Total No. of Questions :10]

SEAT No. :

P2841

[Total No. of Pages :4

[4958] - 1014

T. E. (Mechanical)

THEORY OF MACHINES - II

(End Semester) (2012 Course) (302043) (Semester - I)

Time : 2.30 Hours] *[Max. Marks :70*

Instructions to the candidates:

1) ***Answer Q.1 OR Q2, Q3 OR Q4, Q5 OR Q6, Q7 OR Q8, Q9 OR Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data, if necessary.***

Q1) a) Obtain an expression for minimum number of teeth on a rack to avoid the interference. **[6]**

b) A pair of involute gears is in mesh. The application restricts the space to accommodate these gears with a centre distance of 102 mm. If the gears have a module of 3 mm, and a ratio of speeds of driver to driven is limited to 2, 4:1, determine the number of teeth on these gears. **[4]**

OR

Q2) Two gear wheels having non standard involute teeth mesh externally giving velocity ratio 4:1. The pressure angle is 16 degrees. The arc of approach is not to exceed the circular pitch. **[10]**

Determine

a) Minimum number of teeth on each wheel to avoid the interference.

b) Addendum of the wheel in terms of circular pitch.

c) Angle of action during approach on both the wheels, taking 2 mm module.

Assume the smaller wheel to be driver.

P.T.O.

Q3) a) Explain with example the difference between gearbox and gear train. **[4]**

b) In a reverted epicyclic train, the arm A carries two wheels B and C and a compound wheel D-E. The wheel B gears with wheel E and the wheel C gears with wheel D. The number of teeth on wheels B, C and D are 75, 30 and 90 respectively. Find the speed and direction of wheel C when the wheel B is fixed and arm A makes 110 r.p.m. clockwise. **[6]**

OR

Q4) Derive an expression for efficiency of spiral gears and hence determine the expression for efficiency of worm and worm gear. **[10]**

Q5) a) Explain any three types of mechanical variators with their capacities. **[6]**

b) A four wheeled trolley car has a total mass of 3000 kg. Each axle with its two wheels and gears have a total moment of inertia of 32 kg-m^2. Each wheel is of 500 mm radius. The centre distance between the two wheels on an axle is 1.4m. Each axle is driven by a motor with a speed ratio of 1:3. Each motor along with its gear has a moment of inertia of 16kg- m^2 and rotates in the opposite direction to that of the axle. The centre of mass of the car is 1.2 m above the rails. Calculate the limiting speed of the car when it has to travel around a curve of 20m radius without leaving the rails. **[10]**

OR

Q6) a) Compare stepped and stepless regulation of speed. What is self tightening effect in stepless drives? **[6]**

b) The turbine rotor of a ship has a mass of 2.2 tonnes and rotates at 200 rpm clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when the

i) Ship turns right at a radius of 20 m at a speed of 20 km/h.

ii) Ship pitches with bow rising at an angular velocity of 0.7 rad/s.

iii) Ship rolls at an angular velocity of 0.l rad/s. **[10]**

Q7) a) Derive Freudenstein's equation for the four bar mechanism. **[8]**

b) Synthesize a slider crank mechanism to satisfy following data.Use relative pole method. **[8]**

$\theta_{12} = 30°;$ $S_{12} = 15mm;$

$\theta_{13} = 50°;$ $S_{13} = 25mm;$

$e = 100mm$

OR

Q8) a) Determine the four precision points and three angular positions for the following data **[8]**

$1 \le x \le 4;$ $20° \le \theta \le 55°;$

$y = \left(\frac{x}{1.2}\right)^{0.6};$ $40° \le \phi \le 105°;$

Use Chebychave spacing formula

b) Synthesize a four bar mechanism using inversion method for three precision positions using the following data. **[8]**

$\theta_{12} = 30°;$ $\psi_{12} = 40°;$

$\theta_{13} = 50°;$ $\psi_{13} = 100°;$

Take length of fixed link as 10 units and length of crank as 2 units. The crank has turned through 10° measured anticlockwise from horizontal in its first position.

Q9) a) Describe the following terms **[6]**

i) Undercutting of cam

ii) Significance of pressure angle

iii) 3-4-5 Polynomial cam.

b) Draw a cam profile using following data **[12]**

- Radial roller follower with diameter 10 mm.
- Minimum radius of the cam 40 mm.
- Maximum displacement of the follower 50 mm.
- Cam rotation angle during rise of follower 60°.
- Type of follower motion during rise- Parabolic.
- Cam rotation angle during return of follower 180°.
- Type of follower motion during return- SHM.
- Dwell at highest position of the follower 20°.
- Cam rotates clockwise.

Also determine the maximum pressure angle during rise and return of the follower

OR

Q10)a) Derive an expression for the jump speed of the eccentric cam. **[6]**

b) Draw a cam profile operating an offset roller follower of 12 mm diameter, rotating at 600 rpm counterclockwise direction. Take the following data. **[12]**

- Minimum radius of the cam 50 mm.
- Outstroke with Cycloidal motion with cam rotation of 80°.
- In stroke with uniform acceleration retardation with cam rotation of 120°.
- Dwell at highest position of the follower 30°.

Locate the pitch point and pitch circle.