(viii) The pressure angle of the cam _____ with increase in the base circle diameter.
(a) decreases
(b) increases
(c) does not change
(d) may decrease or increase.

(ix) The transmission ratio of a gear train is
(a) equal to velocity ratio of a gear train
(b) reciprocal of velocity ratio of a gear train
(c) always greater than unity
(d) always less than unity.

(x) Mitre gears are
(a) gears having different modules
(b) helical gears having same pitch
(c) spur gears of equal diameter and pitch
(d) right angle bevel gears having the same number of teeth.

Group – B

2. (a) What is Kutzbach's criterion for degree of freedom of plane mechanism? In what way Gruebler's criterion different from it. Determine the degree of freedom of the linkages as shown in Figure 1(a) and 1(b).
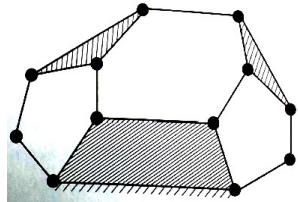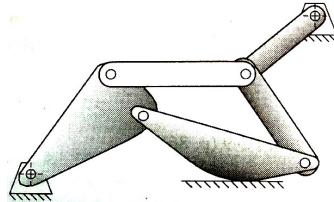

Fig.1(a)   *Fig.1(b)*

(b) Sketch the equivalent linkage for the cam and follower mechanism shown in Figure 2. in the position shown. Show that it has same DOF as the original mechanism.
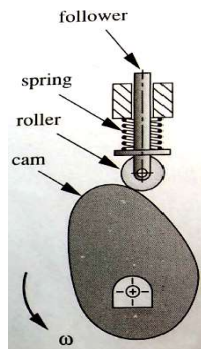

Fig.2

(2 + 1 + 4) + (2 + 3) = 12

3. (a) Sketch and describe the working of Crank and Slotted lever quick return motion mechanism. Derive an expression for the ratio of times taken in forward and return stoke for the mechanism.

(b) What is meant by inversions of mechanism. Classify the four-bar mechanism based on its possible motion, when the length of the links are l_1 = 30 cm, l_2 = 12.5 cm, l_3 = 30 cm, l_4 = 10 cm.

(3 + 2 + 2) + (2 + 3) = 12

Group – C

4. The dimensions of the various links of the mechanism shown in Figure 3 are: AD = DE = 150mm, BC = CD = 450mm, EF = 375mm.
The crank AB rotates at 120 rpm. The lever DC oscillates about the fixed point D. Determine (i) velocity of slider F and (ii) angular speed of CD.
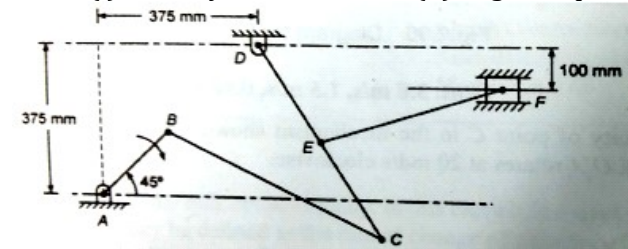

Fig.3

12

5. Draw the acceleration diagram for the shaper mechanism shown in Figure 4. OB = 150mm, CB = 150mm, Find the coriolis acceleration of slider B.

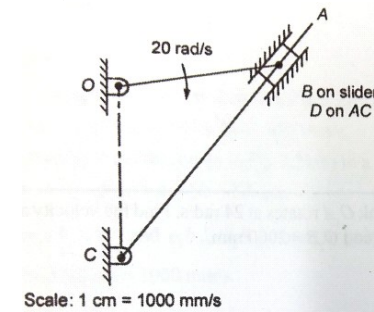*Fig. 4*

12

## Group – D

6. (a) A gear wheel having 20 teeth of involute form of module 6 mm and pressure angle of 20°, drives another wheel of the same dimensions. Calculate the length of the arc of contact if the addendum is one module. If the addendum was altered so that the arc of contact was the maximum possible, what would be the length of this arc and the addendum required for this?

