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D 4006

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Fourth Semester

Aeronautical Engineering

AE 1253/AT 1252/ PR 1252 — MECHANICS OF MACHINES

(Common to Automobile Engineering and Production Engineering)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the important kinematic chains with four kinematic pair?

2. What is the importance of finding accelerations of various points in a mechanism? Name the two different methods of finding acceleration in a mechanism.

3. Prove that the angle of friction is equal to the angle of the inclined plane, when a solid body of weight W placed on the inclined plane, is about to slide down.

4. Differentiate between:

   (a) Pivot and collar bearing

   (b) Theory of uniform pressure and theory of uniform wear.

5. Explain the terms :

   (a) module

   (b) pressure angle.

6. What do you mean by 'interference between two mating gears?

7. What do you mean by static balancing and dynamic balancing? What are the necessary conditions to achieve them?

8. Define and explain the term 'Balancing of Rotating Masses'. What is the effect of unbalancing of rotating parts in a high speed engine?

9. Prove that the natural angular velocity (or circular frequency) of a body having free longitudinal vibration is given by

$$w_n = \sqrt{\frac{s}{m}}$$

Where w_n = Circular frequency or natural angular velocity,

s = Stiffness of the spring to which the body of mass m is attached and
m = Mass of vibrating body

10. What do you understand by "Torsionally equivalent shaft"?

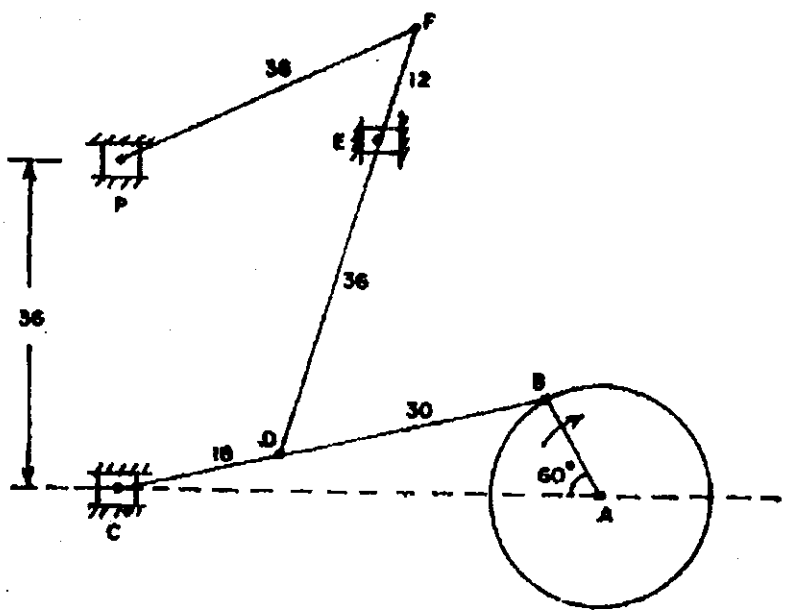
PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain in details the double-slider crank mechanism. Name all the inversions of double-slider crank mechanism.

(ii) With a neat sketch explain the inversion of double-slider crank mechanism which is used in elliptical trammel.

Or

(b) In the steam engine mechanism, shown in figure 1 the crank AB rotates at 200 r.p.m. Find the velocities of C, D, E, F and P. Also find the acceleration of the slider at C. The dimensions of the various links are: AB = 12cm, BC = 48 cm, CD = 18 cm, DE = 36cm and EF = 12 cm and FP = 36 cm.



All Dimensions are in cm.

Figure 1

12. (a) The external and internal radii of a friction clutch of disc type are 90 mm and 50 mm respectively. Both sides of the friction clutch are effective and co-efficient of friction is equal to 0.25. The friction clutch is used to rotate a machine from a shaft which is rotating at a constant speed of 240 r.p.m. The moment of inertia of the rotating parts of the machine is 5.5 kg m^2. The intensity of pressure is not to exceed $0.8 \times 10^5 N/m^2$. Assuming uniform wear, determine the time required for the machine to attain the full speed when the clutch is suddenly applied. Also determine the energy lost in slipping of the clutch.

Or

(b) An open belt connects two flat pulleys, the smaller pulley being of 400 mm in diameter. The angle of lap on the smaller pulley is 160° and co-efficient of friction between belt and pulley is 0.25.

Which of the following alternatives would be more effective in increasing the power that could be transmitted:

(i) increasing the initial tension by 10%.

(ii) increasing the co-efficient of friction by 10% by the application of suitable dressing to the belt?

13. (a) Two mating involute spur gears of 20° pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 r.p.m. The modular pitch of the teeth is 12 mm. If the addendum on each wheel is such that the path of approach and the path of recess on each side are half the maximum possible length each, find :

(i) the addendum for pinion and gear wheel ;

(ii) the length of arc of contact ;

(iii) the maximum velocity of sliding during approach and recess,

Assume pinion to be the driver

Or

(b) Figure 2 shows an epicyclic gear train. Pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel D. Pinion C has 15 teeth and is integral with B (B, C 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 1000 r.p.m., find the speed of the machine shaft. Find the torque exerted on the machine shaft if the motor develops a torque of 100 Nm.

