

B. Tech 4th Semester Examination  
Kinematics of Machines (NS)

ME-224

Time : 3 Hours

Max. Marks : 100

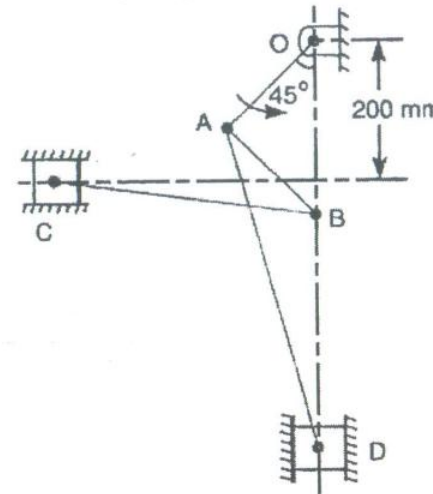
The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question each from Sections A, B, C & D of the paper and all sub-parts of question no. 9 of Section E.

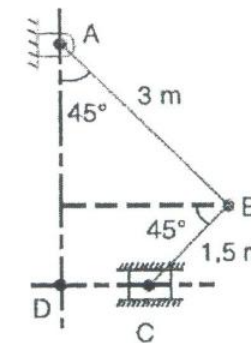
SECTION - A

1. (a) What is meant by degree of freedom of a mechanism and explain Grubler's criterion for determining degree of freedom for mechanisms. (5)
- (b) A crank and slotted lever mechanism used in a shaper has a centre distance of 300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of time of cutting to the time of return stroke. (5)
- (c) The dimensions of the various links of a pneumatic riveter, as shown in figure are as follows:  
 $OA = 175 \text{ mm}$ ;  $AB = 180 \text{ mm}$ ;  $AD = 500 \text{ mm}$ ; and  $BC = 325 \text{ mm}$ . Find the velocity ratio between C and ram D when OB is vertical. What will be the efficiency of the machine if a load of 2.5 kN on the piston C causes a thrust of 4 kN at the ram D? (10)

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2. In the mechanism shown in figure, the slider C is moving to the right with a velocity of 1 m/s and an acceleration of  $2.5 \text{ m/s}^2$ . The dimensions of various links are  $AB = 3 \text{ m}$  inclined at  $45^\circ$  with the vertical and  $BC = 1.5 \text{ m}$  inclined at  $45^\circ$  with the horizontal. Determine (a) the magnitude of vertical and horizontal component of the acceleration of the point B and (b) the angular acceleration of the links AB and BC. (20)



SECTION - B

3. (a) Sketch and explain the following terms used in Cam: base circle, trace point, pressure angle, pitch point, pitch circle, pitch curve, prime circle, stroke. (10)

- (b) A cam drives a flat reciprocating follower in the following manner:  
 During first  $120^\circ$  rotation of the cam, follower moves outwards through a distance of 20 mm with simple harmonic motion. The follower dwells during next  $30^\circ$  of cam rotation. During next  $120^\circ$  of cam rotation, the follower moves inwards with simple harmonic motion. The follower dwells for the next  $90^\circ$  of cam rotation. The minimum radius of the cam is 25mm. Draw the profile of the cam. (10)

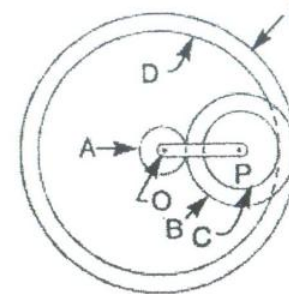
4. (a) Derive an expression for the length of a cross drive belt. (10)
- (b) A 100mm wide and 10mm thick belt transmits 5kW between two parallel shafts. The distance between the shaft centres is 1.5m and the diameter of the smaller pulley is 440 mm. the driving and driven shafts rotate at 60 r.p.m. and 150 r.p.m respectively. Find the stress in the belt if the two pulleys are connected by : (a) an open belt, (b) a cross belt. Take coefficient of friction as 0.22. (10)

#### SECTION - C

5. (a) State and explain law of gearing. (5)  
 (b) Define pressure angle and its effects. (5)  
 (c) Obtain an expression for minimum number of teeth on pinion to avoid interference. (10)
6. Figure shows a compound epicyclic gear train. Wheels A, D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the teeth on different wheels have the same module. A has 12 teeth, B has 30 teeth and C has 14 teeth cut externally. Find the number of teeth on wheels D and E which are cut internally. If the wheel A is driven clockwise at 1 r.p.s while D is driven counter clockwise at 5 r.p.s, determine the

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magnitude and direction of the angular velocities of the arm OP and wheel E. (20)



#### SECTION - D

7. Synthesize a four bar linkage using Freudenstein's equation to generate the function  $y = x^{1.5}$  for the interval  $1 \leq x \leq 4$ . The input crank angle is to start from  $30^\circ$  and is to have a range of  $90^\circ$ . Take three accuracy points. The output crank angle from 0 to  $90^\circ$ . (20)
8. Explain Freudenstein's equation and its importance in kinematic synthesis of mechanism. In detail explain the concept of function generation, path generation and motion generation of a mechanism. (20)

#### SECTION - E

9. (a) State the importance of quick return mechanism.  
 (b) Define a pantograph and its applications.  
 (c) What do you mean by dwell angle of a cam?  
 (d) Differentiate between flat belt and V belt.  
 (e) What do you mean by interference, in a gear?  
 (f) What is a reverted gear train?  
 (g) Differentiate between lower pair and higher pair.  
 (h) State the importance gear tooth profile.  
 (i) Differentiate between spur and helical gear.  
 (j) State the advantages of gears over belts. (2×10=20)