14115

3 Hours / 100 Marks   Seat No.

Instructions : (1) All Questions are *compulsory*.

               (2) Illustrate your answers with neat sketches wherever necessary.

               (3) Figures to the right indicate full marks.

               (4) Assume suitable data, if necessary.

                                                                     Marks

1. **(A)** **Attempt any SIX of the following :**   **12**

    (a) Define :

        (i) Spherical pair

        (ii) Higher pair

    (b) Define :

        (i) Radial follower

        (ii) Off-set follower

    (c) What do you mean by crowning of pulleys in flat belt drive ? State its use.

    (d) Define initial tension in belt drive & state its effect.

    (e) Define fluctuation of speed and fluctuation of energy in case of flywheel.

    (f) Define the sensitivity in relation to governer. State its significance.

    (g) Draw a neat labelled sketch of internal expanding brake.

    (h) State the adverse effect of imbalance of rotating elements of machine.

  (B) **Attempt any TWO of the following :**   **08**

    (a) State any four inversions of single slider crank chain. Describe any one with neat sketch.

    (b) State any four types of friction clutch, along with its application each.

    (c) Define slip and creep with reference to belt drive. Also state their effect on velocity ratio.

2. **Attempt any FOUR of the following :** 16

   (a) What is a machine ? Differentiate between a machine and a structure.

   (b) Describe with neat sketch the working of scotch yoke mechanism.

   (c) Explain the inter-relation between linear and angular velocity, linear and angular acceleration with suitable example.

   (d) Explain the Klein's construction to determine velocity and acceleration of a link in an I.C. engine mechanism.

   (e) Draw the labelled displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion.

   (f) A pulley rotating at 50 m/s transmits 40 kW. The safe pull in belt is 400 N/cm width of belt. The angle of lap is 170º. If coefficient of friction is 0.24, find required width of belt.

3. **Attempt any FOUR of the following :** 16

   (a) In a four-link mechanism, the crank AB rotates at 36 rad/sec. The lengths of a link are AB = 200 mm, BC = 400 mm, CD = 450 mm and AD = 600 mm. AD is the fixed link. At the instant when AB is at right angles to AD determine the velocity of :

     (i) The midpoint of link BC

     (ii) A point on the link CD, 100 mm from the pin connecting the link CD & AD.

   (b) In a slider crank mechanism, the length of crank OB and connecting rod AB are 125 mm and 500 mm respectively. The centre of gravity G of the connecting rod is 275 mm from the slider. The crank speed is 600 rpm closewise. When the crank has turned 45º from the inner dead centre position, determine

     (i) Velocity of slider 'A'

     (ii) Velocity of the point 'G' graphically.

      Draw the configuration diagram also.

   (c) State four advantages and four disadvantages of chain drive over belt drive.

   (d) Explain with neat sketch working of a centrifugal clutch.

   (e) Explain the process of balancing of single rotating mass by a single mass rotating in the same plane.

   (f) Define the following terms as applied to cam with a neat sketch :

     (i) Base circle   (ii) Pitch circle

     (iii) Pressure angle   (iv) Stroke of the follower

4. **Attempt any FOUR of the following :** 16

   (a) Draw neat labelled sketch of spur gear terminology.

   (b) Justify that slider crank mechanism is a modification of the basic four bar mechanism with neat sketch.

   (c) Compare flywheel and governor on any four points.

   (d) Draw a neat labelled sketch of Eddy current dynamometer and state its working principle.

   (e) A car engine has a single plate clutch having outside diameter of 25 cm and inside diameter of 20 cm. If the axial load exerted by springs is 1500 N, determine the power transmitted by the clutch at 700 rpm. Assume uniform wear $\mu = 0.3$.

   (f) Four masses are 260 kg, 160 kg, 300 kg and 200 kg. The corresponding radii of rotation 300 mm, 250 mm, 150 mm and 200 mm respectively. The angle between successive masses are, 0º, 45º, 90º and 135º. Find the position and magnitude of balancing mass required, if its radius of rotation is 200 mm by using graphical method.

5. **Attempt any TWO of the following :** 16

   (a) In a slider crank mechanism, the crank is 480 mm long and rotates at 20 rad/sec in the counter – closewise direction. The length of the connecting rod is 1.6 m when the crank turns 60º from the inner-dead centre determine by relative velocity method

   (i) Velocity of slider

   (ii) Velocity of a point E located at a distance 450 mm on the connecting rod extended.

   (iii) Angular velocity of the connecting rod.

   (b) Construct the profile of a cam to suit the following specifications :

   Cam shaft diameter = 40 mm, least radius of Cam = 25 mm, Diameter of roller = 25 mm, Angle of lift = 120º, Angle of fall = 150º, lift of the follower = 40 mm, number of pauses are two of equal interval between motions. During the lift the motions is SHM. During the fall the motion is uniform acceleration and deceleration. The speed of the cam shaft is uniform. The line of stroke of the follower is off-set by 12.5 mm from the centre of the cam.

   (c) An epicyclic gear train is shown in figure no. 1. The number of teeth on A and B are 80 and 200. Determine the speed of the arm, 'a'

   (i) if A rotates at 100 rpm clockwise and B at 50 rpm counter-clockwise.

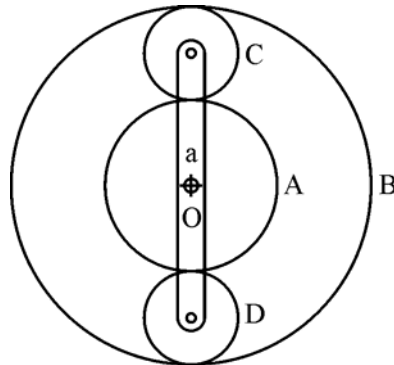(ii) if A rotates at 100 rpm clockwise and B is stationary.

Figure No. 1

6. **Attempt any TWO of the following :** 16

(a) (i) Explain with sketch working principle of epicyclic gear train.
(ii) Draw the neat labelled sketch of centrifugal governor.

(b) A band brake acts on the $\frac{3^{th}}{4}$ of the circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N.m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the (i) anticlockwise direction (ii) clockwise direction.
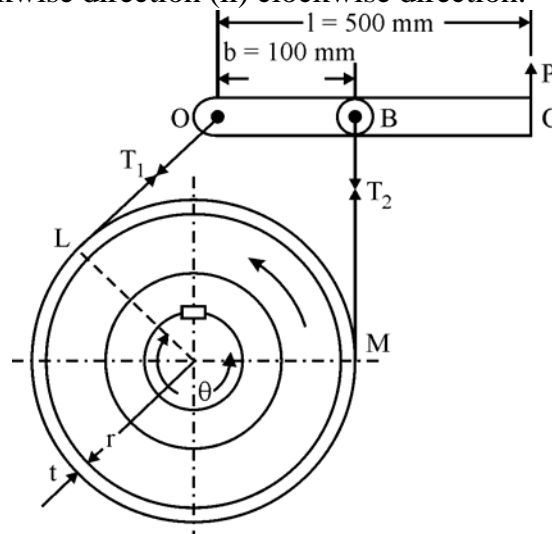

Figure No. 2

(c) Determine the power lost in a footstep bearing due to friction if a load of 15 kN is supported and the shaft is rotating at 100 rpm. The diameter of bearing is 15 cm and coefficient of friction is 0.05. Assume : (i) Uniform wear condition (ii) Uniform pressure condition.

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