(vii) The velocity of the belt for maximum power is

(a) $\sqrt{\frac{T}{3m}}$ (b) $\sqrt{\frac{T}{4m}}$ (c) $\sqrt{\frac{T}{5m}}$ (d) $\sqrt{\frac{T}{6m}}$

Where, 'T' = Maximum allowable belt tension and 'm' = Mass of the belt in kg per meter length.

(viii) The maximum length of arc of contact for two mating gears, in order to avoid interference, is

(a) (r+R) sinφ (b) (r+R) cosφ
(c) (r+R) tanφ (d) none of these.

Where r = Pitch circle radius of pinion R= Pitch circle radius of gear
φ = Pressure angle

(ix) The angle between the direction of the follower motion and a normal to the pitch curve is called

(a) pitch angle (b) prime angle
(c) base angle (d) pressure angle.

(x) Which motion of follower is best for high speed cams?

(a) SHM follower motion
(b) Uniform acceleration and retardation of follower motion
(c) Cycloidal motion follower
(d) All of the above.

Group – B

2. Determin the mobility of the mechanisms shown in figures 1and 2 below using Kutzbach's criterion, Gruebler's criterion. Validate your answer using Loop equation.

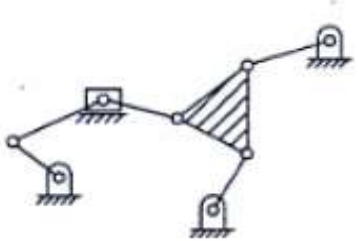

Fig.: 1

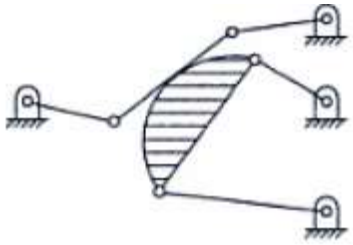

Fig.: 2

6 + 6 = 12

3. (a) In a crank and slotted lever quick return mechanism, as shown in figure 3 below, the driving crank length is 75 mm. The distance between the fixed centers is 200 mm and the length of the slotted lever is 500 mm. Find the ratio of the times taken on the cutting and idle

Group – D

6. (a) A 20° involute pinion with 20 teeth drives a gear having 60 teeth. Module is 8 mm and addendum of each gear is 10 mm. Find the length of path of contact and arc of contact if pinion is driver.

(b) An epicyclic gear train consists of a Sun wheel S, a stationary internal gear E and three identical planet wheels P carried on a star-shaped planet carrier C as shown in figure 8. The sizes of different toothed wheels are such that the planet carrier C rotates at 1/5 of the speed on the sun wheel S. The minimum number of teeth on any wheel is 16. Determine the number of teeth on different wheels of the train

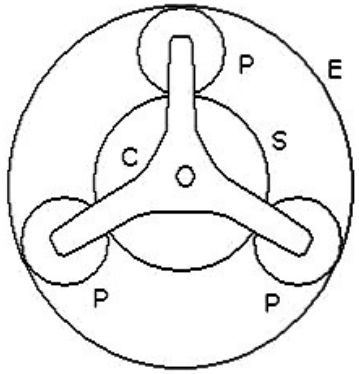

Figure 8

6 + (2 + 2 + 2) = 12

7. An open belt drive is required to transmit 10kW of power from a motor running at 600 rpm. Diameter of the driving pulley is 250 mm. The speed of the driven pulley is 220 rpm. The belt is 12 mm thick and has a mass density of 0.001 g/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. The two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine width of the belt.

12

Group – E

8. A 60 mm minimum diameter cam is to be designed for a knife-edge follower with the following data:
To raise the follower through 40 mm during 50° rotation of the cam
Dwell is for next 45° of the cam rotation
Descending of the follower during the next 105° of the cam rotation

Dwell during the rest of the cam rotation

(i) Draw the profile of the cam if the ascending and descending of the cam is with simple harmonic motion and the line of stroke of the follower is offset 12 mm from the axis of the cam shaft.

(ii) Determine the maximum velocity and acceleration of the follower during the ascent and the descent if the cam rotates at 200 rpm.

8 + 4 = 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) Derive an expression for the ratio of shaft velocities for Hooke's joint and draw the polar diagram depicting the salient features of driven shaft speed.

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

B.TECH/ME/4TH SEM/MECH 2202/2017

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) The lead screw of a lathe with nut is
(a) rolling pair (b) screw pair
(c) turning pair (d) sliding pair.

(ii) The Coriolis component of acceleration is taken into account for
(a) slider crank mechanism (b) four bar chain mechanism
(c) quick return motion mechanism (d) none of these.

(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) The radial distance of a tooth from the pitch circle to the bottom of the tooth, is called
(a) Dedendum (b) Addendum
(c) Clearance (d) Working depth.

(v) A class-I four bar mechanism will work as a Rocker-Rocker mechanism if
(a) link opposite to the shortest link is fixed
(b) shortest link is fixed
(c) link adjacent to the shortest link is fixed
(d) none of these.

(vi) Klien's construction is used mainly to determine the
(a) linear velocity of the piston
(b) linear acceleration of the piston
(c) linear displacement of the piston
(d) none of the above.

strokes. Determine the effective stroke also.

