Printed Pages: 04 **Subject Code:NME502**

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BTECH
(SEM V) THEORY EXAMINATION 2018-19
KINEMATICS OF MACHINE

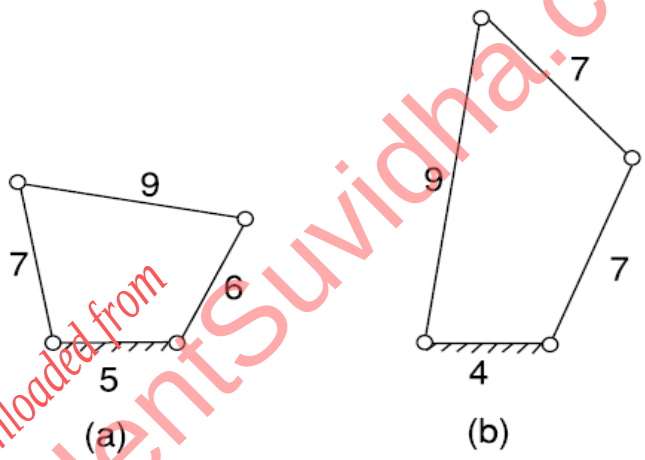
Time: 3 Hours ***Total Marks:100***

Notes: *Assume any Missing Data.*

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. What is degree of freedom of a mechanism? Explain its importance in brief
b. Two gears having an angular velocity ratio of 3: 1 are mounted on shafts whose centers are 136 mm apart. If the module of the gears is 4 mm, how many teeth are there on each gear?
c. Explain why Ackerman steering gear mechanism is preferred over Davis steering gear mechanism in practice.
d. Figure shows some four link mechanism in which the figure indicate the dimensions in standard units of length .Indicate the type of each mechanism whether crank-rocker or double crank or double rocker.



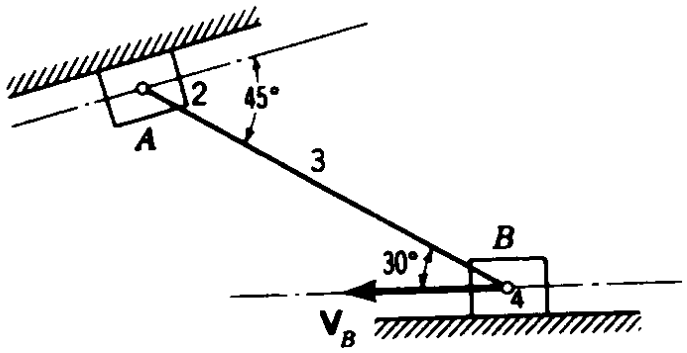
e. What do you mean by instantaneous Centre? Explain properties of it.
f. In what way a mechanism differs from a machine? Explain with example.
g. Why is a cycloidal motion programme the most suitable for high-speed cams?
h. Draw the polar diagram depicting the salient features of driven shaft speed
i. What do you understand by the term 'interference' as applied to gears?
j. Which of the two assumptions-uniform intensity of pressure or uniform rate of wear, would you make use of in designing friction clutch and why?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. The two shafts of a Hooke's coupling have their axes inclined at 20^0. The shaft *A* revolves at a uniform speed of 1000 rpm. The shaft *B* carries a flywheel of mass 30 kg. If the radius of gyration of the flywheel is 100 mm, find the maximum torque in shaft *B*.
b. Attempt both parts:
   I. Explain the working of Hart mechanism with suitable diagram and prove that it will produce straight line motion.

II. The velocity of point B of the linkage shown in the figure is 40 m/s. Find the velocity of point A and angular velocity of link 3



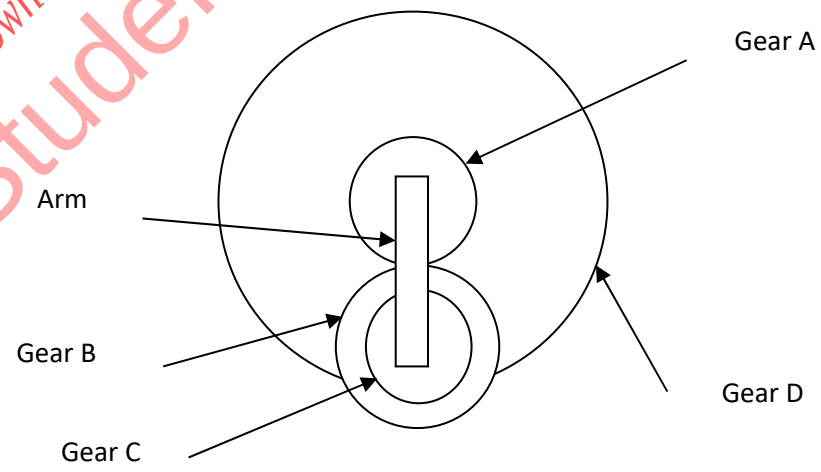
c. The following data relate to a symmetrical circular cam operating a flat-faced follower:

Minimum radius of the cam 40 mm
Lift -24 mm
Angle of lift =75°
Nose radius = 8 mm
Speed of the cam = 420 rpm

