CBCS SCHEME

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15AU52

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Dynamics of Machines

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define equilibrium of 2 force, 3 force, two force and torque members with neat sketches. **(06 Marks)**

b. The Fig.Q1(b) shows a slider-crank mechanism. A force of F = 3000 N is applied on the slider. Determine various forces on each member and also the driving torque T_2 on the crank.

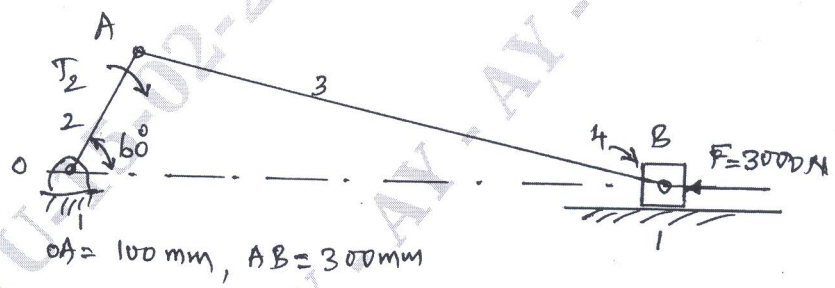

Fig.Q1(b) **(10 Marks)**

OR

2 a. Define Inertia force and inertia torque. **(02 Marks)**

b. Give the statement of D-Alembert's principle. **(02 Marks)**

c. The connecting rod of a gasoline engine is 300 mm long between its centers. It has a mass of 15 kg and mass moment of inertia of 7000 kg/mm^2. The centre of gravity is at 200 mm from its small end centre. Determine the dynamical equivalent two mass system of the connecting rod if one of the mass is located at the small end centre. **(12 Marks)**

Module-2

3 a. Why is balancing of rotating parts necessary for high speed engine? **(02 Marks)**

b. A shaft carries four masses A, B, C and D are 200 kg, 300 kg, 240 kg and 360 kg respectively, revolving at radii 90 mm, 70 mm, 100 mm and 120 mm respectively. The distance from the plane A are 270 mm, 420 mm and 720 mm. Angle between the crank A and B is 45°, B and C is 75 °, C and D is 130°. Balancing masses are placed 120 mm and 100 mm from D and A respectively. The distance between them being 500 mm. Find the balancing masses and their angular position, if they are placed at a radius of 100 mm. **(14 Marks)**

OR

4 a. What is "primary balancing" and "secondary balancing" as applied to balancing of reciprocating masses? **(04 Marks)**

b. The pistons of a 4-cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. Pitch of cylinder = 0.35 m, crank radius = 0.12 m, length of connecting rod = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has a mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **(12 Marks)**

Module-3

5 a. Derive for height of Porter governor analytically. **(08 Marks)**

b. The TMD of a single cylinder double acting engine consists of 2 isosceles triangles. The maximum T.m are 2000 and 1500 Nm respectively when the engine works against a uniform resistance at a mean speed of 240RPM. Find :

i) Power
ii) Maximum fluctuation of energy
iii) Mass of flywheel

Radius of gyration is 0.75m and the fluctuation of speed is limited to 20% mean speed. **(08 Marks)**

OR

6 a. A porter governor has all four arms 300mm long, the upper arms are pivoted on the axis of rotation and lower arms are attached to the sleeve at a distance 35mm from axis. The mass of each ball is 7kg and the load on the sleeve is 540N. Determine the equilibrium speed for the two extreme radii of 200mm and 260mm of rotation of governor balls. **(08 Marks)**

b. In a spring controlled governor, the curve of controlling force is a straight line. When the balls are 0.4m apart, the controlling force is 1500N and when 0.25m apart it is 750N. At what speed the governor will rum when the balls are 0.3m apart. What initial tension will be required for isochronisms and what would be the speed mass of each ball is 6kg. **(08 Marks)**

Module-4

7 a. Enumerate laws of friction. **(04 Marks)**

b. Derive an equation for frictional torque developed in a flat pivot bearing. **(06 Marks)**

c. A shaft has a number of collars integral with it. The external diameter of the collar is 400 mm and the shaft diameter is 250 mm. If the intensity of pressure is 0.35 N/mm^2 (uniform), and the coefficient of friction is 0.05, estimate the power absorbed when the shaft runs at 105 rpm carrying a load of 150 kN and number of collars required. **(06 Marks)**

OR

8 a. Derive an expression for centrifugal tension in the belt. **(04 Marks)**

b. A pulley is driven by a flat belt, the angle of lap being 120°. The belt is 100 mm wide by 6 mm thick and density 1000 kg/m^3. If coefficient of friction is 0.3 and maximum stress in the belt is not to exceed 2 MPa, find the greatest power which the belt can transmit and the corresponding speed of the belt. **(12 Marks)**

Module-5

9 A rear engine automobile is traveling along a track of 100 mm mean radius. Each of four road wheels has a moment of inertia of 2 $kg\text{-}m^2$ and an effective diameter of 60 cm. The rotating parts of the engine has a moment of inertia of 1 $kg\text{-}m^2$. The engine axis is parallel to the rear axle. The crank shaft rotates in the same sense as the road wheels. The gear ratio of engine to back axle is 3:1. The mass of the vehicle is 1500 kg and has its centre of gravity 500 mm above road level. Width of track is 1.5 m. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the read surface, if this is not cambered. **(16 Marks)**

OR

10 In a four stroke petrol engine, the crank angle is 4° after top dead centre, when the suction valve opens and 50° after bottom dead centre, when the suction valve closes. The lift is 10 mm, the nose radius is 2.5 mm and the least radius of the cam 20 mm. The shaft rotates at 600 rpm. The cam is of the circular type with a circular nose and flanks while the follower is flat faced. Determine the maximum velocity, maximum acceleration and retardation of the valve. What is the minimum force exerted by the springs to overcome the inertia of moving parts weighing 250 gm? **(16 Marks)**

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