CBCS SCHEME

USN | | | | | | | | | | 18ME53

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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 static equilibrium. State two conditions for equilibrium **(04 Marks)**

b. In a slider crank mechanism, the force applied to the piston is 1 kN, when the crank is at 60° from IDC. The length of the crank is 100mm and connecting rod is 300 mm. Calculate the driving torque T_2 on the crank to attain equilibrium. **(16 Marks)**

OR

2 The dimensions of a four-link mechanism are AB = 500mm, BC = 660mm, CD = 560mm and AD = 1000mm. The link AB has an angular velocity of 10.5 rad/sec counterclockwise and an angular retardation of 26 rad/sec^2 at the instant when it makes an angle of 60° with AD, the fixed link. The mass of the links BC and CD is 4.2 kg/m length. The link AB has a mass of 3.54 kg, the center of which lies at 200mm from A and a moment of inertia of 88,500 kg-mm^2. Neglecting gravity and friction effects, determine the instantaneous value of the drive torque required to be applied on AB to overcome the inertia forces. **(20 Marks)**

Module-2

3 a. Justify the need of balancing of rotating parts for high speed engines. What is the difference between static and dynamic balancing? **(04 Marks)**

b. A shaft carries four masses A, B, C and D placed in parallel planes perpendicular to the shaft axis and in this order along the shaft. The masses B and C are 40 kg and 28 kg and both are at 160mm radius. While the masses in planes A and D are at 200 mm radius. Angle between B and C is 100°, B and A is 190°, both angles being measured in the same sense. Planes A and B are 250mm apart, B and C are 500mm apart. If the shaft is to be in complete balance, determine (i) Masses in planes A and D (ii) Distance between planes C and D (iii) Angular position of mass D. **(16 Marks)**

OR

4 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 is 0.35m, crank radius is 0.12m, length of connecting rod is 0.42m. The engine runs at 600rpm. If the reciprocating parts of each engine has a mass of 2.5kg, find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference plane. **(20 Marks)**

Module-3

5 a. Define the following terms with reference to governors:
(i) Sensitiveness (ii) Hunting (iii) Isochronism (iv) Governor power **(08 Marks)**

b. Each arm of a porter governor is 300mm long and is pivoted on the axis of the governor. Each ball has a mass of 6 kg and the mass of sleeve is 18kg, the radius of rotation of ball is 200mm when the governor begins to lift and 250mm when the speed is maximum. Determine the maximum and minimum speed and range of speed of the governor. **(12 Marks)**

OR

6 a. Define gyroscopic effect. With usual notations and diagram, derive an expression for the gyroscopic couple produced by a rotating disc. **(08 Marks)**

b. An aeroplane has engine speed 2000rpm clockwise when viewed from rear. It is flying at 240 kmph speed and turns towards lift and completes a quarter circle of 60m radius. The mass of the rotor engine and the propeller of the plane is 450kg with a radius of gyration of 320 mm. Determine the gyration couple on the aircraft and its effect. In what way the effect changes when the (i) Aeroplane turns towards right (ii) Engine rotates clockwise when viewed from the front (nose end) and the aeroplane turns right. **(12 Marks)**

Module-4

7 a. Define the following terms:
(i) Simple harmonic motion (ii) Natural frequency (iii) Resonance
(iv) Forces vibration (v) Phase difference **(10 Marks)**

b. Find the natural frequency of the following system shown in Fig.Q7(b). **(10 Marks)**

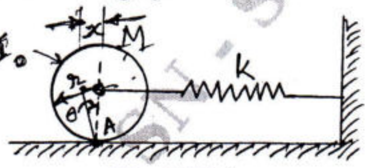

Fig.Q7(b)

OR

8 a. Set up the differential equation for a spring mass damper system and obtain complete solution for the over-damped system. **(10 Marks)**

b. A vibrating system consists of mass 25kg, a spring of stiffness 15 kN/m and a Damper. The damping provided is only 15% of critical value. Determine (i) Critical damping coefficient (ii) Damping factor (iii) Natural frequency (iv) Logarithmic decrement (v) Ratio of two consecutive amplitudes of vibration. **(10 Marks)**

Module-5

9 a. Define transmissibility and derive an expression for the transmissibility ratio and the phase angle for the transmitted force. **(10 Marks)**

b. A mass of 100 kg has been mounted on a spring-dash pot system having spring stiffness of 19600 N/m and damping coefficient 100 N-sec/mt. The mass acted upon by a harmonic force of 39N at the undamped natural frequency of the system; find
(i) Amplitude of vibration of the mass
(ii) Phase difference between the force and displacement
(iii) Forces transmissibility ratio. **(10 Marks)**

OR

10 a. Derive an expression for magnification factor or amplitude ratio for spring mass system with viscous damping subjected to harmonic force. **(10 Marks)**

b. A 54 N weight is suspended by a spring with a stiffness of 1100 N/m. It is forced to vibrate by a harmonic force of 5 N. Take viscous damping of 77 N-s/m and find,
(i) Resonant frequency (ii) Amplitude at resonance (iii) Phase angle at resonance.
(iv) Damped natural frequency (v) Frequency at which maximum amplitude of vibration occurs (vi) Maximum or Peak amplitude (vii) Phase angle corresponding to peak amplitude (viii) Speed at which maximum amplitude of vibration would occur. **(10 Marks)**

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