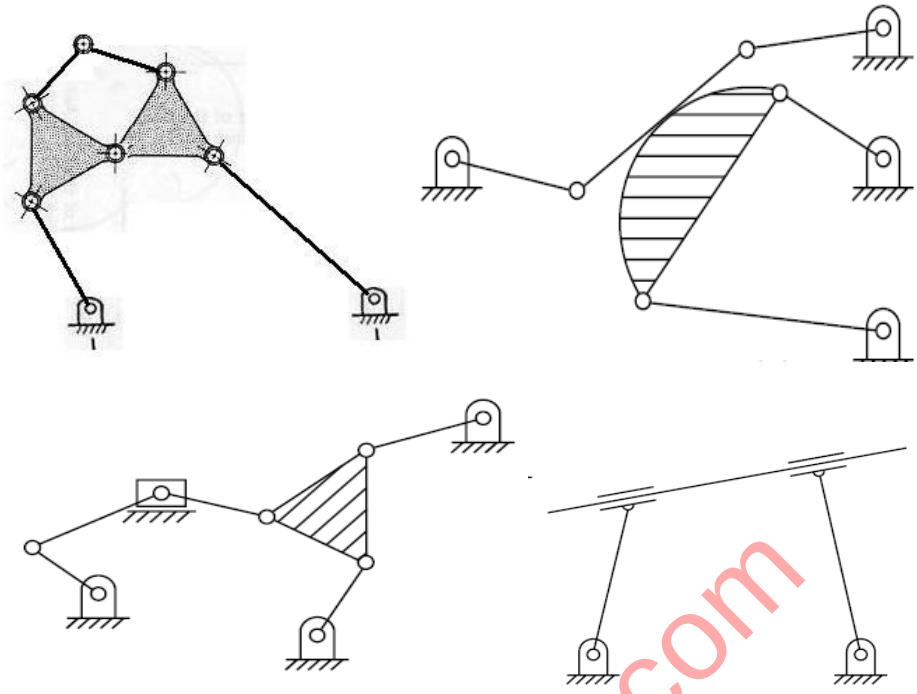
Determine the main dimensions of the cam and the acceleration of the follower at:

(i) the beginning of the lift
(ii) the end of contact with the circular flank
(iii) the beginning of contact with the nose
(iv) the apex of nose.

d. Figure shows an epicyclic gear train in which gear A drives the internal gear D through compound gears B and C. The number of teeth on gear A is 20 and center distance between the center of gears A and B is 300 mm. If module of all gears is 10 mm and gear C has 30 teeth, find the speed of gear D. The arm rotates at 600 rpm in counter clockwise direction and gear A is fixed.



e. Determine the degree of freedom of following cases:



SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10

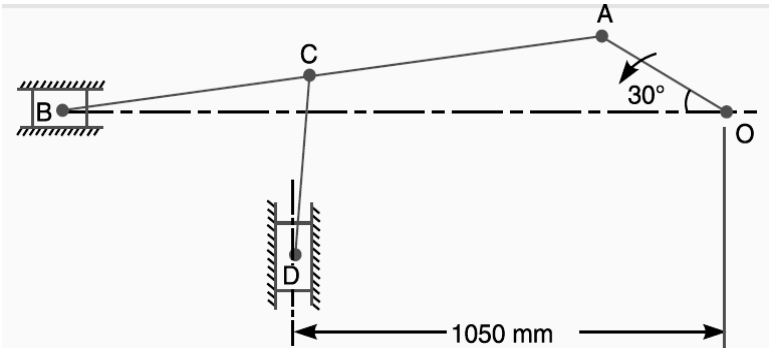
(a) Explain Kennedy's theorem. Also prove that if three bodies are in relative motion with respect to one another, the three-relative instantaneous center of velocity are collinear.

(b) What do you mean by kinematic inversion of mechanism? Explain inversions of double slider chain with neat diagrams.

(c) In a slider crank mechanism, the lengths of the crank and the connecting rod are 200 mm and 800 mm respectively. Locate all I-centers of the mechanism for the position of the crank when it has turned 30^0 from the outer dead center. Also find the velocity of slider and the angular velocity of the connecting rod, if the crank rotates at 40 rad/sec.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) In the mechanism, as shown in Figure, the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. For the given configuration, Determine : **1.** velocities of sliding at B and D, **2.** Angular velocity of CD, **3.** linear acceleration of D, and **4.** angular acceleration of CD.



(b) Determine the lengths of the links of a four-bar linkage to generate $y = \log_{10} x$ in the interval $1 \leq x \leq 10$. The length of the smallest link is 5 cm. Use three accuracy points with Chebyshev' spacing.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) A cam with 30 mm minimum radius is rotating clockwise at 1200 rpm to give the following motion to a knife edged follower:

Lift = 25 mm
Follower rises during 120^0 cam rotation with constant acceleration motion
Follower to dwell for 60^0 cam rotation
Follower to return during 90^0 rotation with constant velocity
Follower to dwell for remaining period

Draw cam profile and find the maximum velocity and acceleration of follower during ascent and descent.

(b) Derive relations to find velocity and acceleration of a roller follower moving on the tangent cam, when roller is in contact with flank and nose.

6. Attempt any *two* parts of the following: 5 x 2 = 10

(a) State and prove the law of gearing. Derive an expression for the velocity of sliding between a pair of involute teeth.

(b) Attempt any two of the following:

I. Pressure angle and its importance in case of geared drive
II. Difference between involute and cycloidal profile teeth
III. Different methods to prevent interference in gears

(c) Two mating involute gears of 20^0 pressure angle have a gear ratio of 2. The number of teeth on pinion is 20 and speed is 250 rpm. Take module as 12 mm.

If the addendum on each wheel is such that the path of approach and path of recess on each side are half of the maximum possible length each. Find:

- Addendum for pinion and gear
- Length of arc of contact
- Maximum velocity of sliding

7. Attempt any *two* parts of the following: 5 x 2 = 10

(a) Derive an expression to calculate the power lost in collar bearing assuming uniform wear theory.

(b) Derive the relation between tension on tight and side of V-belt.

(c) An open belt drive running over two pulleys of diameter 200 mm and 600 mm connects two parallel shafts placed at a distance of 2.5 m. The smaller pulley rotates at 300 rpm and transmits 7.5 kW. The coefficient of friction is 0.3. Determine:

I. Length of belt
II. Initial Tension

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