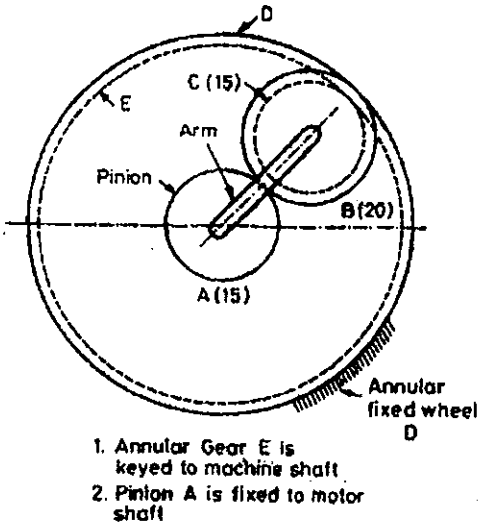


Figure 2

14. (a) Figure 3 shows a long shaft carries three pulleys, two at its ends and the third at midpoint. The two end pulleys have masses 48 kg and 20 kg and their centre of gravities are 1.5cm and 1.25 cm respectively from the axis of the shaft, the middle pulley has mass 56 kg and its C.G. is 1.5 cm from the shaft axis. The pulleys are so keyed to the shaft that the assembly is in static balance. The shaft rotates at 300 r.p.m. in two bearings 180 cm apart with equal overhungs on either sides. Determine relative angular position of the pulleys.

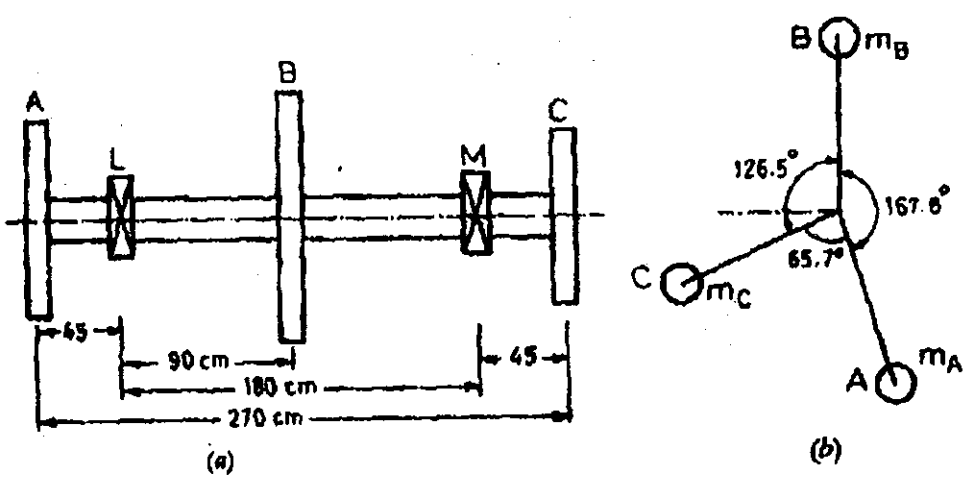


Figure 3

Or

(b) A four-cylinder vertical engine is in complete primary balance. The length of the cranks are 150 mm. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find (i) the mass of the reciprocating parts for the third cylinder and (ii) the relative angular positions of the cranks.

15. (a) Figure 4 show a flywheel of mass 750 kg mounted on a vertical shaft of diameter 50 mm. The both ends of the shaft are fixed. The length L_1, of the shaft is 1350 mm whereas the length L_2 is 900 mm. If E = 200 GN/m^2, then find the natural frequencies of the longitudinal and transverse vibrations. Neglect the weight of the shaft.

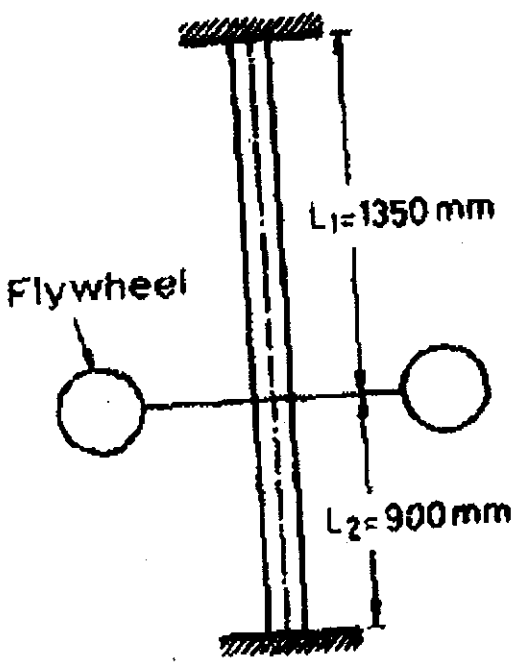


Figure 4

Or

(b) A reciprocating I.C. engine is coupled to a centrifugal pump through a pair of gears. The shaft from the flywheel of the engine to the gear wheel has a 45 mm diameter and is 1 m long. The shaft from the pinion to the

pump has a 30mm diameter and is 810mm long. Pump speed is four times the engine speed. The moment of inertia of flywheel, gear wheel, pinion and pump are 400 kg m^2, 8 kg m^2, 2 kg m^2 and 10 kg m^2 respectively. If the modulus of rigidity of shaft material is 80 GN/m^2, find the natural frequency of torsional vibrations of the systems.
