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S.E. (Mechanical/Automobile) (Second Semester)

EXAMINATION, 2018

THEORY OF MACHINES-I

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Answer Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6,

Q. 7 or Q. 8.

(ii) Neat diagrams must be drawn wherever necessary.

(iii) Figures to the right indicate full marks.

(iv) Use of calculator is allowed.

(v) Assume suitable data, if necessary.

1. (a) Explain different types of constrained motions with suitable examples. [6]

(b) Find degrees of freedom for the mechanism as shown in the following figure : [4]



P.T.O.

Or

2. (a) With the help of neat schematic diagram derive frequency equation of Trifilar Suspension method. [5]

(b) The connecting rod of an oil engine has a mass of 60 kg, the distance between the bearing centers is 1 meter. The diameter of the big end bearing is 120 mm and of the small end bearing is 75 mm. When suspended vertically with a knife-edge through the small end, it makes 100 oscillations in 190 seconds and with knife-edge through the big end it makes 100 oscillations in 165 seconds. Find the moment of inertia of the rod in  $\text{kg-m}^2$  and the distance of C.G. from the small end centre. [5]

3. (a) Explain construction and working of Epicyclic train dynamometer with neat sketch. [4]

(b) A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform wear and coefficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 25 kW at 1575 r.p.m. [6]

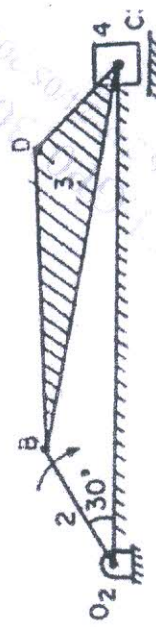
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Or

4. (a) Derive an equation for finding angular velocity and angular acceleration of connecting rod analytical method. [5]
- (b) The driving shaft of a Hooke's joint runs at a uniform speed of 240 r.p.m. and the angle  $\alpha$  between the shafts is  $20^\circ$ . The driven shaft with attached masses has a mass of 55 kg at a radius of gyration of 150 mm. [5]
- (i) If a steady torque of 200 N-m resists rotation of the driven shaft, find the torque required at the driving shaft, when  $\theta = 45^\circ$ .

- (ii) At what value of ' $\alpha$ ' will the total fluctuation of speed of the driven shaft be limited to 24 r.p.m. ?

5. (a) Explain with neat sketch Velocity Image Principle. [3]
- (b) For the mechanism as shown in figure below, find the acceleration of point D on link  $O_2B$  when link  $O_2B$  rotates at 30 r/s using relative velocity and acceleration method. Link lengths are  $O_2B = 200$  mm,  $BD = 460$  mm,  $DC = 175$  mm and  $BC = 600$  mm. [12]



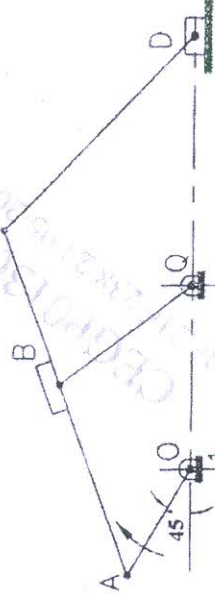
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P.T.O.

Or

6. (a) Explain with the help of neat sketch different type of ICR's. [3]
- (b) For the configuration shown in the following figure, enumerate and locate all the instantaneous centers of velocities and hence find the velocity of slider D, if the link OA rotates at 1000 rpm. Link lengths are  $OQ = 225$  mm,  $QB = 200$  mm,  $AB = 250$  mm,  $OA = 150$  mm,  $AC = 450$  mm,  $CD = 325$  mm. [12]



7. (a) Explain with neat sketch Acceleration Image Principle. [3]
- (b) The cylinder of rotary engine rotates at uniform speed of 900 rpm clockwise about the lower end B of fixed vertical crank AB 10 cm long. The connecting rod AP 40 cm long rotates about the upper end. The piston reciprocates in the cylinder. Determine the angular acceleration of connecting rod for a

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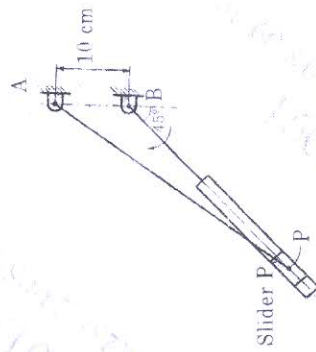
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rad/s<sup>2</sup> second square. Find the following using Klein's

construction :

- (i) The velocity and acceleration of piston,
- (ii) The angular velocity and angular acceleration of the connecting rod
- (iii) The location of point X on the connecting rod which has minimum acceleration. [8]

cylinder which has turned through an angle 45° past the dead centre position as shown in figure, using relative velocity and acceleration method. [12]



Or

8. (a) The crank of reciprocating engine is 225 mm long, the connecting rod is 900 mm long and rpm is 150. Find the velocity and acceleration of the piston and angular velocity and angular acceleration of the connecting rod using Klein's construction when the angle which the crank makes with i.d.c. is 30°. [7]

- (b) The crank of reciprocating engine is 225 mm long, the connecting rod is 900 mm long. When the crank has turned through 120° from inner dead centre, it has an instantaneous speed of 240 rpm clockwise, decreasing at the rate of 100

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