

(viii) Which of the following mechanisms using lower pairs is an exact straight line mechanism? (a) Watt mechanism, (b) modified Scott-Russel mechanism, (c) Grasshopper mechanism, (d) Scott-Russel mechanism.

(ix) The most suitable follower motion programme for high-speed engine is (a) Uniform acceleration and deceleration, (b) Uniform velocity, (c) Simple harmonic motion, (d) Cycloidal.

(x) In automobiles, the power is transmitted from gear box to differential through (a) Bevel gears, (b) Knuckle joint, (c) Hooke's joint, (d) Cotter joint.

7.(a) What is an automobile steering gear? Define the fundamental equation of steering gears? Which steering gear fulfils this condition? Find out its degree of freedom. (12+8=20)

(b) The track arm of a Davis steering gear is at a distance of 192 mm from the front main axle whereas the difference between their lengths is 96 mm. If the distance between steering pivots of the main axle is 1.4 m, determine the length of the chassis between the front and the rear wheel. Also, find the inclination of the track arms to the longitudinal axis of the vehicle.

8.(a) Sketch a Paucellier mechanism. Show that it can be used to trace a straight line. (12+8=20)

(b) In a Hooke's joint the maximum permissible variation in speed of the driven shaft is $\pm 8\%$ of the mean speed. Determine the maximum permissible angle between the axes of the shafts.

9.(a) Sketch and explain Lazy Tong mechanism

(b) Sketch and explain the Toggle mechanism. (4x5=20)

(c) Sketch an intermittent motion mechanism and explain its practical applications.

(d) Explain elliptical trammel mechanism. Also find out its mobility.

10.(a) What is cam? Define pitch circle and pressure angle of a cam.

$$(1+4)+(10+2\frac{1}{2}+2\frac{1}{2})=20$$

(b) Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60° . The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20mm. What will be the maximum velocity and acceleration of the follower during the lift and the return?

JADAVPUR UNIVERSITY
Bachelor in Production Engineering Supplementary Examination – 2017
(Second Year – 1st Semester)

Analysis and Synthesis of Mechanisms

Time : 3 Hours

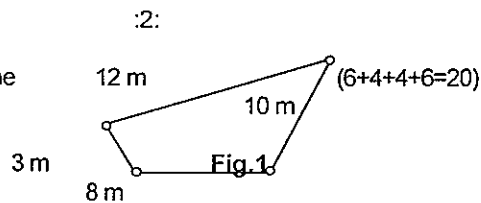
Full Marks : 100

Answer Group – A & Group – B [50+50 = 100]

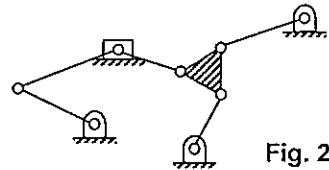
Group – A [Answer question no.1 and any two from the rest] [10+2x20=50]

1. (i) In a kinematic pair, when the elements have surface contact while in motion, it is a _____ (1x10=10)
(a) higher pair, (b) lower pair, (c) closed pair, (d) sliding pair.
- (ii) Which mechanism generates intermittent rotary motion from continuous rotary?
(a) Elliptical trammel, (b) Geneva mechanism, (c) Scotch yoke mechanism, (d) Whitworth mechanism.
- (iii) The ratio of circular pitch and the module is
(a) π , (b) $1/\pi$, (c) π^2 , (d) $1/\pi^2$, (e) none of these.
- (iv) ABCD is a four-link mechanism. AD is the fixed link. AB=30mm, BC=50mm, CD=60mm, and AD=70mm. It is a _____ mechanism
(a) crank-rocker, (b) double-rocker, (c) double-crank, (d) none of these.
- (v) The mechanism forms a structure, when the number of degrees of freedom
(a) 0, (b) 1, (c) -1, (d) None of these.
- (vi) The coriolis component of acceleration is taken into account for
(a) Slider crank mechanism, (b) Four bar chain mechanism, (c) Quick return mechanism, (d) None of these.
- (vii) Two shafts vertical each other can be connected by
(a) Straight spur gear, (b) Spiral gear, (c) Cross-helical gear, (d) Straight bevel gear.
- (viii) If the axes of first and last gear of a gear train are co-axial, the gear train is known as : (a) Simple gear train, (b) Compound gear train, (c) Reverted gear train, (d) Epicyclic gear train.
- (ix) In a kinematic chain, a ternary joint is equivalent to : (a) One binary joint, (b) Two binary joints, (c) Three binary joints, (d) Four binary joints.
- (x) Quick return motion mechanism is used in : (a) Lathe machine, (b) Shaper machine, (c) Milling Machine, (d) Grinding machine, (e) Drilling machine.

