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Question Paper Code: 1085028

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024

Fifth Semester

Agricultural Engineering

U20AG501 – THEORY OF MACHINERY

(Regulation 2020)

Time: Three Hours

Maximum: 100 Marks

Answer ALL questions

PART – A

(10 x 2 = 20 Marks)

1. List any two inversions of the four-bar chain mechanism.
2. Show the layout of typical slider-crank mechanism.
3. Interpret the role of friction in screw threads and its effect on efficiency.
4. Summarize the significance of lubrication in bearings, and how it affects friction.
5. List the primary function of a cam and follower mechanism in machinery application.
6. Illustrate the dwell period in cam and follower motion.
7. What is the function of a gear train in power transmission systems.
8. Outline the importance of gear ratio in a simple gear train mechanism.
9. State the role of mass moment of inertia in the performance of a flywheel.
10. Outline the impact of static and dynamic balancing on high-speed rotors.

PART – B

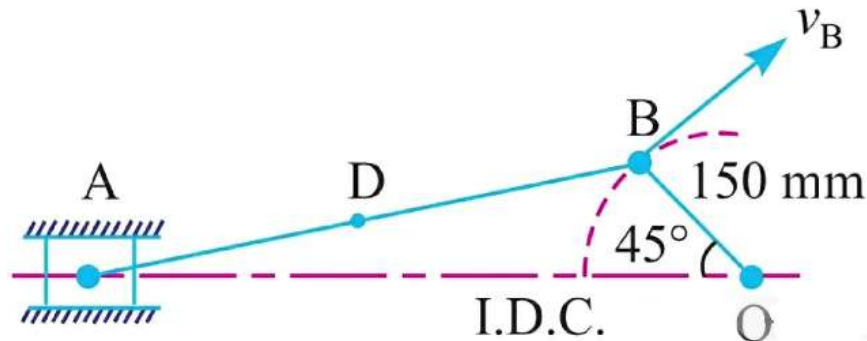
(5 x 16 = 80 Marks)

11. (a) Explain the term kinematic inversion in mechanisms. Also, demonstrate the four applications of inversions of slider crank mechanism with suitable sketches. (16)

(OR)

- (b) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150 mm and the connecting rod is 600 mm long. Represent the velocity diagram of the slider crank and find the following:

- Linear velocity and acceleration of midpoint of the connecting rod and angular velocity
- Angular acceleration of the connecting rod at a crank angle of 45° from the inner dead-centre position



(16)

12. (a) A single plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is limited to 70 kN/m^2 . The mean radius of the plate is 4.5 times the radial width of the friction surface. If both sides of the plate are effective and the coefficient of friction is 0.25, then solve the

- the inner, outer and mean radius of the plate
- width of the friction lining

(16)

(OR)

- (b) A square-threaded bolt with a core diameter of 25 mm and a pitch of 10 mm is tightened by screwing a nut. The mean diameter of the bearing surface of the nut is 60 mm. The coefficient of friction for the nut and the bolt is 0.12 and for the nut and the bearing surface, it is 0.15. Solve the force required at the end of a 400-mm long spanner if the load on the bolt is 12 kN.

(16)

13. (a) A cam with a minimum radius of 25 mm is to be designed for a knife-edge follower with the following data:

- To raise the follower through 35 mm during 60° rotation of the cam
- Dwell for next 40° of the cam rotation
- Descending of the follower during the next 90° of the cam rotation
- Dwell during the rest of the cam rotation

Construct the profile of the cam if the ascending and descending of the cam is with simple harmonic motion and the line of stroke of the follower is offset 10 mm from the axis of the camshaft.

What is the maximum velocity and acceleration of the follower during the ascent and the descent if the cam rotates at 150 rpm?

(16)

(OR)

- (b) The following data relate to a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent.

Minimum radius of cam = 25 mm

Roller diameter = 7.5 mm

Lift = 28 mm

An offset of follower axis = 12 mm towards the right

Angle of ascent = 60°

Angle of descent = 90°

The angle of dwell between ascent and descent = 45°

Speed of cam = 200 rpm

Develop the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke.

(16)

14. (a) Two gears with stub teeth of 0.84 module addendum are engaged when the power component is 0.95 times the normal thrust. Determine the minimum number of teeth to avoid the undercutting and arc of contact when,

(16)

- gear ratio is one
- gear ratio is three
- pinion engages with a rack

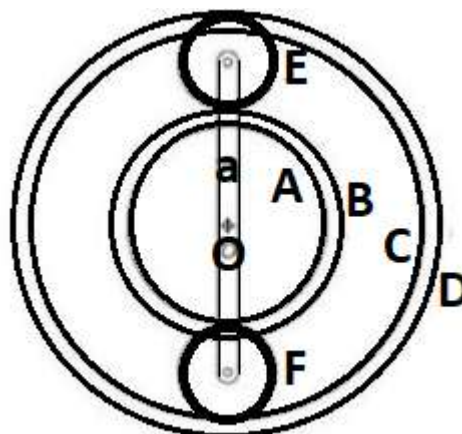
(OR)

- (b) In the epicyclic gear train shown in Figure - Gear train, the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pin fixed to the arm a. All the wheels are of the same module. The number of teeth on the wheels is: $T_A = 52$, $T_B = 56$, $T_E = 36$, $T_F = 36$.

Determine the speed of C if

- the wheel "D" is fixed and arm "a" rotates at 200 rpm clockwise.
- the wheel "D" rotates at 200 rpm counter-clockwise and the arm "a" rotates at 20 rpm counter-clockwise.

(16)



15. (a) Four masses A, B, C and D were carried by a rotating shaft at radii 80mm, 100mm, 200mm and 125mm respectively. The planes of rotation are spaced 500mm apart. The masses B, C and D are 8kg, 4kg and 3kg respectively. Determine the magnitude of mass A and the relative angular position of the entire system, if it is completely balanced. (16)

(OR)

- (b) The turning moment diagram for a multicylinder engine has been drawn to a scale of 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows:
+ 52, - 124, + 92, - 140, + 85, - 72 and + 107 mm², when the engine is running at a speed of 600 rpm. Determine the necessary mass of the flywheel of radius 0.5 m, If the total fluctuation of speed is not to exceed $\pm 1.5\%$ of the mean. (16)