KINEMATICS OF MACHINES
(MECH 2202)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Which of the following is an inversion of single-slider crank chain?
   (a) Elliptical trammel   (b) Hand pump
   (c) Scotch yoke   (d) Oldham's coupling.

   (ii) In a crank and slotted lever mechanism, if the lengths of the crank and the fixed links are 100mm and 200mm respectively, what will be ratio of cutting time to the return time?
   (a) 0.5   (b) 1   (c) 2   (d) 4.

   (iii) A mechanism has 7 links with all binary pairs except one which is a ternary pair. The number of instantaneous centres of this mechanism are
   (a) 14   (b) 21   (c) 28   (d) 42.

   (iv) Coriolis components of acceleration exists whenever a point moves along a path that has
   (a) linear displacement   (b) rotational motion
   (c) tangential acceleration   (d) centripetal acceleration.

   (v) In a slider crank mechanism, the velocity of the piston is maximum when
   (a) crank and connecting rod are perpendicular to each other
   (b) crank and connecting rod are in the same line
   (c) crank is perpendicular to the line of stroke
   (d) crank is at 120° with the line of stroke.

   (vi) For maximum power transmission by a belt drive, the maximum tension must be
   (a) $2T_c$ (b) $3T_c$ (c) $4T_c$ (d) $5T_c$.

   (vii) The point on the cam with the maximum pressure angle is known as the
   (a) cam centre   (b) pitch point
   (c) trace point   (d) prime point.

(b) A leather belt is required to transmit 8kW from a pulley 1.5m diameter running at 240rpm. The angle of contact is 160° and the coefficient of friction between belt and pulley is 0.25. The safe working stress for leather is 2.5MPa and the density of leather is 1000kg/m³. Determine the width of the belt if its thickness is 10mm. Take into account the effect of centrifugal tension.

                 6 + 6 = 12

7. (a) In an epicyclic gear train, as shown in following figure, the number of teeth on wheels A, B, and C are 50, 25, and 52 respectively. If the arm rotates at 420rpm clockwise, find (i) speed of wheel C when A is fixed, and (ii) speed of wheel A when C is fixed.
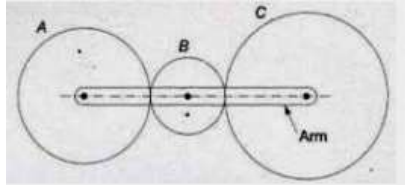
   (b) Power is transmitted using a V-belt drive. The included angle of V-groove is 30°. The belt is 20mm deep and maximum width is 20mm. If the mass of the belt is 0.35kg per metre length and maximum allowable stress is 1.4MPa, determine the maximum power transmitted when the angle of lap is 140°. Take μ = 0.15.

                 6 + 6 = 12

Group – E

8. A cam rotating in clockwise direction at a uniform speed of 1000 rpm is required to give a roller follower the motion defined below:
   1. Follower moves outwards through 50 mm during 120° of cam rotation.
   2. Follower dwells for next 60° of cam rotation.
   3. Follower returns to its original position during next 90° of cam rotation
   4. Follower dwells for rest of cam rotation.
   The minimum radius of the cam is 40 mm and the diameter of roller is 8 mm. If the displacement of the follower is to take place with uniform and equal acceleration and retardation on both the strokes. Draw the profile of the cam and find the max velocity and acceleration during the outwards and return strokes.

                 12

9. (a) Sketch and describe the Peaucellier straight line mechanism indicating clearly the conditions under which the point P on the corners of the rhombus of the mechanism, generates a straight line. Prove geometrically that the above mechanism is capable of producing straight line.

   (b) In a Davis steering gear, the distance between the pivots of the front axle is 1.2 m and the wheel base is 2.8 m. When the automobile is moving along a straight path, find the inclination of the track arms to the longitudinal axis of the automobile?

                 (6 + 3) + 3 = 12