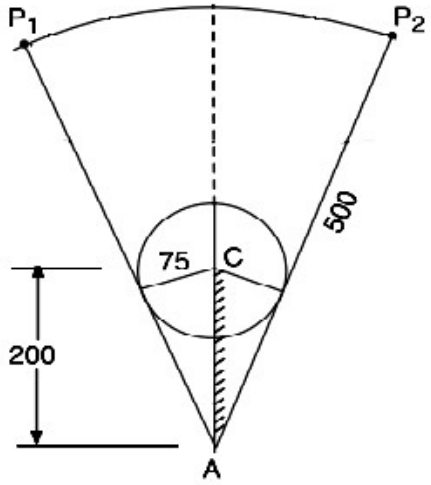

Fig: 3

(b) Figures 4 and 5 below show few four bar mechanisms with the mention of dimensions of the links in standard unites. Indicate the type of mechanism and also determine whether the mechanism is crank-crank or crank-rocker or rocker-rocker.

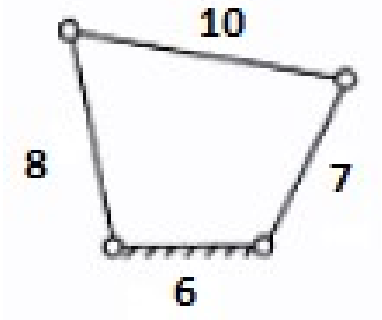

Fig: 4

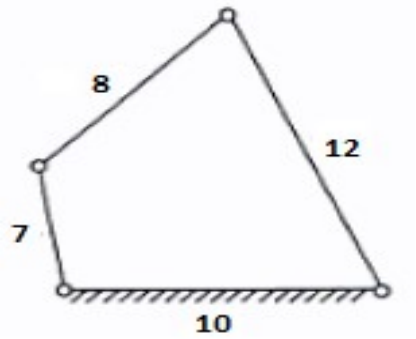

Fig: 5

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

Group – C

4. (a) Explain the procedure to construct Klein's construction to determine the velocity and acceleration of a slider-crank mechanism.

(b) The crank OA of the mechanism shown in figure 6 rotates at 100 rpm clockwise. Using instantaneous centre method determine (i) linear

velocities of points B, C and D, and (ii) angular speeds of links AB, BC and CD.

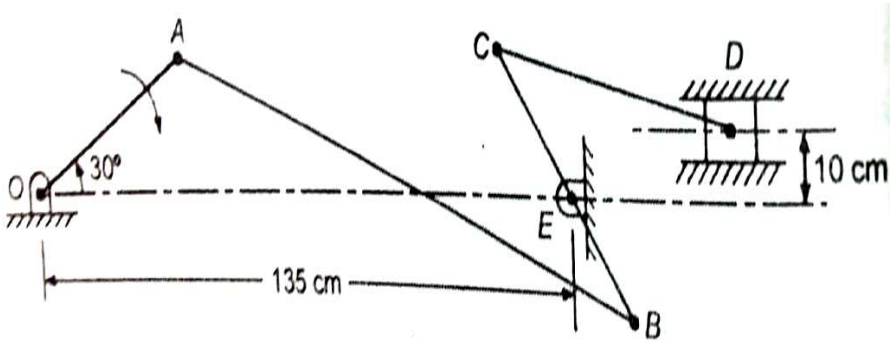

Figure 6

6 + (3 + 3) = 12

5. (a) State Aronhold-Kennedy theorem.

(b) The kinematic diagram of one of the cylinders of a rotary engine is shown in figure 7. The crank OA which is vertical and fixed, is 50 mm long. The length of connecting rod AB is 125 mm. The line of stroke OB is inclined at 50° to the vertical. The cylinder is rotating at a uniform speed of 300 rpm, in a clockwise direction, about the fixed centre O. Calculate (i) acceleration of the piston inside the cylinder and (ii) angular acceleration of connecting rod.

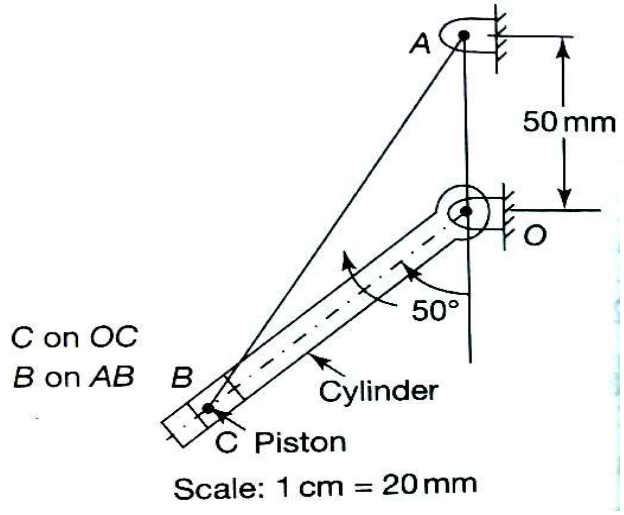

Figure 7

2 + (5 + 5) = 12