CBCS SCHEME

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18AU52

Fifth Semester B.E. Degree Examination, June/July 2023
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. Define the following with neat sketches:
(i) Two force member
(ii) Three force member
(iii) Two force and a torque member **(06 Marks)**

b. The Fig.Q1(b) below 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.

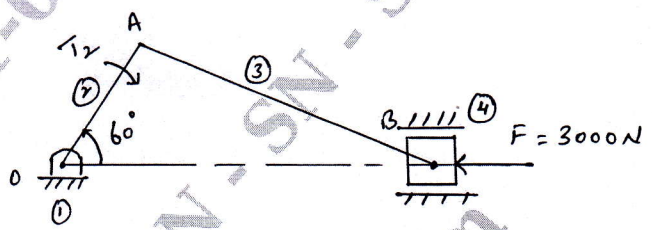

Fig.Q1(b)

OA = 100 mm, AB = 300 mm **(14 Marks)**

OR

2 a. State and explain D-Alembert's principle. **(04 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. 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. **(16 Marks)**

Module-2

3 a. Explain static and dynamic balancing. **(04 Marks)**

b. A shaft carries four rotating masses A, B, C and D in this order along its axis. The mass A may be assumed concentrated at a radius of 120 mm, B at 150 mm, C at 140 mm and D at 180 mm. The masses of A, C, D are 15 kg, 10 kg and 8 kg respectively. The planes of revolution of A and B are 150 mm apart and of B and C are 180 mm apart. The angle between A and C is 90°. If the shaft is in complete dynamic balance, determine:
(i) The angles between the radii of A, B and D
(ii) The distance between the planes of revolution of C and D
(iii) The mass B. **(16 Marks)**

OR

4 An air compressor has four vertical cylinders 1, 2, 3 and 4 in line and driving cranks at 90° intervals reach their uppermost positions in this order. The cranks are of 150 mm radius. The connecting rods 500 mm long and the cylinder centre line 400 mm apart. The mass of the reciprocating parts for each cylinder is 22.5 kg and speed of rotation is 400 rpm. Show that there are no out of balance primary or secondary forces and determine the corresponding couples, indicating the position of No.1 crank for maximum values. The control plane of the machine may be taken as reference plane. **(20 Marks)**

Module-3

5 Turning moment curve for one revolution of a multi cylinder engine above and below line of mean resisting torque are given by –0.32, +4.06, –2.71, +3.29, –3.16, +2.32, –3.74, +2.71 and –2.45 sq.cm. The vertical and horizontal scales are 1 cm = 60000 kgcm, and 1 cm = 24° respectively. The fluctuation of speed is limited to ±1.5% of mean speed which is 250 rpm. The hoop stress in rim material is limited to 56 kg/cm^2. Neglecting effect of boss and arms determine suitable diameter and cross section of flywheel rim. Density of rim material is 0.0072 kg/cm^3. Assume width of rim equal to 4 times its thickness. **(20 Marks)**

OR

6 a. Define following:
(i) Sensitiveness (ii) Effort (iii) Stability
(iv) Isochronism (v) Controlling force **(10 Marks)**

b. In an engine governor of the porter type, the upper and lower arms are 200 mm and 250 mm respectively and are pivoted on the axis of rotation. The mass of sleeve is 15 kg, the mass of each ball is 2 kg and friction of the sleeve together with the resistance of operating gear is equal to a load of 25 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, find taking friction into account, range of speed on the governor. **(10 Marks)**

Module-4

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

b. Derive an equation for frictional torque developed in a flat pivot bearing. **(08 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. **(08 Marks)**

OR

8 a. Derive an expression for ratio of belt tensions for a flat belt drive. **(08 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. Explain the gyroscopic effect on aeroplane. **(10 Marks)**

b. Find the angle of heel with respect to the vertical of a two wheeler taking a turn. Given combined mass of vehicle with its rider 250 kg. moment of inertia of the engine flywheel 0.3 kgm^2, moment of inertia of each road wheel 1 kgm^2, speed of engine fly wheel 5 times that of road wheels and in the same direction height of c.g. of rider with vehicle 0.6 m, 2 wheeler speed 90 kmph, wheel radius 300 mm, radius of turn 50 m. **(10 Marks)**

OR

10 The following particulars relate to a symmetrical circular can operating a flat faced follower: Least radius = 16 mm, nose radius = 3.2 mm, distance between cam shaft centre and nose centre equals 25 mm, angle of action of cam equals 150° and cam shaft speed equals 600 rpm. Assuming that there is no dwell between ascent and descent, determine the lift of the valve, the flank radius and the acceleration and retardation of the follower at a point where circular nose merges into circular flank. **(20 Marks)**

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