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**Question Paper Code : 51341**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third/Fourth Semester

Mechanical Engineering

ME 3491 — THEORY OF MACHINES

(Common to Mechanical Engineering (Sandwich)/Mechanical and Automation  
Engineering/Agricultural Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of A3 Drawing sheet is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the main components of a slider-crank mechanism?
2. How are cams classified?
3. Sketch two teeth of a gear and show the following: face, flank, addendum and dedendum.
4. What is the law of gearing?
5. Enumerate the kinds of friction.
6. The inner and the outer radii of a single plate clutch are 40 mm and 80 mm respectively. Find the maximum pressure, when the axial force is 3 kN.
7. Give examples of simple machine members that undergo static force analysis.
8. What are inertia forces in dynamic force analysis?
9. Why is balancing necessary for rotors of high-speed engines?
10. Define the term 'vibration isolation'.

PART B — (5 × 13 = 65 marks)

11. (a) For the mechanism shown in figure 11(a), determine the angular velocity of link AB.

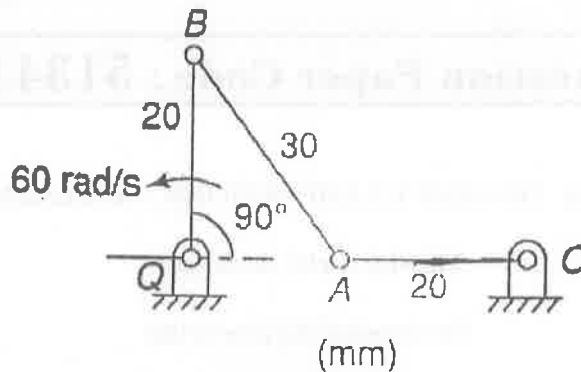


Figure 11(a)  
Or

- (b) The following data relate to a circular cam operating a flat-faced follower :  
Least diameter = 40 mm  
Lift = 12 mm  
Angle of action = 160 degree  
Speed = 500 rpm

If the period of acceleration of the follower is 60 degree of the retardation during the lift, determine the main dimensions of the cam and acceleration at the main points. Also, find the maximum acceleration and deceleration during the lift.

12. (a) Explain the working principle and application of a simple gear train. Derive the expression for the gear ratio in a simple gear train.

Or

- (b) Figure 12(b) shows an epicyclic gear train in which the driving gear A has 20 teeth, the fixed annular gear C has 150 teeth and the ratio of teeth in gears D and E is 21:50. If 2 kW of power at a speed of 800 rpm is supplied to the gear A, determine the speed and the direction of rotation of gear E. Also, find the fixing torque required at the gear C.

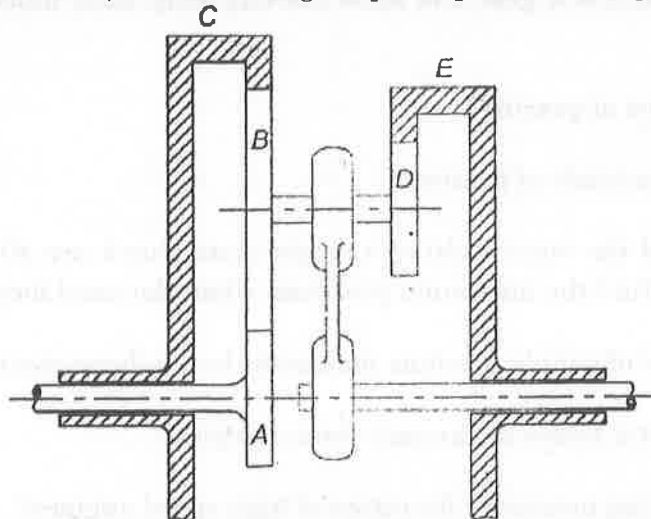


Figure 12(b)

13. (a) If the capacity of a single-plate clutch decreases by 13% during the initial wear period, determine the minimum value of the ratio of internal diameter to external diameter for the same axial load. Consider both the sides of the clutch plate to be effective.

Or

- (b) In a belt drive, the mass of the belt is 1 kg/m length and its speed is 6 m/s. The drive transmits 9.6 kW of power. Determine the initial tension in the belt and the strength of the belt. The coefficient of friction is 0.25 and the angle of lap is 202 degree.
14. (a) A truss is composed of three members and supported by a pin joint at each end. The members are made of steel and have cross-sectional areas of 2 cm<sup>2</sup>, 3 cm<sup>2</sup> and 4 cm<sup>2</sup> respectively. The truss is loaded with a force of 500 N applied at an angle of 60 degrees to the horizontal. Determine the axial forces in each of the members and draw the free body diagram.

Or

- (b) Explain D'Alembert's principle and its significance in dynamic force analysis.
15. (a) Explain the method of finding the counter-masses in two planes to balance the dynamic unbalance of rotating masses .

Or

- (b) A torsional system is shown in figure 15(b). Find the frequencies of torsional vibrations and the positions of the nodes. Also, find the amplitudes of vibrations.  $G = 84 \times 10^2 \text{ N/m}^2$

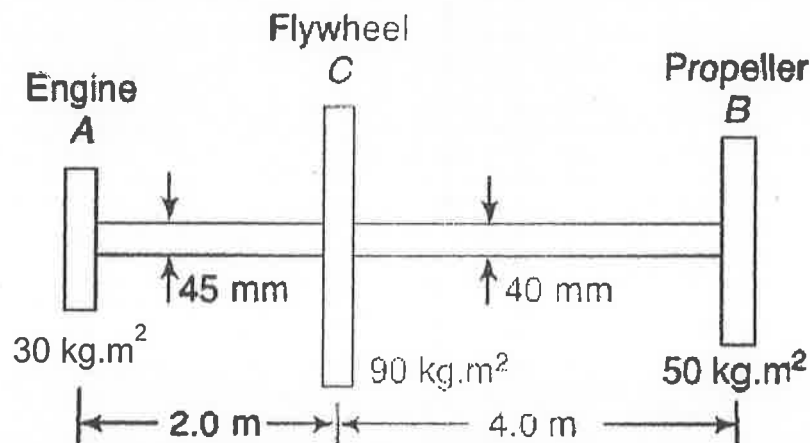


Figure 15(b)

PART C — (1 × 15 = 15 marks)

16. (a) A gear with 20 teeth and a pitch circle diameter of 40 mm is in mesh with another gear with 30 teeth. The pressure angle is 20 degrees and the module is 3 mm. Determine the addendum, dedendum and tooth thickness of each gear. Also, calculate the contact ratio and the minimum number of teeth required to avoid interference.

Or

- (b) Discuss the challenges and opportunities involved in the design high-speed mechanisms, including the importance of minimizing vibrations and ensuring accuracy and safety.

