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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCDOM **Max Marks: 100**
Course: Dynamics of Machines **Date: 27.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) What are the conditions of static equilibrium of a two-force member, three-force member and a member with two forces and a torque? **06**

b) In a four-bar mechanism shown in fig Q1(b), determine the forces acting on all the pin joints and the external moment applied to the link 2 to hold the mechanism in equilibrium. **14**

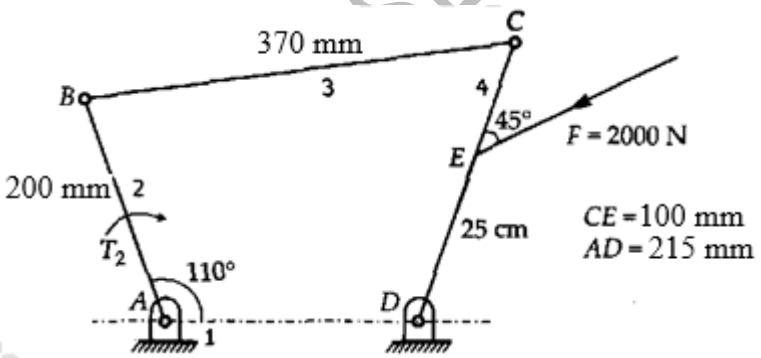

Fig.Q1(b)

OR

2 a) Define the terms: **06**
i) Coefficient of fluctuation of energy
ii) Coefficient of fluctuation of speed

b) A machine shaft running at 200 rpm. requires a torque which varies uniformly from 1200 Nm to 3600 Nm during the first half revolution, remains constant for the next one revolution, decreases uniformly to 1200 Nm during the next one revolution and then remains constant for the next two revolutions, thus completing a cycle of operations. Motor has a constant torque and has a rotor of mass 50 kg with radius of gyration of 0.25 m. If, in addition a flywheel of mass 2000 kg and radius of gyration 0.60 is fitted to the shaft, find: **14**
i) The power of the motor, and
ii) Percentage fluctuation of speed.

UNIT - II

3 a) State the laws of solid friction and explain with a neat sketch the angle of liming friction. **05**

b) Derive the relation, $\frac{T_1}{T_2} = e^{\mu\theta}$ for a flat belt drive with usual notation. **05**

c) A flat belt is required to transmit 35 kW from a pulley of 1.5 m effective diameter running at *300* rpm. The angle of contact is spread over 11/24 of the circumference and the coefficient of friction between belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is 1.1 *x* 10^3 kg/m^3 and the related permissible working stress is 2.5 N/mm^2. **10**

OR

4 A tangent cam with a base circle diameter of 50 mm operates a roller follower 20 mm in diameter. The line of stroke of the roller follower passes through the axis of the cam. The angle between the tangential faces of the cam is 60°, speed of the cam shaft 200 rpm and the lift of the follower 15 mm. Calculate: **20**

(i) the main dimensions of the cam
(ii) the acceleration of the follower at the beginning of the lift
(iii) where the roller just touches the nose
(iv) the apex of the circular nose.

UNIT - III

5 a) Explain static and dynamic balancing. **06**

b) A shaft carrier four masses in parallel planes A, B, C and D in order along a shaft. The masses at B and C weigh 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190° both the angles measured in the same sense. The axial distance between the planes A and B is 100 mm and between B and C is 200 mm. If the shaft is in complete dynamic balance determine: **14**

(i) The weight of masses at A and D.
(ii) The distance between plane C and D,
(iii) Angular position of mass at D.

UNIT - IV

6 a) Explain partial primary balancing of reciprocating masses. **06**

b) The reciprocating masses of first three cylinders of a four-cylinder engine are 4.1, 6.2 and 7.4 tonnes respectively. The centre lines of three cylinders are 5.2 m, 3.2 m, and 1.2 m from the fourth cylinder. If the cranks for all cylinders are equal, determine the reciprocating mass of 4th cylinder and angular position of crank such that system is completely balanced for the primary force and couple. If the crank radius 800 mm, connecting rod 3.8 m, and speed of the engine 75 r.p.m., find the maximum unbalanced secondary force and crank angle at which it occurs. **14**

UNIT - V

7 a) Derive an expression for gyroscopic couple, $C_{gyro} = I\ \omega\ \omega_p$ **06**

b) A rear engine automobile is travelling along a track of 100 m mean radius. Each of 4 road wheels has moment of inertia of 2 kg-m^2 and effective diameter of 600 mm. The rotating parts of engine have moment of inertia of 1 kg-m^2. The engine axis is parallel to rear axle and crank shaft rotates in the same sense as the road wheels. The gear ratio between engine to back axle is 3: 1. The vehicle weighs 1500 kg and has C.G. 500 mm above road level. The width of track of vehicle is 1.5 m. Determine the limiting speed of vehicle around the curve for all four wheels to maintain contact with the road surface if this is not cambered. **14**

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