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WEST BENGAL UNIVERSITY OF TECHNOLOGY

ME-402

MECHANISMS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) The Cam & follower constitute the following :

(A) Higher pair (B) Lower pair
(C) Helical pair (D) Spiral pair

(ii) If n links are connected at the same joint, the joint is equivalent to :

(A) (n – 1) binary joints (B) (n – 2) binary joints
(C) (2n – 1) binary joints (D) none of these

(iii) A slider moves with a velocity of 6 m/s on a link revolving at 120 rpm. The magnitude of Coriolis component of acceleration of slider is

(A) 604 m/s^2 (B) 151 m/s^2
(C) 906 m/s^2 (D) 302 m/s^2

(iv) Watt mechanism is capable of generating

(A) Approximate straight line (B) Exact straight line
(C) Approximate circular path (D) Exact circular path

(v) Geneva wheel is used to generate

(A) Circular motion (B) Intermittent motion
(C) Continuous motion (D) Parabolic motion

(vi) If the initial tension in the belt is increased then the power transmitted by the belt

(A) reduces (B) increases
(C) remains same (D) depends on speed

(vii) In a four-link mechanism, the sum of the shortest and the longest link is less than the sum of the other two links. It will act as a drag-crank mechanism if

(A) the longest link is fixed
(B) the shortest link is fixed
(C) the link opposite to the shortest link is fixed
(D) any link adjacent to shortest link is fixed

(viii) The ratio of tight side and slack side tensions in a V-belt is

(A) $e^{\mu\theta \sin\alpha}$ (B) $e^{\frac{\mu\theta}{\cos\alpha}}$
(C) $e^{\mu\theta\cos\alpha}$ (D) $e^{\frac{\mu\theta}{\sin\alpha}}$

(ix) The contact ratio of gear is always

(A) more than one (B) one
(C) less than one (D) zero

(x) The minimum number of teeth in rack and pinion for 20 pair angle teeth is

(A) 20 (B) 18
(C) 22 (D) 24

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(xi) If the axes of the first and last gears of a compound gear train are co-axial, the gear train is known as

(A) simple (B) epicyclic
(C) reverted (D) compound

(xii) 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

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Determine the mobility of the devices shown in the figure 1 and 2 below. 3+2

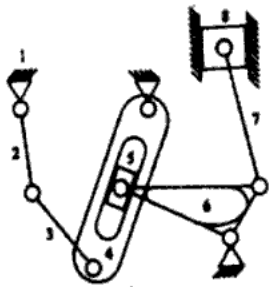

Fig 1

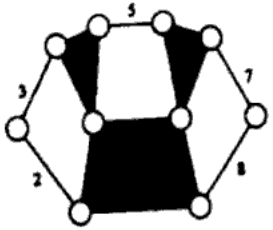

Fig 2

3.(a) What is the difference between class-I and class-II mechanism? 2

(b) State whether the following linkage is mechanism with one degree of freedom. If not, make suitable changes to make it mechanism of one degree of freedom. 3

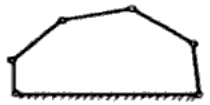
Figure-3

4. Prove that to avoid interference in 'Rack and Pinion' mechanism, the minimum number of teeth on the pinion for 20° pressure angle and addendum coefficient $a_r = 1$ is 18. 5

5. An assortment of links contains the following links : 5
100 mm long – one; 70 mm log – two
45 mm long – two; 35 mm long – one
Construct a crank-rocker mechanism using four links out of the above stock and indicate the link lengths and identify the crank.

