

B. TECH
(SEM-V) THEORY EXAMINATION 2019-20
THEORY OF MACHINES - I

Time: 3 Hours

Total Marks: 100

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

- a. Define the following: Links, Kinematic chain
- b. Explain in brief: Instantaneous centre of rotation and types of ICs.
- c. How is the sense and direction of Coriolis component of acceleration determined?
- d. Difference between Davis and Ackermann gearing mechanisms.
- e. What are the uniform pressure and uniform wear theories?
- f. What is Dynamometer? Gives its classification.
- g. Classify the different types of cams and followers.
- h. Differentiate between Radial cam and Cylindrical cam.
- i. How simple gear train is differed from epicyclic gear train?
- j. What do you understand by the term epicycloids and hypocycloid?

SECTION B

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

- a. In a crank and slotted lever quick return motion mechanism, the distance between the fixed centre is 240 mm and the length of the driving crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to the return stroke.
If the length of the slotted bar is 450 mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.
- b. Explain the Klein's construction for finding velocity and acceleration of piston in slider crank mechanism.
- c. Differentiate between brakes and dynamometers. Find out the expression of ratio of tension in a band and block brake.
- d. Analyze the movement of a Reciprocating roller follower on a tangent cam. Find expression for the Displacement, velocity and acceleration of the follower, when the follower is on the flank portion and also when the follower is on the nose portion of the cam.
- e. In a reverted epicyclic geartrain, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise.

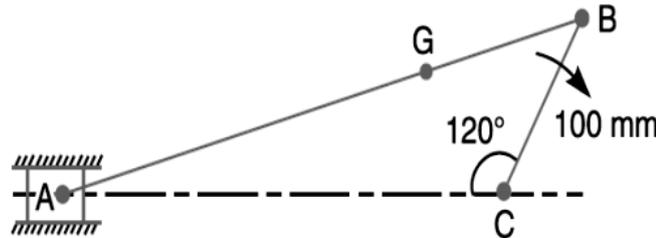
SECTION C

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

- (a) What do you understand by *Degree of freedom*? For a plane mechanism derive an expression for *Grubler's* equation
- (b) What do you mean by constraint motion? What are the different types of constrained motion, Explain each type with example and neat sketches.

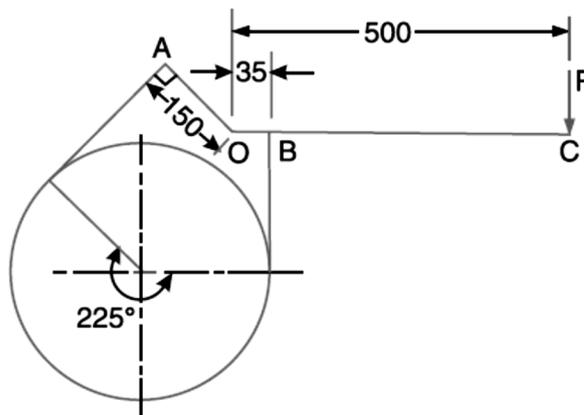
4. Attempt any *one* part of the following: 10 x 1 = 10

- (a) Give a neat sketch of the straight-line motion ‘Hart mechanism’. Prove that it produces an exact straight-line motion.
- (b) An engine mechanism is shown in Figure. The crank $CB = 100$ mm and the connecting rod $BA = 300$ mm with centre of gravity G , 100 mm from B . In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s^2 . Find: 1. Velocity of G and angular velocity of AB , and 2. Acceleration of G and angular acceleration of AB . Solve this problem by relative velocity method.



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

- (a) What do you mean by creep of belt? Derive the condition for maximum power transmission by a belt drive considering the effect of centrifugal tension.
- (b) A differential band brake, as shown in Figure, has an angle of contact of 225° . The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and the coefficient of friction between the band and the drum is 0.3. Find: 1. The necessary force (P) for the clockwise and anticlockwise rotation of the drum; and 2. The value of ‘ OA ’ for the brake to be self-locking, when the drum rotates clockwise.



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

- (a) Define the following with respect to Cam: Pressure angle, Pitch point, Pitch curve, Prime circle and Stroke of follower
- (b) Design a cam for operating the exhaust valve of an oil engine. It is required to give S.H.M. during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain open in the fully open position for 20° of cam rotation.

The lift of the valve is 36 mm and the least radius of cam is 50 mm. The follower is provided with a roller of 40 mm diameter and its line of stroke passes through

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the cam axis. Find maximum velocity and acceleration of the follower during opening and closing periods for a cam shaft speed of 240 r.p.m.

7. Attempt any *one* part of the following:

10 x 1 = 10

- (a) Two mating involute spur gears of 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250rpm the module pitch of the teeth is 12mm.

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

- (i) The addendum for pinion and gear wheel
- (ii) The length of arc of contact
- (iii) The maximum velocity of sliding during approach and recess

Assume pinion to be driver.

- (b) State and derive the law of gearing. What is the difference between a simple gear train and reverted gear train? Explain with the help of sketches.