CBCS SCHEME

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15ME52

Fifth Semester B.E. Degree Examination, June/July 2023
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State the condition for static equilibrium of a body subjected to a system of, (i) Two forces (ii) Three forces (iii) Member with two forces and a torque. **(06 Marks)**

b. In the slider crank mechanism shown in Fig. Q1 (b) the value of force applied to slider 4 is 2 KN. The dimensions of the various links are AB = 80 mm, BC = 240 mm, $\theta = 60^\circ$. Determine the forces on various links and the driving torque T_2.

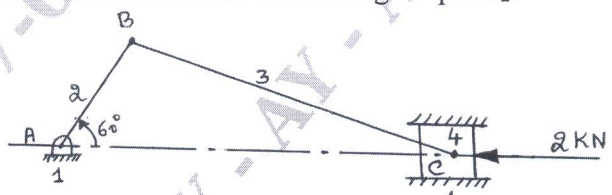

Fig. Q1 (b) **(10 Marks)**

OR

2 A slider crank mechanism of a single cylinder diesel engine shown in Fig. Q2 is subjected to a gas force of 18000 N. The crank rotates counter clockwise at a constant speed of 1850 rpm. Determine

(i) Force F_{14} and F_{12} and the torque T_2 exerted by the crankshaft on the crank for equilibrium.

(ii) Magnitude and direction of the Shaking force and its location from point O_2.

Take $m_2 = 2.5$ kg, $m_3 = 3.7$ kg, $m_4 = 3$ kg, $I_2 = 0.0055$ kg-m^2, $I_3 = 0.041$ kg-m^2

$O_2B = 80$ mm
BC = 280 mm
$O_2G_2 = 55$ mm
$BG_3 = 120$ mm

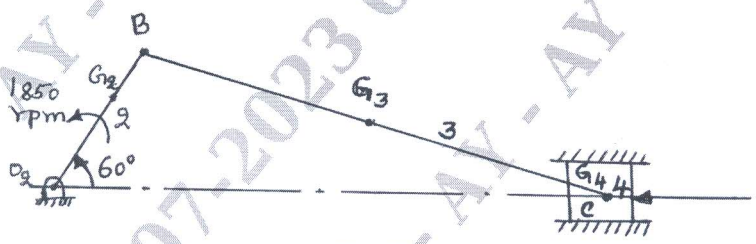

Fig. Q2

(16 Marks)

Module-2

3 a. Briefly explain the static and dynamic balancing. **(04 Marks)**

b. A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 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 being measured in the same direction the axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine

(i) The magnitude of the masses at A and D.

(ii) The distance between planes A and D

(iii) The angular position of the mass at D. **(12 Marks)**

OR

4 Crank and connecting rods of a 4-cylinder inline engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an view in the order 1-4-2-3. Reciprocating mass corresponding to each cylinder is 1.5 kg. Determine
(i) Unbalanced primary and secondary forces.
(ii) Unbalanced primary and secondary couples with reference to central plane of the engine. **(16 Marks)**

Module-3

5 a. Define the following terms with respect to Governors :
(i) Sensitiveness (ii) Stability (iii) Isochronism (iv) Hunting **(04 Marks)**

b. A porter governor has equal arms each 300 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the sleeve is 15 kg. The radius of rotation of the ball is 200 mm when the governor begins to lift and 250 mm when the governor is at maximum speed. Find the range of speed
(i) When the friction at the sleeve is neglected.
(ii) When the friction at the sleeve is equivalent to 30 N. **(12 Marks)**

OR

6 a. Derive an expression for gyroscopic couple. **(06 Marks)**

b. A rear engine automobile is travelling along a track of 100 m mean radius. Each of four road wheels has a moment of inertia of 2 kg-m^2 and effective dia of 600 mm. The rotating parts of the engine have a moment of inertia of 1 kg-m^2. The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The gear ratio of engine to back axle is 3 : 1. The vehicle weight 15,000 N and has its centre of gravity 500 mm above the road level. Determine the limiting speed of the vehicle around the curve for all four wheels to maintain contact with the road surface if this is not cambered. **(10 Marks)**

Module-4

7 a. Define the following terms :
(i) Simple Harmonic motion
(ii) Resonance
(iii) Degrees of Freedom
(iv) Natural frequency
(v) Time period
(vi) Phase difference **(06 Marks)**

b. A body subjected to two harmonic motions as given below :
$x_1 = 15\sin(wt + 30^\circ)$, $x_2 = 8\cos(wt + 60^\circ)$
Add the two harmonic motions and check it graphically. **(10 Marks)**

OR

8 a. Derive the differential equation for undamped free vibrations (Newton's method). **(06 Marks)**

b. Determine the natural frequency of a spring mass system where the mass of it also to be taken into account. **(10 Marks)**

Module-5

9 a. Explain the following :
   (i) Critical damping
   (ii) Damping ratio
   (iii) Logarithmic decrement (06 Marks)

b. Determine
   (i) Critical damping co-efficient (ii) Damping factor
   (iii) Natural frequency (iv) Logarithmic decrement
   (v) Ratio of two consecutive amplitudes of a librating system which consists of a mass of 25 kg, a spring of stiffness 15 kN/m and a damper. The damping provided is only 15% of the critical value. (10 Marks)

OR

10 a. Define magnification factor, vibration isolation and transmissibility ratio. (06 Marks)

b. A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19,600 N/m and damping coefficient of 100 N-S/m, The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine
   (i) Amplitude of vibration of the mass.
   (ii) Phase difference between the force and displacement.
   (iii) Forced transmissibility ratio. (10 Marks)

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