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**Question Paper Code : 11519**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Third Semester

Mechanical Engineering

ME 2203/113302/ME 35/10122 ME 404/ME 1202 A/080120010 — KINEMATICS OF MACHINERY

(Common to PTME 2203 — Kinematics of Machinery for B.E. (Part-Time) Third Semester Mech. – Regulations 2009)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write Grashoff's law for 4-bar mechanism.

2. What is meant by indexing mechanism? Where do we use it?

3. What is a configuration diagram? What is its use?

4. Define rubbing velocity. What will be the expression for rubbing velocity at a pin joint when the two links rotate in opposite direction?

5. State the expressions for maximum acceleration of a follower moving with cycloidal motion.

6. Why sometimes the axes of translating roller followers in cam follower mechanisms are offset from the axis of rotation of cam?

7. Define the term 'arc of contact' in gears.

8. Name two applications of reverted gear train.

9. Why self locking screws have lesser efficiency?

10. What is meant by a self-locking and a self-energised brake?

PART B — (5 × 16 = 80 marks)

11. (a) Sketch and explain the four inversions of Single-slider crank chain. (16)

Or

(b) (i) What are straight-line mechanisms? Sketch the Peaucellier straight-line motion mechanism and prove that the generating point moves in straight line. (8)

(ii) Sketch a Hooke's joint and derive the condition for equal speeds of driving and driven shafts. (8)

12. (a) In a four bar chain ABCD, AD is fixed and is 120 mm long. The crank AB is 30 mm long and rotates at 100 rpm clockwise while the link CD = 60 mm oscillates about D; BC = 120 mm. Using graphical method, find the angular velocity and angular acceleration of link BC when angle BAD = 60°. (16)

Or

(b) (i) Derive the expressions for the velocity and acceleration of the piston of a reciprocating engine mechanism. (8)

(ii) In a reciprocating engine mechanism, the lengths of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine

(1) velocity of the piston (2)

(2) acceleration of the piston (2)

(3) crank angle for maximum velocity of the piston and the corresponding velocity. (4)

13. (a) A cam with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give motion to a roller follower, at the end of a valve rod, as described below :

(i) To raise the valve through 50 mm during 120° rotation of the cam.

(ii) To keep the valve fully raised through next 30°.

(iii) To lower the valve during next 60° and

(iv) To keep the valve closed during rest of the revolution.

The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. The line of the stroke is offset by 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered is to take place with SHM.

(1) Draw the displacement diagram. Sketch roughly the shapes of velocity and acceleration diagrams. (6)

(2) Draw the profile of the cam. (10)

Or

(b) In a symmetrical tangent cam operating a roller follower, the least radius of the cam is 30 mm and roller radius is 17.5 mm. The angle of ascent is 75° and the total lift is 17.5 mm. The speed of the cam shaft is 600 rpm. Assume that there is no dwell between ascent and descent.

(i) Calculate the principal dimensions of the cam. (6)

(ii) Find the acceleration of the follower at the beginning of the lift. (2)

(iii) Draw the profile of the cam. (8)

14. (a) (i) State and prove the law of gearing. (10)

(ii) Show that the involute curves as the profiles of mating gears satisfy the law of gearing. (6)

Or

(b) A compound gear train using spur gears is required to give a total reduction ratio of 250 to 1 in four steps. The modules of the gears are 5 mm for the first step, 7 mm for the second, 10 mm for the third and 16 mm for the fourth.

(i) Arrive at the individual speed ratios, if a tolerance of ±0.2% is allowed in the total reduction ratio. (4)

(ii) Find the numbers of teeth of all gears, if the minimum number of teeth for any pinion is 20. (4)

(iii) Find the pitch circle diameters of all gears and the centre distances. (4)

(iv) Sketch a line diagram showing the gear train. (4)

15. (a) (i) In a thrust bearing, the external and internal diameters of the contacting surfaces are 320 mm and 200 mm respectively. The total axial load is 80 kN and the intensity of pressure is 350 kN/m$^2$. The shaft rotates at 400 rpm. Taking the coefficient of friction as 0.06, calculate the power lost in overcoming the friction and the number of collars required. (8)

(ii) A screw-jack has a square thread of mean diameter 60 mm and pitch 8 mm. The co-efficient of friction at the screw thread is 0.09. A load of 3 kN is to be lifted through 120 mm. Determine the torque required and the work done in lifting the load through 120 mm. Find also the efficiency of the jack. (8)

Or

(b) (i) Derive an expression for the centrifugal tension in a belt passing round a pulley rim. (6)

(ii) A leather belt is required to transmit 7.5 kW from a pulley 1.2 m in diameter, running at 250 rpm. The angle embraced is 165° and the coefficient of friction between the belt and the pulley is 0.3. The safe working stress for the leather belt is 1.5 MPa; the density of leather is 1000 kg/m$^3$ and thickness of belt is 10 mm. Determine the width of the belt taking centrifugal tension into account. (10)

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