CBCS SCHEME

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15ME52

Fifth Semester B.E. Degree Examination, July/August 2022
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. Explain equilibrium with respect to two force and three force members. **(04 Marks)**

b. Determine the required input torque on the crank of a slider crank mechanism shown in Fig.Q1(b) for static equilibrium.

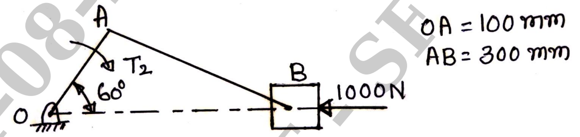

Fig.Q1(b) **(12 Marks)**

OR

2 a. Explain D'Alembert's principle. **(04 Marks)**

b. A slider crank mechanism of a single cylinder diesel engine shown in Fig.Q2(b) 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 crank shaft 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.

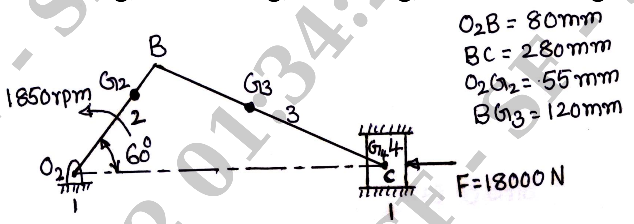

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Define static and dynamic balancing. **(02 Marks)**

b. A rotating shaft carries four masses A, B, C and D of 10kg, 15kg, 18kg and 20kg at radii 50mm, 60mm, 60mm and 80mm respectively. The masses B, C and D revolve in planes 400mm, 600mm and 800mm respectively measured from plane of mass A and are angularly located at 60°, 145° and 270° respectively measured counter-clockwise from mass A. The shaft is dynamically balanced by two masses located at 50mm radii and revolving in plane L and M placed midway between the masses A and B and midway between those of masses C and D respectively. Determine the magnitude of balance mass and their angular positions. **(14 Marks)**

OR

4 The firing order in a 6-cylinder vertical four stroke in-line engine is 1-4-2-6-3-5. The piston stroke is 100mm and the length of each connecting rod is 200mm. The pitch distances between the cylinder centre lines are 100mm, 100mm, 150mm, 100mm and 100mm respectively. The reciprocating mass per cylinder is 1 kg and the engine runs at 300 rpm. Determine the out of balance primary and secondary forces and couples on this engine, taking a plane midway between the cylinder 3 and 4 as the reference plane. **(16 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Define the following :
(i) Isochronism (ii) Sensitiveness. **(02 Marks)**

b. A porter governor has equal arms each 250mm along and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of central load on the sleeve is 25 kg. The radius of rotation of ball is 150mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following cases:
(i) When the friction at the sleeve is neglected.
(ii) When the friction at the sleeve is equivalent to 10 N. **(14 Marks)**

OR

6 a. With a neat sketches, explain the effect of gyroscopic couple on steering of aeroplane, when it takes a right turn. The runs is clockwise when viewed from rear. **(04 Marks)**

b. Each wheel of a motor cycle is of 600mm diameter and has a moment of inertia of 1.2 kg-m^2. The total mass of the motor cycle and rider is 180 kg and the combined centre of mass is 580mm above the ground level. When the motor cycle is upright. The moment of inertia of the rotating parts of the engine is 0.2 kg-m^2. The engine speed is 5 times the speed of the wheels and is in the same sense. Determine the angle of heel necessary when the motor cycle takes a turn of 35m radius at a speed of 54 kmph. **(12 Marks)**

Module-4

7 a. Define the following :
(i) Periodic motion (ii) Resonance (iii) Degree of freedom (iv) Phase angle **(04 Marks)**

b. Add the following motion analytically and check the solution graphically.
$x_1 = 2\cos(wt + 0.5)$
$x_2 = 5\sin(wt + 1.0)$ **(12 Marks)**

OR

8 a. Determine the Natural frequency of the system shown in Fig.Q8(a).

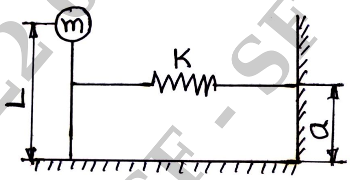

Fig.Q8(a) **(08 Marks)**

b. Find the Natural frequency of the system shown in Fig.Q8(b) by using (i) Newton's method (ii) Energy method.

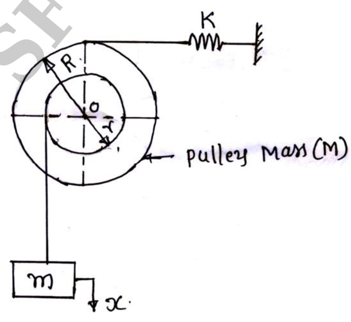

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Set up the differential equation for a spring mass damper system and obtain the complete solution for the under damped condition. **(08 Marks)**

b. In a spring mass system, the mass of 10 kg makes 40 oscillation in 20 seconds without damper. With damper the amplitude decreases to 0.20 of the original value after 5 oscillations. Find out (i) Stiffness of the spring (ii) Logarithmic decrement (iii) Damping factor (iv) Actual damping coefficient. **(08 Marks)**

OR

10 a. Define the term "Transmissibility" derive the expression for transmissibility ratio due to harmonic excitation. **(08 Marks)**

b. A machine mass one tonn is acted upon by an external force 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine
(i) Force transmitted to the foundation
(ii) Amplitude of vibration of the machine
(iii) Phase lag of the transmitted force with respect to the external force. **(08 Marks)**

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