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Question Bank

Branch: Mechanical Engg. (Second Year B.Tech.) **Sem.:- IV**

Subject with Subject Code:- Theory of Machines – I **Subject Code: BTMC 402**

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UNIT I

1) What do you understand by inversion of a kinematic chain? Explain with the help of neat sketches any one inversion of a single slider crank chain, giving their practical applications.
2) Find degrees of freedom for the mechanism as shown in the Fig.1.

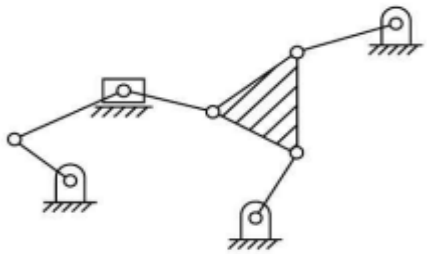

Fig.1.

3) In a four bar mechanism as shown in Fig.2 AB = 200 mm, BC = 300 mm, CD = 320 mm and AD = 550 mm. Crank AB rotates at a uniform speed 200 rpm in anticlockwise direction. When the crank AB has turned 60°, locate all the instantaneous centers and find the angular velocity of link BC.

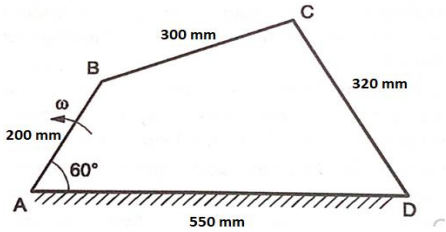

Fig.2.

4) Fig.3 shows a combined four bar & slider mechanism in which the crank AB rotates at a uniform angular speed of 420 rpm.
   Determine:
   The velocity and acceleration of slider, F
   Angular velocity & angular acceleration of link FB

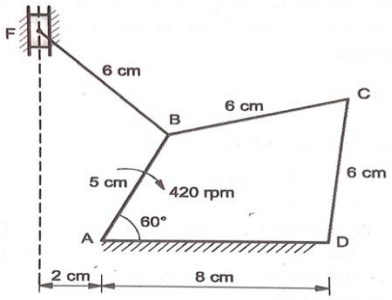

Fig.3.

5) i) Define Grashof's law.
   ii) Describe various types of constrained motions.
6) What is an indexing mechanism? Describe how it is used to divide the periphery of a circular piece into a number of equal parts.
7) Explain the condition for correct steering.

UNIT 2

1) Find expression for the screw efficiency of a square thread. Also determine condition for maximum efficiency.
2) Explain hydrostatic lubrication & hydrodynamic lubrication.
3) Deduce an expression for the efficiency of an inclined plane when a body moves up a plane
4) What are uniform pressure & uniform wear theories? Deduce expressions for the friction torque considering both the theories for a flat collar.
5) In a thrust bearing the external & the internal diameters of the contacting surfaces are 320 mm & 200 mm respectively. The total axial load is 80 kN & 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. Also find the number of collars required for bearing.
6) The following data relate to a screw jack:
   Pitch of a threaded screw = 8 mm
   Diameter of a threaded screw = 40 mm
   Coefficient of friction between screw & nut = 0.1
   Load = 20 kN
   Assuming that the load rotates with the screw, determine the
   i. Ratio of torques required to raise & lower the load
   ii. Efficiency of machine
7) What are the types of threads for power screw?
8) A double-threaded power screw, used for lifting a load, has a nominal diameter of 30 mm and a pitch of 6 mm. The coefficient of friction at the screw threads is 0.1. Neglecting collar friction, calculate:
   i. efficiency of the screw with square threads; and
   ii. efficiency with Acme threads ($2\Theta = 29°$).

UNIT 3

1) What are the two theories applied to friction plates?
2) An automotive single plate clutch consists of two pairs of contacting surfaces. The outer diameter of the friction disk is 270 mm. The coefficient of friction is 0.3 and the maximum intensity of pressure is 0.3 N/mm2. The clutch is transmitting a torque of 531 N-m. Assuming uniform wear theory, calculate:
   i. the inner diameter of the friction disk; and
   ii. spring force required to keep the clutch engaged
3) A centrifugal clutch, transmitting 18.5 kW at 720 rpm, consists of four shoes. The clutch is to be engaged at 75% of the running speed. The inner radius of the drum is 165 mm, while the radius of the centre of gravity of each shoe, during engaged position, is 140 mm. The coefficient of friction is 0.25. Calculate the mass of each shoe.
4) What is partially self-energizing block brake?
5) An automotive-type internal-expanding brake is shown in Fig. 4. The face width of the friction lining is 50 mm and the coefficient of friction is 0.4. The maximum intensity of pressure on the lining is 0.8 N/mm^2. The angle Θ_1 can be assumed to be zero. Calculate:
   i. The actuating force;
   ii. The torque capacity of the brake.