6. Why is a cycloidal motion programme the most suitable for high-speed cams? How pressure angle of a radial cam can be defined? Define 'Under cutting in cam'. 5

7. What do you mean by instantaneous centres? Illustrate Aronhold-Kennedy theorem of three centres. 5

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GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

8. (a) What is the importance of equivalent mechanism? Elucidate the same with suitable sketch. 3

(b) What is transmission angle and mechanical advantage with regard to a 4-bar Linkage? 3

(c) What is meant by Kinematic inversion? Illustrate the different kinematic inversions for an R-R-R-P system. 4+2

(d) For the kinematic chain shown in Figure-1, find out the degrees of freedom. 3

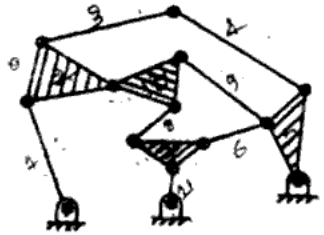

Figure-1

9. A cam is to be designed for a knife edge follower with the following data: 15

(i) Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.

(ii) Dwell for the next 30°.

(iii) During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.

(iv) Dwell during the remaining 180°.

Draw the profile of the cam when

(a) the line of stroke of the follower passes through the axis of the cam shaft and

(b) The line of stroke is offset 20 mm from the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 r.p.m.

10.(a) What is meant by Dimensional Synthesis in respect of mechanisms? Explain in short the Function Generation and Freudenstein's equation. 7

(b) A pinion of 20° involute teeth and 125mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25 mm. What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of the arc of contact and the minimum number of teeth in contact at a time. 8

11.(a) A pair of involute gear with 16° pressure angle and module of 6 mm is in mesh. The number of teeth on the pinion is 16 and the rotational speed is 240 rpm, when the gear ratio is 1.75. In order to avoid interference, find out- 10

(i) The Addendum on pinion and gear wheel.

(ii) The length of path of contact.

(iii) The maximum velocity of sliding of teeth on either side of the pitch point.

(b) In an epicyclic gear of the 'sun & planet' type as shown in the Fig-3, the pitch circle diameter of the internally toothed ring is to be 224 mm and module 4 mm. When the ring D is stationary, the spider 'A', which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sun wheel of 'B' for the every five revolutions of the driving spindle carrying the sun wheel B. Determine suitable number of teeth for all the wheels. 5

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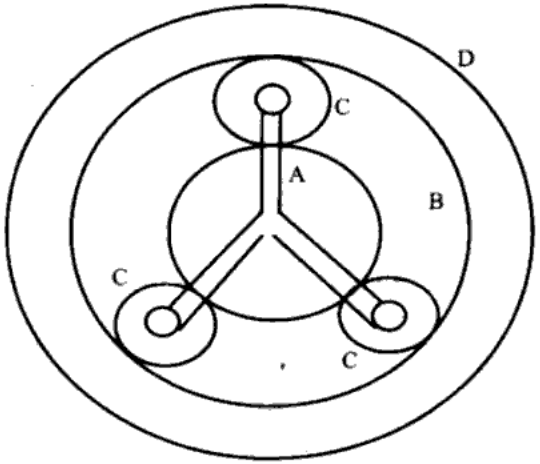

Fig.3

12. (a) The sun and planet gear of an epicyclic gear train are shown in Fig.4. The annular gear D has 100 internal teeth, the sun gear A has 50 external teeth and planet gear B has 25 external teeth. Gear B meshes with gear D and gear A. The gear B is carried on the arm E, which rotates about the center of annular gear D. If the gear D is fixed and arm rotates at 20 rpm, then find the speeds of gear A and B. 10

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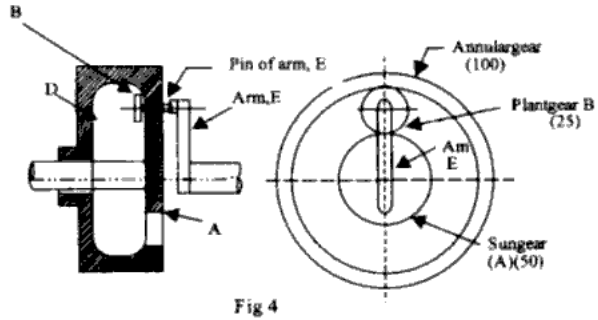

Fig 4

(b) For a flat belt drive, prove that $\frac{T_1}{T_2} = e^{\mu\theta}$, where T_1= Tension on the tight side of the belt, T_2= Tension on the slack side. 5

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