Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : X 20836

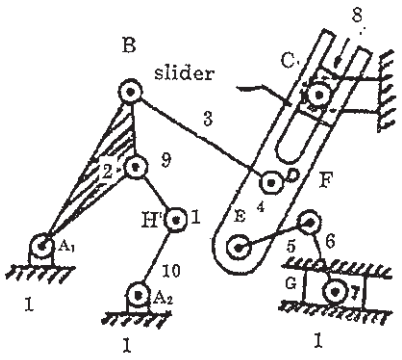
B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Third/Fourth Semester
Mechanical Engineering
ME 6401 – KINEMATICS OF MACHINERY
(Common to Mechanical Engineering (Sandwich) Mechatronic Engineering)
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Determine the number of freedom of the mechanism shown in the figure below :




2. Write a short note on complete and incomplete constraints in lower and higher pairs, depict your answer with neat sketches.

3. What is the total number of instantaneous centers that are possible for mechanism consisting 'n' links ?

4. Name the mechanism in which Corolis component of acceleration is taken into account.

5. What is maximum velocity and acceleration of the follower on both the strokes of uniform acceleration and retardation ?

6. Classify cams based on their physical shape.

7. Define normal and axial pitch in helical gears.

8. What is the advantage when arc of recess is equal to arc of approach in meshing gears ?

9. What kind of friction acts between the tyre and road in an automobile ?

10. State the functional difference between a clutch and a brake.

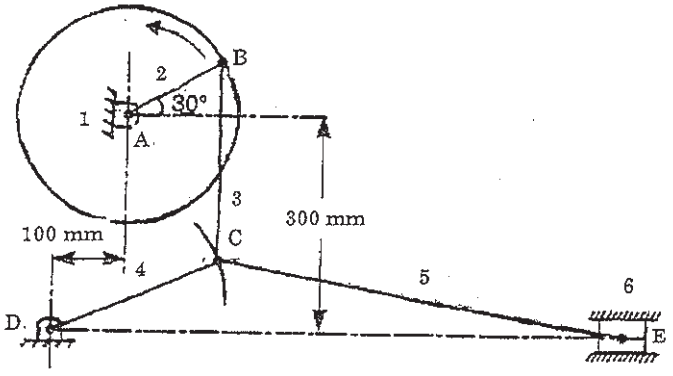
PART – B **(5×13= 65 Marks)**

11. a) Briefly explain the following inversions :
    i) Beam engine
    ii) Scotch yoke mechanism
    iii) Crank and slotted lever quick return mechanism. **(13)**

(OR)

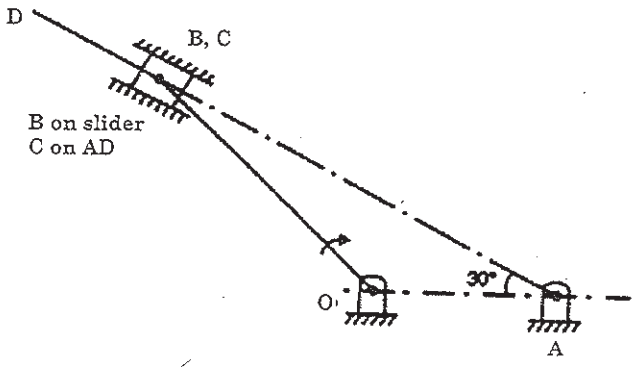
b) i) Explain different types of constrained motion with suitable examples. **(6)**
ii) Describe the working of Peaucellier mechanism and Offset slider mechanism. **(7)**

12. a) Locate. all the instantaneous centres of the mechanism as shown in Fig. shown below. The lengths of various links are: AB = 150 mm ; BC = 300 mm ; CD = 225 mm ; and CE = 500 mm. When the crank AB rotates in the anticlockwise direction at a uniform speed of 240 r.p.m. ; Find
    i) Velocity of the slider E, and
    ii) Angular velocity of the links BC and CE. **(13)**




(OR)

b) A single cylinder rotary engine is shown below. OA is the fixed link, 200 mm long. OB is the connecting rod and is 520 mm long. The line of stroke is along AD and at the instant is inclined at 30° to the vertical. The body of the engine consisting of cylinders rotates at a uniform speed of 400 rpm about fixed centre A. Determine the acceleration of slider B and angular acceleration of connecting rod. **(13)**




13. a) Draw the profile of a cam operating a knife edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return ? **(13)**

(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 r.p.m. Calculate: (i) The principal dimensions of the cam; (ii) the accelerations of the follower at the beginning of the lift, where straight flank merges into the circular nose and at the apex of the circular nose; (iii) Draw the profile of the cam. Assume that there is no dwell between ascent and descent. **(13)**

14. a) The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400N on a flat surface of 60 mm internal diameter and 90 mm external diameter. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut, when the cutting speed is 6 m/min. **(13)**

(OR)

b) Following data is given for a rope pulley transmitting 23.628 kW. Dia of pulley = 40 cm; speed = 110 r.p.m, angle of groove = 45°; angle of lap = 60°, co-efficient of friction = 0.28, No. of ropes = 10. Mass in kg/m length of ropes = $0.0053 \times C^2$ and working tension is limited $12.2\ C^2$ N where C = girth of rope in cm. Find (i) initial tension, and (ii) diameter of each rope. **(13)**

15. a) The external and internal radii of a friction plate of a single clutch are 120 mm and 60 mm respectively. The total axial thrust with which the friction surfaces are held together is 1500 N. For uniform wear, find the maximum, minimum and average pressure on the contact surfaces. **(13)**

(OR)

b) Determine the maximum power that can be transmitted using a belt of 100 mm × 10 mm with an angle of lap of 160°. The density of the belt is 1000 kg/m$^3$ and the co-efficient of friction may taken as 0.25. The tension in the belt should not exceed 1.5 N/mm$^2$. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A compressor, requiring 90 KW to operate at 250 rpm. The drive is by V-belts from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulleys is limited to 1.75m. The belt speed should not exceed 1600m/min. Determine the number of V belts required to transmit the power if each belt has a cross sectional area of 375mm$^2$, density 1000kg/m$^3$ and an allowable tensile stress of 2.5Mpa. The groove angle of the pulley is 35$^o$. The coefficient of friction between the belt and the pulley is 0.25. Also calculate the length of each belt. **(15)**

(OR)

b) i) Derive an expression for minimum number of teeth on the wheel in order to avoid interference. **(7)**

ii) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240 mm and the length of the driving crank is 120 mm. Determine the inclination of the slotted bar with the vertical in the extreme position and the time ratio. If the length of the slotted bar is 450mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever. **(8)**

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