Reg. No. : | E | N | G | G | T | R | E | E | . | C | O | M |

Question Paper Code : 50029

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

Fourth Semester

Aeronautical Engineering

AE 3491 – MECHANICS OF MACHINES

(Common to : Aerospace Engineering/Industrial Engineering/ Industrial Engineering and Management)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the lower and higher pair.
2. Define Mechanism.
3. Define the term diametral pitch.
4. What is Interference and under cutting in Gear?
5. Define film friction.
6. Define laws of friction.
7. What is applied and constrained forces?
8. Recall the D'Alembert's principle.
9. What is damped vibration?
10. What is the difference between free and forced vibration?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Interpret the Grashof's law with all three conditions. (6)

(ii) Explain the inversions of the slider crank mechanism with a diagram. (7)

Or

(b) (i) Derive the expression of Grubler's formula for planar mechanisms. (6)

(ii) Explain the inversions of the four-bar mechanism with a diagram. (7)

12. (a) (i) Illustrate the interference and undercutting of spur gears. (7)

(ii) Differentiate between involute and cycloidal tooth profiles of the gears. (6)

Or

(b) (i) Describe the procedure of the law of tooth gearing. (7)

(ii) Explain the various types of gear trains with a neat sketch. (6)

13. (a) (i) Derive the expression of screw threads with a neat sketch. (8)

(ii) Discuss the disc and multi-plate clutch with a diagram. (5)

Or

(b) (i) Explain the sliding and rolling friction with a neat sketch. (8)

(ii) Discuss the cone and centrifugal clutch with a diagram. (5)

14. (a) (i) Explain the superposition theorem as applicable to a system of forces acting on a mechanism. (8)

(ii) Derive the expression of inertia of the connecting rod with the diagram. (5)

Or

(b) (i) Illustrate the conditions for a body to be in equilibrium under the action of two forces, three forces and a torque. (8)

(ii) Derive the torque expression for the turning moment on the crankshaft. (5)

15. (a) (i) Derive the expression of balancing of several masses in different planes. (7)

(ii) Illustrate the expression of spring mass damper for undamped free vibration with a neat sketch. (6)

Or

(b) (i) Derive the static balance if the combined mass center of the system on the axis of rotation. (7)

(ii) Illustrate the expression for forced vibration with diagram. (6)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Construct 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 the least radius of 20 mm. (8)

(ii) A reverted gear train shown in Fig. 16(a)(ii) is used to provide a speed ratio of 10. The module of gears 1 and 2 is 3.2 mm and of gears
3 and 4 is 2 mm. Determine suitable number of teeth for each gear. No gear is to have less than 20 teeth. The centre distance between shafts is 160 mm. (7)

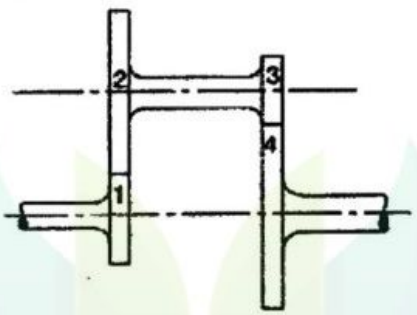

Fig. 16(a)(ii)

Or

(b) (i) PQRS is a four bar chain with link PS fixed is shown in Fig. 16(b)(i). The lengths of the links are PQ = 62.5 mm; QR = 175 mm; RS = 112.5 mm; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity diagram when angle QPS = 60° and Q and R lie on the same side of PS. Calculate the angular velocity and angular acceleration of links QR and RS. (8)

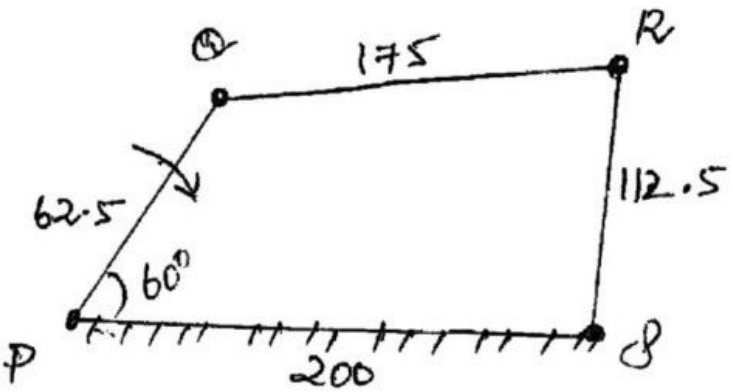

Fig. 16(b)(i)

(ii) An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates about the centre of the gear A at a speed 80 rpm counter clockwise Fig. 16(b)(ii). Determine the speed of the gear B. if (1) the gear A is fixed (2) the gear A revolves at 240 rpm clockwise instead of being fixed. (4+3)

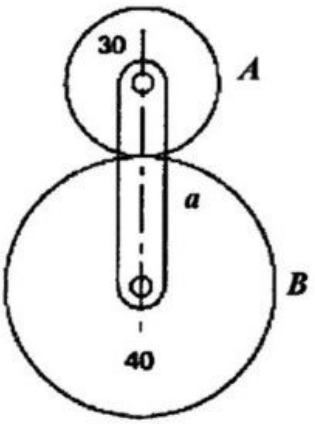

Fig. 16(b)(ii)