CBCS SCHEME

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18AU52

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

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 A slider Crank mechanism is shown in Fig. Q1. The force applied to the piston is 1000 N when the crank is at 60° from IDC. Calculate the driving torque T_2.

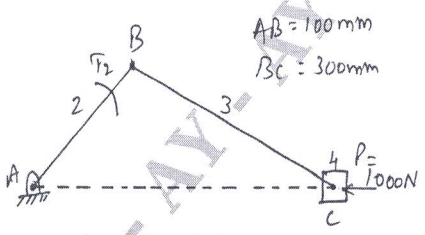

Fig. Q1 **(20 Marks)**

OR

2 a. A connecting rod of an IC engine has a mass of 2 kg and the distance between the centre of gudgeon pin and centre of crank pin is 250 mm. The C.G falls at a point 100 mm from the gudgeon pin along the line of centres. The radius of gyration about an axis through the C.G perpendicular to the plane of rotation is 110 mm. Find the equivalent dynamical system if only one of the masses is located at gudgeon pin. If the connecting rod is replaced by two masses one at the gudgeon pin and the other at the crank pin and the angular acceleration of the rod is 2300 rad/sec^2 clockwise. Determine the correction couple applied to the system to reduce it to a dynamically equivalent system. **(10 Marks)**

b. The connecting rod of a gasoline engine is 300 mm long between its centres. It has a mass of 15 kg and mass moment of inertia of 7000 kg-mm^2. Its 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 masses is located at the small end centre. **(10 Marks)**

Module-2

3 A shaft running in bearings carries masses 20, 30, 40 kg in planes A, B and C with C.G from the axis of the shaft 30 mm, 20 mm and 15 mm respectively. The distances of planes B and C from A are 1000 mm and 2000 mm to the right of A. The relative angular positions of the C.G of the unbalanced masses are such that they are in static balance. Find to obtain complete dynamic balance suitable masses are introduced in planes D and E with C.G 100 mm from the axis D is 500 mm to the left of A and E 500 mm to the right of C. Determine the position and magnitude of the balancing masses. **(20 Marks)**

OR

4 A five cylinder inline engine running at 500 rpm has successive cranks at 144° apart. The distance between the cylinder centerline is 300 mm. Piston stroke = 240 mm,
Length to CR = 480 mm. Examine the engine for balancing of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150 N. **(20 Marks)**

Module-3

5 a. Discuss the relation between E, e_{max} and K_S. **(05 Marks)**

b. Prove that the maximum fluctuation of energy C is given by C = 0.02 qE for a flywheel. **(05 Marks)**

c. During one revolution of the crank of a multicylinder engine the areas above and below the manufacturing moment line taken in order are +0.36, −0.81, +0.75, −0.64, +0.92, −0.58 cm^2. Horizontal scale : 1 cm = 45°, Vertical scale : 1 cm = 7200 Nm, Speed of engine = 150 rpm. Total fluctuation of speed 2% of mean speed. Find (i) Mass of fly wheel (ii) Area of cross section of rim. Neglect the effect of arms and boss and take material density as 7260 kg/m^3 and mean peripheral speed as 1000 m/min. **(10 Marks)**

OR

6 a. Derive an expression for Hartnell governor for stiffness of spring. **(10 Marks)**

b. The upper arms of a portor governor are pivoted to the axis of rotation. The length is 40 cm. The lower arm pivoted on the sleeve at a distance of 2 cm from the axis. Their length is 30 cm. Mass of each ball is 5 kg and the sleeve mass is 50 kg. Determine the equilibrium speed for the radius of rotation of 20 cm and also the effort and power for 1% speed change. **(10 Marks)**

Module-4

7 a. Explain the types of friction. **(05 Marks)**

b. Discuss the laws of solid friction. **(05 Marks)**

c. Derive an expression for flat collar bearing. **(10 Marks)**

OR

8 a. Derive an expression for length of belt for cross belt drive. **(10 Marks)**

b. Derive an expression for ratio of belt tensions. **(10 Marks)**

Module-5

9 a. Explain with neat sketch the principle of gyroscopic couple and also derive the expression for gyroscopic couple. **(10 Marks)**

b. Each road wheel of a motor cycle has a moment of inertia of 2 $kg\text{-}m^2$. The rotating parts of the engine of the motor cycle has a moment of inertia of 0.2 $kg\text{-}m^2$. The speed of the engine is 5 times the speed of the wheel and is in the same sense. The mass of the motor cycle with rider is 200 kg and its C.G is 500 mm above ground level. The diameter of the wheel is 500 mm, the motor cycle is travelling at 15 m/sec on a curve of 30 m radius. Determine (i) Gyrocouple, Centrifugal couple, Overturning couple and balancing couple in terms of angle of heel and (ii) Angle of heel **(10 Marks)**

OR

10 Derive an expression for circular arc cam with flat faced follower. **(20 Marks)**

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