Reg. No. :

Question Paper Code : X10698

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020 AND APRIL/MAY 2021

Third/Fourth Semester

Mechanical Engineering

ME 8492 – KINEMATICS OF MACHINERY

(Common to Mechanical Engineering (Sandwich)/Mechatronics Engineering)

(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Differentiate between a structure and a mechanism.
2. Identify whether the kinematic chain with the following link lengths is Grashofian or not 60 mm, 120 mm, 90 mm and 110 mm.
3. Define instantaneous centre.
4. Draw a sketch to locate the instantaneous center of rotation of a thin disc rolling on a plane rigid surface.
5. Write any two conditions to avoid undercutting in a cam-follower mechanism.
6. Draw a sketch to show prime circle in a cam-follower mechanism.
7. Name the gear drives used for each of the following :
   (i) very high speed reduction ratio (100:1) and (ii) intersecting perpendicular shaft axes.
8. Compare reverted gear train and epicyclic gear train.
9. Distinguish between band brake and block brake.
10. Give two mechanical assemblies where sliding friction exists.

PART – B **(5×13=65 Marks)**

11. a) i) The link lengths of a quadratic cycle chain are shown in Fig. Q. 11 (a) (i). Find all the inversions of the given chain and classify them. **(8)**

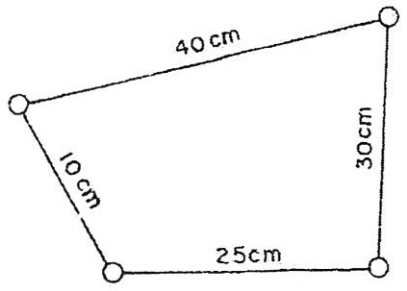

Fig. Q. 11 (a) (i)

ii) A crank-rocker mechanism has a 70 mm fixed link, a 20 mm crank, 50 mm coupler and a 70 mm rocker. Determine the maximum and minimum transmission angles. **(5)**

(OR)

b) Explain the working of any one quick return motion mechanism with a neat sketch. Also ,write the equation for time ratio.

12. a) Fig Q. 12 (a) shows a toggle mechanism in which link D is constrained to move in a horizontal direction. Find the velocity of slider D and angular velocities of links CB and BD. Crank OA rotates at 60 rpm in anticlockwise direction. OA is at 45° to the horizontal. Use graphical method.

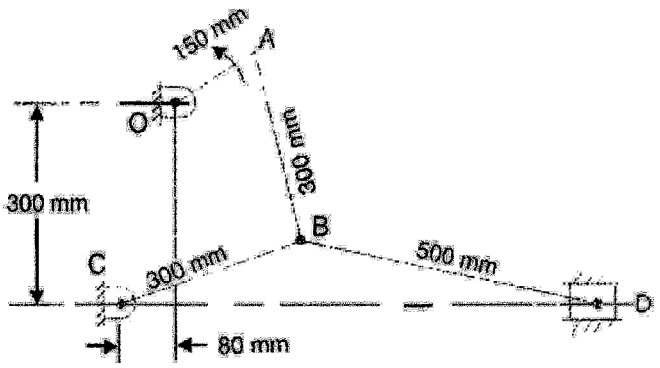

Fig Q. 12 (a)

(OR)

b) For the given configuration of the mechanism shown in Fig. Q. 12 (b), using instantaneous centre method find velocity and angular velocities of links CB and BD. The slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter clockwise direction at a speed of 180 rpm. The dimensions of the various links are OA = 180 mm, CB = 240 mm, AB = 360 mm and BD = 540 mm. For the given configuration find velocity and acceleration of slider D.

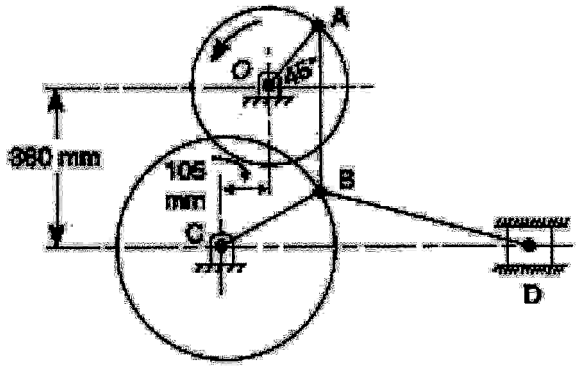

Fig. Q. 12 (b)

13. a) An off-set knife-edged follower is operated by a uniformly rotating cam. The follower is raised to a distance of 30 mm in 90° rotation of the cam, remains at rest for the next 90° and lowered during further 180° rotation of the cam. The rising and falling of the follower take place with cycloidal motion and uniform acceleration and retardation motions respectively. The least radius of the cam is 32 mm. Off-set is 15 mm. Draw the cam profile.

(OR)

b) The radial roller follower and cam mechanism has the following data : Minimum radius of cam = 32 mm; lift = 40 mm; angle of ascent with simple harmonic motion = 160°, dwell = 80° and angle of descent with uniform velocity = 120°; and roller radius = 12 mm. Draw the cam profile.