- 2.(a) Find all the inversions of the chain given in Fig.1

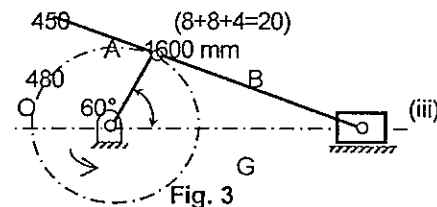


- (b) A kinematic linkage is shown in Fig. 2. Find the number of degrees of freedom using Gruebler's criterion.

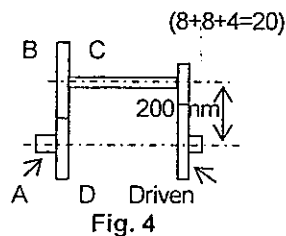


- (c) In a crank and slotted lever mechanism, if the lengths of the crank and the fixed links are 100 mm and 200mm respectively, what will be ratio of return time to the cutting time?
- (d) Design a mechanism for an indicator to obtain the indicator diagram of an engine. The distance between the fixed point and the tracing point of the indicator is 100 mm. the indicator diagram should represent four times the gas pressure inside the cylinder of an engine.

3. For the configuration of a slider-crank mechanism shown in Fig.3, calculate the
 (i) Acceleration of the slider at B
 (ii) Acceleration of the point E
 Angular acceleration of the link AB.
 Driving crank rotates at 20 rad/sec counter-clockwise.



- 4.(a) A belt drive transmits 8 kW of power from a shaft rotating at 240 rpm to another shaft rotating at 160 rpm. The belt is 8 mm thick. The diameter of the smaller pulley is 600 mm and the two shafts are 5 m apart. The coefficient of friction is 0.25. If the maximum stress in the belt is limited to 3 N/mm², find the width of the belt for an open belt drive.

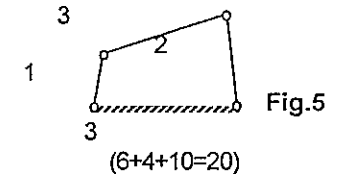


- (b) The speed ratio of the reverted gear train as shown in Fig. 4. is to be 12. The module pitch of gear A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth. Driver

:3:

- (c) The distance between two parallel shafts is 18 mm and they are connected by an Oldham's coupling. The driving shaft revolves at 160 rpm. What will be the maximum speed of sliding of the tongue of the intermediate piece along its groove?

- 5.(a) Find the maximum and minimum transmission angles for the mechanisms shown in Fig. 5. The figures indicate the dimensions in standard units of length. Indicate also the type of mechanism.



- (b) Sketch a Paucellier mechanism to trace a exact Straight line.
- (c) Design a four-link mechanism to coordinate three positions of the input and the output links given by $\theta_1 = 25^\circ$, $\theta_2 = 35^\circ$, $\theta_3 = 50^\circ$ and $\phi_1 = 30^\circ$, $\phi_2 = 40^\circ$, $\phi_3 = 60^\circ$.

Group – B [Answer question no. 6 and any two from the rest] [10+2x20=50]

6. (i) Which mechanism generates intermittent rotary motion from continuous rotary motion? (1x10=10)
 (a) Elliptical trammel, (b) Geneva mechanism, (c) Scotch yoke Mechanism, (d) Crank and slotted link mechanism, (e) Toggle mechanism.
- (ii) A Hooke's joint is used to join two shafts which are
 (a) Aligned, (b) Intersecting, (c) Parallel, (d) Skew.
- (iii) Transmission angle is the angle between the
 (a) Input link and the coupler, (b) Output link and the coupler, (c) Input link and the fixed link, (d) Output link and the fixed link.
- (iv) Inversion of a mechanism means: (a) Turning it upside down, (b) Fixing different links in a kinematic chain, (c) Changing a higher pair to lower pair, (d) Changing the input and output links.
- (v) A kinematic chain is known as a mechanism when:
 (a) None of the links is fixed, (b) One of the links is fixed, (c) Two of the links are fixed, (d) All of the links are fixed.
- (vi) Which of the following is an inversion of double-slider crank chain?
 (a) Whitworth quick return mechanism, (b) Reciprocating compressor, (c) Scotch yoke, (d) Rotary engine
- (vii) A pantograph has
 (a) 4 links, (b) 6 links, (c) 8 links, (d) 5 links.

[Turn Over]