

Total No. of printed pages = 6

ME 181304

Roll No. of candidate

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2023

B.Tech. 3rd Semester End-Term Examination

Mechanical Engineering

THEORY OF MACHINES

(New Regulation and New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Choose the correct option from the following: (10 × 1 = 10)

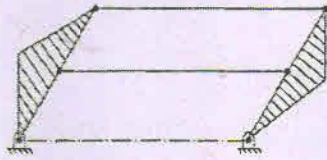
(i) The type of gear used to connect two parallel co – planar shafts is

- (a) Straight spur gear
- (b) Straight bevel gear
- (c) Cross helical gear
- (d) Spiral gear

(ii) Pitch point as refereed to cam is

- (a) Any point on pitch curve
- (b) The point on pitch curve with maximum pressure angle
- (c) The point on pitch curve with minimum pressure angle
- (d) Any point on pitch circle

(iii) Number of degrees of freedom of the mechanisms shown in figure below.



- (a) 0
- (b) 1
- (c) 2
- (d) 3

[Turn over

- (iv) The angular velocity of two pulleys connected by crossed belt or open belt are
- (a) Directly proportional to their diameters
 - (b) Inversely proportional to of their diameters
 - (c) Directly proportional to the square of their diameters
 - (d) Inversely proportional to the square of their diameters
- (v) In a simple gear train, if number of idlers is odd, then the direction of rotation of first and last gear shall be
- (a) Opposite
 - (b) Same
 - (c) Depends on types of gears
 - (d) Depends on the number of teeth on the gears
- (vi) In a kinematic chain, a quaternary joint is equivalent to
- (a) Two binary joints
 - (b) Three binary joints
 - (c) Four binary joints
 - (d) None of the above
- (vii) Proell governor is _____ type of governor.
- (viii) The maximum fluctuation of energy of a flywheel is
- (a) Directly proportional to coefficient of fluctuation of speed
 - (b) Directly proportional to square of the angular velocity of the flywheel
 - (c) Directly proportional to moment of inertia of the flywheel
 - (d) All of the above
- (ix) Considering the safe design, a friction clutch should be designed
- (a) Assuming uniform pressure
 - (b) Assuming uniform wear
 - (c) Assuming any criteria, either uniform pressure or uniform wear
 - (d) None of the above

(x) Sensitivity of the governor is expressed as

(a) $\frac{N_1 - N_2}{N_1 + N_2}$

(b) $2\left(\frac{N_1 - N_2}{N_1 + N_2}\right)$

(c) $\frac{N_1 + N_2}{2(N_1 - N_2)}$

(d) None of the above

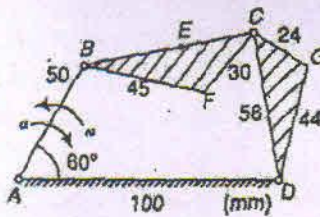
Where N_1 = maximum speed, N_2 = minimum speed.

2. (a) What is meant by inversions of mechanism? Describe with the help of suitable sketches the inversions of a slider crank mechanism. (5)

(b) In the four-link mechanism shown in the figure, the link AB rotates at an angular velocity of 10.5 rad/s and a retardation of 26 rad/s² in counter-clockwise direction. Length of link BE = 40 mm and BC = 66 mm. Find.

(i) The angular acceleration of the links BC and CD

(ii) The linear acceleration of the points E, F and G. (10)



3. (a) Explain the meaning of the following terms : (5)

(i) Hunting of Governor.

(ii) Sensitiveness of Governor.

(iii) Isochronism

(iv) Effort of Governor

(v) Power of Governor.

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- (b) Each ball of a Porter governor has a mass of 3 kg and the mass of the sleeve is 15 kg. The Governor has equal arms, each of 200 mm length and pivoted on the axis of rotation. The minimum and maximum radius of rotation of the balls are 120 mm and 160 mm respectively. Determine the following :

(10)

- (i) Range of speed
- (ii) Lift of the sleeve
- (iii) Effort of the governor
- (iv) Power of the governor.

Also determine the effect of friction on these parameters considering the frictional force as 8 N.

4. (a) With the help of a neat diagram, define the terms as referred to cams : (5)

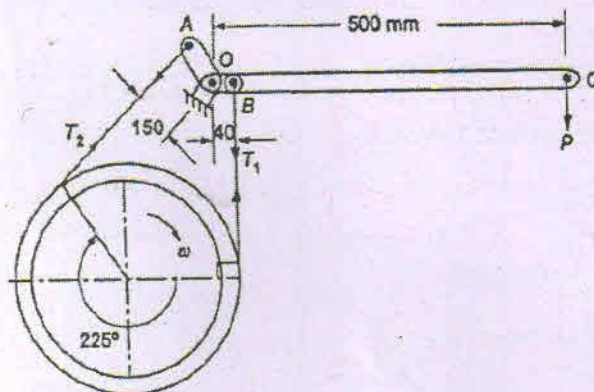
- (i) Prime circle
- (ii) Pitch circle
- (iii) Pressure angle
- (iv) Lift
- (v) Cam angle.

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- (b) A disc cam with base circle radius of 50 mm is operating a roller follower with SHM. The lift is 25 mm, angle of ascent 120° , dwell 90° , and dwell during the remaining period. The cam rotates at 300 rpm. Find the maximum velocity and acceleration during ascent and descent. The roller radius is 10 mm. Draw the cam profile when the line of reciprocating of follower is offset by 20 mm. (10)

5. (a) What is self-locking and self-energizing block brake? A differential band brake as shown in figure, has an angle of contact of 225° . The band has a lining whose coefficient of frictions is 0.3 and the drum diameter is 400 mm. The brake is to sustain a torque of 375 Nm. Find

- (i) The necessary force for the clockwise and counter-clockwise rotation of the drum and
- (ii) The value of OA for the brake to be self-locking, when the drum rotates clockwise. (8)



- (i) The wheel D is fixed and arm α rotates at 200 rpm clockwise.
- (ii) The wheel D rotates at 200 rpm counter-clockwise and arm a rotates at 20 rpm counter-clockwise.

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