CBCS SCHEME

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17AU82

Eighth Semester B.E. Degree Examination, July/August 2022
Mechanical Vibrations

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive the following terms:
i) Natural frequency
ii) Resonance
iii) Phase difference
iv) Degrees of freedom
v) Simple harmonic motion. (10 Marks)

b. Add the following harmonics analytically and check the solution graphically:
$x_1 = 3\sin(wt + 30°)$
$x_2 = 4\cos(wt + 10°)$. (10 Marks)

OR

2 a. Determine the natural frequency of spring-may system by
i) Newton's method
ii) Energy method
iii) Rayleigh's method. (10 Marks)

b. Determine the natural frequency of oscillation of the system shown in Fig.Q.2(b) by using:
i) Newton's method ii) Energy method. (10 Marks)

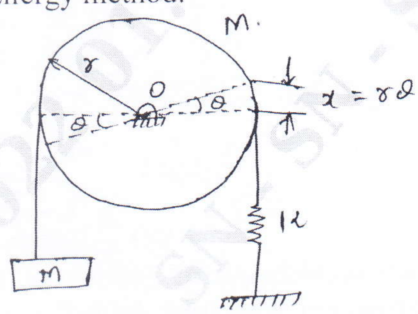

Fig.Q.2(b)

Module-2

3 a. Derive "logarithmic decrement" and show that it can be expressed as $\delta = \frac{1}{n} \ln \frac{x_o}{x_n}$ where n is the number of cycles, x_o initial amplitude, x_n amplitude after 'n' cycles. (10 Marks)

b. A spring may damper system has m = 3kg, k = 100N/m, c = 3N.sec/m. Determine:
i) Damping factor
ii) Natural frequency of damped vibration
iii) Logarithmic decrement
iv) The ration of two successive amplitudes
v) Number of cycles after which the original amplitude is below 20%. (10 Marks)

OR

4 a. Explain the term whirling or critical speed of a shaft. Prove that the whirling speed for a rotating shaft is same as the frequency of natural transverse vibration. **(10 Marks)**

b. A shaft carrying a rotor of weight 450N and eccentricity 2.54mm rotates at 1200rpm. Determine: i) Steady state whirl amplitude ii) Maximum whirl amplitude during start up conditions of the system.
Assume the stiffness of the shaft 36000N/m and the external damping ratio as 0.1. **(10 Marks)**

Module-3

5 a. A machine of total mass 200kg is supported on springs of total stiffness 16,000N/cm has an unbalanced rotating element which results in a disturbing force 800N at a speed of 3000rpm. Assuming $\xi = 0.2$. Determine:
i) Amplitude of motion due to unbalance
ii) Transmissibility
iii) Transmitted force. **(10 Marks)**

b. Determine the critical speed when an automobile trainer is travelling over a road with the road surface varying sinusoidally with a wavelength of 15 meters and an amplitude of 0.075m. The springs of the automobile are compressed 0.125m under its own weight. Also determine the amplitude of vibration at 50km/hr. **(10 Marks)**

OR

6 a. Derive the "Transmissibility". Derive the expression for "motion transmissibility". **(10 Marks)**

b. A mass attached to a spring of stiffness 580N/m has a viscous damping device. When the mass was displaced and released, the period of vibrations is found to be 1.8 sec and the ratio of consecutive amplitudes was 4.2. Determine the amplitude and phase angle of vibration when a force F = 20cos 3t acts on the system. **(10 Marks)**

Module-4

7 a. Derive the expression for amplitudes of vibration of the two masses shown in Fig.Q.7(a).

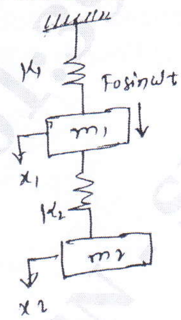

Fig.Q.7(a)

(10 Marks)

b. For the system shown in Fig.Q.7(b).
i) Derive the equation of motion.
ii) Set up frequency equation and obtain natural frequency of the system.
iii) Obtain modal vectors.
iv) Draw mode shapes.
Neglect the inertia of wheels and friction between wheel and surface. **(10 Marks)**

$m_1 = m_2 = m$
$K_1 = K_2 = K_3 = K$

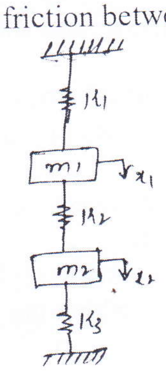

Fig.Q.7(b)

OR

8 a. Explain the frequency measuring instruments:
i) Fullarton Tachometer   ii) Frahm Tachometer. **(10 Marks)**

b. A seismic instrument with a natural frequency of 5Hz is used to measure the vibration of a machine operating at 150rpm. The relative displacement of the seismic mass as read from the instrument is 0.05mm, neglecting air damping, determine the amplitude of vibration of the machine. **(10 Marks)**

Module-5

9 a. Determine the influence co-efficient of the triple pendulum shown in Fig.Q.9(a). **(10 Marks)**

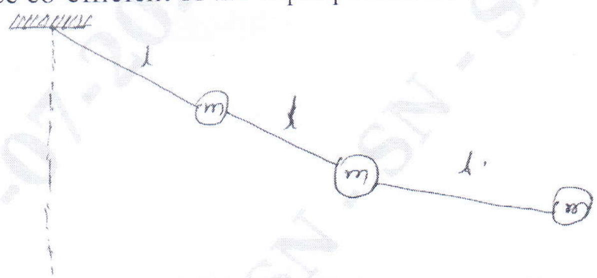

Fig.Q.9(a)

b. Using Stodola's method find the fundamental mode of vibration and its natural frequency of the spring mass system shown in Fig.Q.9(b).
For $k_1 = k_2 = k_3 = 1$N/m and $m_1 = m_2 = m_3 = 1$kg. **(10 Marks)**

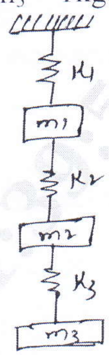

Fig.Q.9(b)

OR

10 a. Explain the Rayleigh's method for solving beam problems. **(06 Marks)**

b. Using Holzer method, find the natural frequency of the system shown in Fig.Q.10(b). Assume $m_1 = m_2 = m_3 = 1$kg , $k_1 = k_2 = k_3 = 1$N/m. **(14 Marks)**

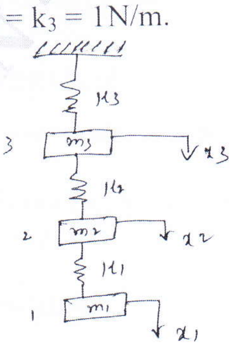

Fig.Q.10(b)

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