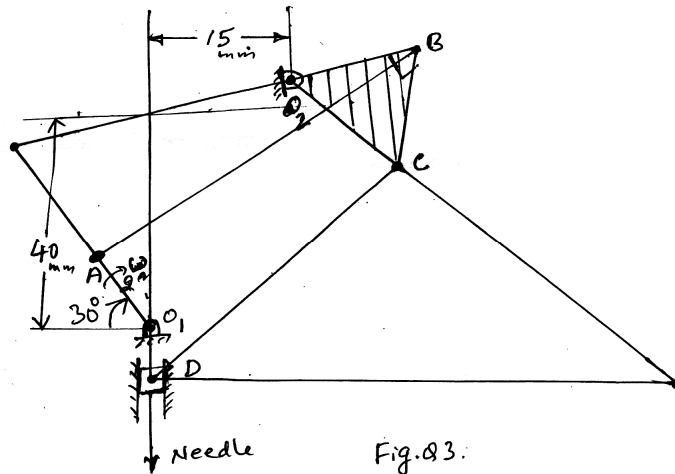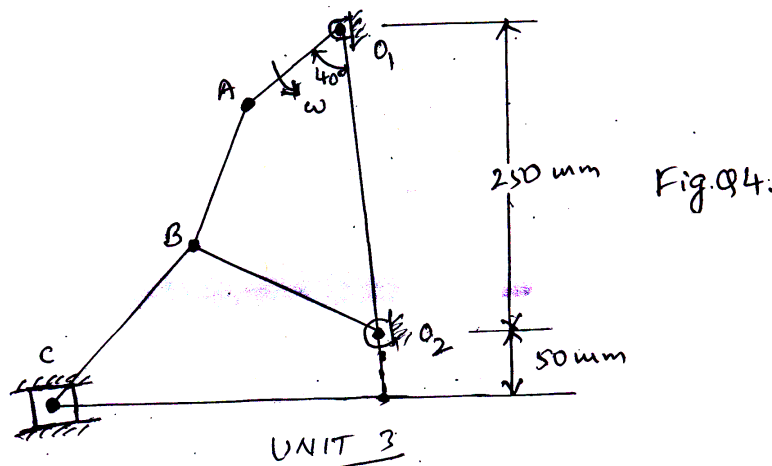
UNIT - II

3. The sewing machine needle bar mechanism is shown in Fig. Q3. The crank 2 rotates at 450 rpm. Determine all the instantaneous centres. Also determine the velocity of needle at D. $O_1A = 15$ mm, $O_2B = 25$ mm, $AB = 65$ mm, $BC = 20$ mm, $CD = 60$ mm, and $\lfloor O_2BC = 90º$ 20

Fig.Q3.

4. In the mechanism shown in Fig. Q4, determine the acceleration of the slider C, $O_1A = 100$ mm, $AB = 105$ mm, $O_2B = 150$ mm and $BC = 300$ mm

   The crank O_1 A rotates at 180 rpm.

250 mm   Fig.Q4.

50 mm

UNIT 3

20

UNIT - III

5 a. What is conjugate action? Discuss fundamental law of gearing.   10

   b. Obtain expressions for the characteristics of the involute action such as arc of contact, length of path of contact and the contact ratio.   10

6 a. A pinion of 20° involute teeth and 120 mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6 mm. Determine the least pressure angle which can be used to avoid interference. With this pressure angle find the contact ratio.   6

   b. What is this interference list the methods of eliminating interference?   4

   c. A 3 mm module, 20° pinion of 24 teeth drives a gear of 60 teeth. Calculate the length of action and contact ratio,   (i) if the gears mesh with zero backlash, and (ii) if the centre distance is increased 0.5 mm, calculate the radii of the operating pitch circles, the operating pressure angle, and backlash produced.   10

UNIT - IV

7 a. Sketch and explain reverted gear train. 4

  b. In a reverted epicyclic gear train, the arm A carries two gears 1 and 2 at centre of rotation O_1 and a compound gear 3 and 4 at the centre of rotation O_2. The gear 1 meshes with gear 4 at the centre of rotation O_2. The gear 1 meshes with gear 4 and the gear 2 meshes with gear 3. The number of teeth are; $Z_1 = 75$, $Z_2 = 30$ and $Z_3 = 90$, Find the speed and direction of gear 2 when gear is 1 is fixed and the arm A makes 120 rpm clockwise. Assume all gears to be of the same module. 16

8 a. Describe the effect of slip in the belt drive. 3

  b. Obtain an expression for ratio of belt tensions for flat belt drive. 6

  c. Obtain an expression for conditions for maximum power transmission. 6

  d. A compressor requires 50 kW to run at 250 rpm from an electric motor of speed 700 rpm, by means of a V - belt drive. The diameter of the compressor shaft pulley should not be more than 500 mm while the centre distance between the shafts is 1m. The belt speed should not exceed 20 m/s. Determine the number of V - belts required to transmit the power if each belt has a cross-sectional area of 375 mm^2, density 1000 kg/m^3, and an allowable tensile stress of 2.5 MPa. The pulley groove angle is 40° and coefficient of friction between the belt and the pulley sides is 0.25. 5

UNIT - V

9. The following data relate for a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent :

Minimum radius of cam = 25 mm, roller radius = 7.5 mm, Lift = 28 mm, offset of follower axis = 12 mm towards right, angle of ascent = 60°, angle of descent = 90°, angle of dwell between ascent and descent = 45°, speed of the cam = 200 rpm clock wise. Draw the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke. 20

10. The following data relate to a cam operating an reciprocating flat faced follower :

Minimum diameter of the cam = 44 mm

Angle of ascent = 75°

Angle of descent = 105°

Angle of dwell for the follower in the highest position = 60°

Draw the profile of the cam if the ascent and descent both take place with SHM. 20

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