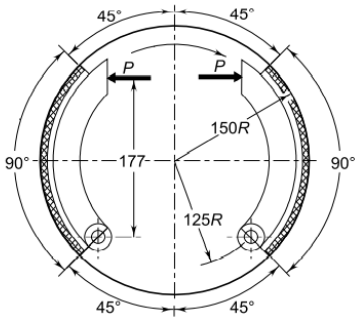

Fig.4.

6) Discuss Prony brake dynamometer & Rope brake dynamometer with neat sketches.
7) Explain transmission type dynamometers.

UNIT 4

1) Define base circle, pitch circle, trace point, pitch curve & pressure angle.
2) How are the cams classified?
3) Draw the profile of a cam operating a knife-edge follower having lift of 30 mm. The cam raises the follower with uniform acceleration & deceleration for 120° of the rotation followed by a period of dwell for 30°. The follower descends for the next 90° rotation of the cam with SHM, again followed by a dwell period. The cam rotates at a uniform speed of 800 rpm & has a least radius of 30 mm. What will be the maximum velocity & acceleration of the follower during the lift & the return?
4) What is a circular arc cam? Find the expression for the velocity & acceleration of a roller follower for such a cam.
5) Draw the profile of a cam operating a roller follower & with following data:
   Minimum radius of cam = 25 mm
   Lift = 30 mm
   Roller diameter = 15 mm
   The cam lifts the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of the cam rotation with uniform acceleration & deceleration followed by a dwell period. If the cam rotates at a uniform speed of 150 rpm, calculate the maximum velocity & acceleration of the follower during the descent period.
6) What is a tangent cam? Find the expression for the velocity & acceleration of a roller follower for such a cam.
7) Describe spring surge, unbalance & wind up.

UNIT 5

1) Explain the direct & reverse crank method for determining unbalanced forces in radial engines.
2) Explain the method of balancing of several masses rotating in different planes.
3) The cranks of a four cylinder marine oil engine are arranged at a interval of 90°. The engine speed is 700 rpm & the reciprocating mass per cylinder is 800 kg. The inner cranks are 1 m apart & symmetrically arranged between the outer cranks which are 2.6 m apart. Each crank is 400 mm long. Determine the firing order of cylinders for best balance of reciprocating masses amongst the firing order 1-2-4-3 & 1-4-2-3 & also determine the magnitude of the unbalanced primary couple for that arrangement.(Neglect the effect of secondary forces & couples)
4) A radial aero-engine has seven cylinders equally spaced with all the connecting rods coupled to a common crank. The crank & each of the connecting rods are 200 mm & 800 mm respectively. The reciprocating mass per cylinder is 3 kg. Determine the

magnitude & the angular position of the balance masses required at the crank radius for complete primary & secondary balancing of the engine. (See Fig.5)

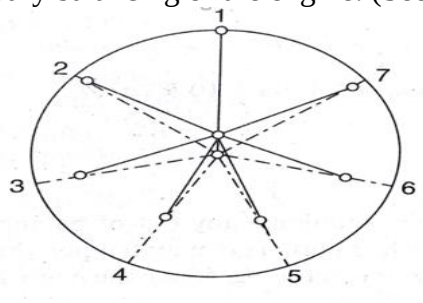

Fig.5.

5) Find the magnitudes of the unbalanced primary & secondary forces in V-engines.
6) The four masses m_1, m_2, m_3 & m_4 having their radii of rotation as 100 mm, 120 mm, 250 mm, & 300 mm are: 200 kg, 250 kg, 150 kg & 100 kg in magnitude respectively. The angles between the successive masses are 45°, 70° & 140° respectively. Find the position & magnitude of the balancing mass required, if its radius of rotation is 350 mm.
7) A rotating shaft carries four unbalanced masses m_1, m_2, m_3 & m_4 of magnitudes 20 kg, 15 kg, 17 kg, & 14 kg revolving at radii 60 mm, 80 mm, 100 mm & 60 mm respectively. The masses m_2, m_3 & m_4 revolve in planes 100 mm, 180 mm & 300 mm respectively from the plane of mass m_1 & are angularly located at 65°, 145° & 270° respectively, measured in anticlockwise direction, from the mass m_1 looking from the mass end of shaft. The shaft is to be dynamically balanced by two masses, both located at 70 mm radii & revolving in plane midway between those of masses m_1 & m_2 & midway between those of masses m_3 & m_4. Determine the magnitudes of the balancing masses & their respective angular position.

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