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Question Paper Code : 91203

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fourth Semester

Production Engineering

PR 8451 — MECHANICS OF MACHINES

(Common to Aeronautical Engineering/Aerospace Engineering/
Automobile Engineering/Industrial Engineering/
Manufacturing Engineering/Mechanical and Automation Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define flexible link. Give example.
2. Write and explain Grubler's equation.
3. What do you understand by the term 'interference' as applied to gears?
4. Classify different types of gear trains.
5. What is role of friction in screw jack?
6. List the desirable properties of belt materials.
7. Give the applications of gyroscopic couple.
8. Whether grinding wheels are balanced or not. If so Why?
9. What do you mean by damping and damped vibration?
10. Specify the importance of vibration isolation.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain any two inversions of a Single Slider Crank Chain mechanism. (5)

(ii) The Figure 11(a) shows the layout of a quick return mechanism of the oscillating link type, for a special purpose machine. The driving crank BC is 30 mm long and time ratio of the working stroke to the return stroke is to be 1.7. If the length of the working stroke of R is 120 mm. determine the dimensions of AC and AP. (8)

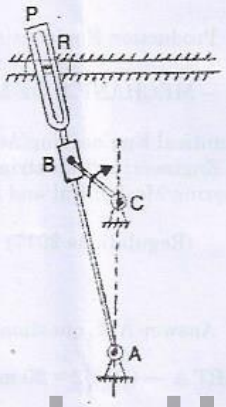

Fig. 11 (a)

Or

(b) (i) Define the following terms :

(1) Base circle (2) Trace point and (3) Pressure angle. (3)

(ii) A cam is to be designed for a knife edge follower with the following data:

Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. Dwell for the next 30°.

During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.

Dwell during the remaining 180°.

Draw the profile of the cam, when the line of stroke of the follower passes through the axis of the cam shaft, and the radius of the base circle of the cam is 40 mm. (10)

12. (a) (i) Give a Detailed Classification of toothed wheels. (7)

(ii) The number of teeth on each of the two equal spur gears in mesh are 40. The teeth have 20° involute profile and the module is 6 mm. If the arc of contact is 1.75 times the circular pitch, find the addendum? (6)

Or

(b) (i) What do you understand by 'gear train'? Discuss the compound gear trains. (5)

(ii) An Epicyclic train of gears is arranged as shown in Fig. How many revolutions does the arm, to which the pinions B and C are attached, make?

when A makes one revolution clockwise and D makes half a revolution anticlockwise. (8)

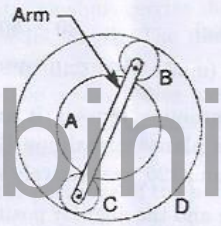

Fig. 12(b)

13. (a) (i) What are various kinds of friction? Discuss Limiting angle of friction. (7)

(ii) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm/min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at the screw threads is 0. 1. Estimate power of the motor. (6)

Or

(b) (i) What is meant by the expression 'friction circle'? Deduce an expression for the radius of friction circle in terms of the radius of the journal and the angle of friction. (5)

(ii) An open belt drive connects two parallel shafts 1.2 m apart. The driving and driven shaft rotate at 350 r.p.m and 140 r.p.m respectively and the driven pulley is 400 mm in diameter the belt 5 mm thick and 80 mm wide. Coefficient friction between belt and pulley is 0.3 and maximum permissible tension in the belting is 1.4 MN/m². Determine

The diameter of driving pulley

Maximum power in kw that may be transmitted by belting, and

The required initial tension in the belt (8)

14. (a) (i) Explain the terms 'static balancing' and 'dynamic balancing'. State the necessary condition to achieve them. (5)

(ii) Four masses A, B, C and D as shown below are to be completely balanced.

	A	B	C	D
Mass (kg)	-	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angles between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Find:

The magnitude and the angular position of mass A: and

The position of planes A and D. (8)

Or

(b) (i) Explain the term height of the governor. Derive an expression for the height in the case of a Watt governor. What are the limitations of a Watt governor? (6)

(ii) An aero plane makes a complete half circle of 50 m radius, towards left, when flying at 200 km per hr. The rotary engine and the propeller of the plane has a mass of 400 kg and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. (7)

15. (a) (i) Derive an expression for the natural frequency of free transverse and longitudinal vibrations by equilibrium method. (7)

(ii) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is 200 GN/m². Determine the frequency of longitudinal and transverse vibrations of the shaft. (6)

Or

(b) (i) Describe the method of finding the natural frequency of torsional vibration for three rotor system (7)

(ii) A flywheel is mounted on a vertical shaft as shown in Fig. The both ends of a shaft are fixed and its diameter is 50 mm. The flywheel has a mass of 500 kg and its radius of gyration is 0.5 m. Find the natural frequency of torsional vibrations, if the modulus of rigidity for the shaft material is 80 GN/m². (6)

PART C — (1 × 15 = 15 marks)

16. (a) A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their center of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The center pulley has a mass of 56 kg and its center of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance, Determine :

(i) Relative angular positions of the pulleys, and

(ii) Dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m.

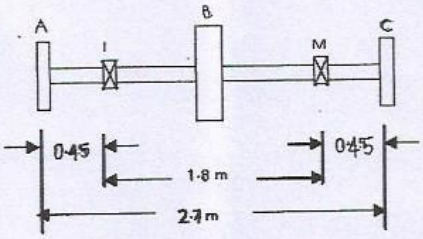

Fig. 16(a)

Or

(b) Draw a cam profile to drive an oscillating roller follower to the specifications given below

(i) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of the cam;

(ii) Follower to return to its initial position during next 120° rotation of the cam;

(iii) Follower to dwell during the next 120° of cam rotation.

The distance between pivot center and roller center = 120 mm: distance between pivot center and cam axis = 130 mm; minimum radius of cam = 40 mm; radius of roller = 10 mm: inward and outward strokes take place with simple harmonic motion.

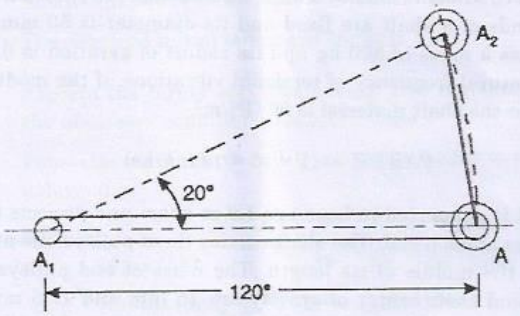

Fig. 16(b)