14. a) A pair of gears having 40 and 20 teeth is rotating in mesh, the speed of the smaller being 2000 rpm. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point and at the point of disengagement if the smaller gear is the driver. The gear teeth are 200 involute, addendum is 5 mm and the module is 5 mm. Also, find the contact ratio and the angle through which the pinion turns while any pair of teeth is in contact.

(OR)

b) In an epicyclic gear train shown in Fig. Q. 14 (b), the pinion A has 16 teeth and is rigidly fixed in the motor shaft. The wheel B has 22 teeth and gears with A and also with annular fixed wheel D. Pinion C has 16 teeth and is integral with B (C, B being a compound gear wheel). Gear C meshes with annular wheel E, which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed and carries the compound wheel B-C. If the motor runs at 2500 rpm, find the speed of the machine shaft. Also, determine the speed of gears B and D when the arm is fixed and the gear A rotates at 850 rpm.

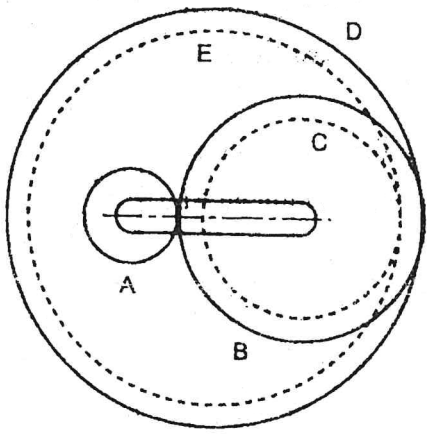

Fig. Q. 14 (b)

15. a) A compressor requires 100 kW to run at 240 rpm from an electric motor of speed 750 rpm by means of a V-belt drive. The diameter of the compressor shaft pulley should not be more than 1 m while the centre distance between the shafts is 2 m. The belt speed should not exceed 25 m/s. Determine the number of V-belts required to transmit the power, if each belt has a cross-sectional area of 375 mm2, density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa. The pulley groove angle is 40° and co-efficient of friction between the belt and the pulley sides is 0.25.

(OR)

b) Derive an equation for the frictional torque acting on the flat pivot bearing considering (i) uniform pressure and (ii) uniform wear.

PART – C **(1×15=15 Marks)**

16. a) Fig. Q. 16 (a) shows a quick return motion mechanism of a shaper. O_1 O_2 = 800 mm, O_1B = 300 mm, O_2D = 1300 mm, DR = 400 mm, crank makes 45° with the horizontal and it rotates at a constant speed of 40 rpm ccw. Determine the velocity and acceleration of tool and angular velocity and angular acceleration of slotted lever. Also, determine the ratio of time for cutting stroke to time for return stroke.

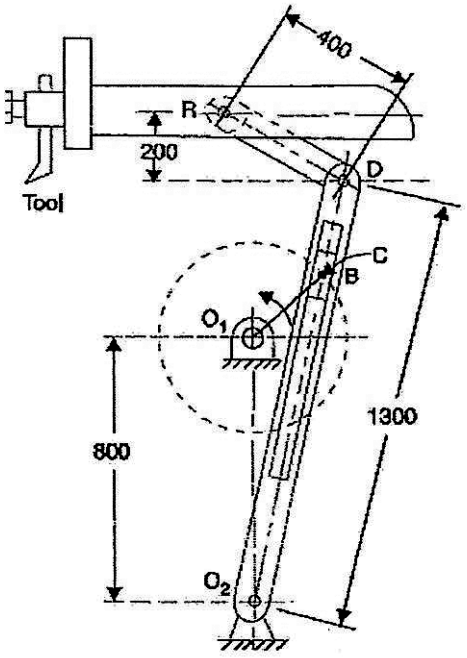

Fig Q. 16 (a)

(OR)

b) In an epi-cyclic gear train shown in Fig. Q. 16 (b), the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm, G. E meshes with A and C and F meshes with B and D. All the wheels have same module and the number of teeth are : $T_C = 28$, $T_D = 26$, $T_E = T_F = 18$. Find the number of teeth on A and B. If the arm G makes 120 rpm anticlockwise and A is fixed, find the speed of B. Also, find the speed of B, if the arm G makes 100 rpm clockwise and A makes 10 rpm counter clockwise.

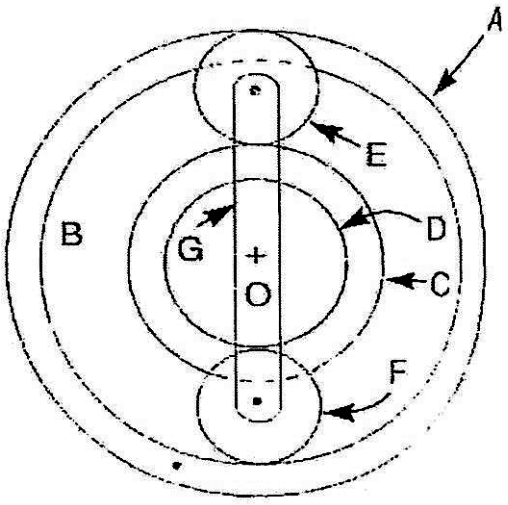

Fig. Q. 16 (b)