CBCS SCHEME

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15AU82

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

Time: 3 hrs. Max. Marks: 80

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

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-1

1 a. Explain Longitudinal Transverse and torsional vibration with a neat sketch. **(06 Marks)**

b. Define the simple harmonic motion with necessary equations. **(02 Marks)**

c. Add the following harmonic motions and check the solution graphically
$x_1 = 2\text{Cos}(wt + 0.5)$
$x_2 = 5\text{ Sin}(wt + 1.0)$ **(08 Marks)**

OR

2 a. Determine the natural frequency of a spring mass system where the mass of the spring is also taken into account. **(10 Marks)**

b. Find the equivalent stiffness of springs connected in series and parallel. **(06 Marks)**

Module-2

3 a. What is the need of Damping? Name and explain different types of damping. **(06 Marks)**

b. Define logarithmic decrement and derive an expression for logarithmic decrement "δ". **(10 Marks)**

OR

4 a. Define Whirling speed. Obtain an expression for whirling speed of shaft without air damping. **(10 Marks)**

b. Explain the following :
i) Critical Damping coefficient
ii) Damping factor
iii) Damped Natural frequency **(06 Marks)**

Module-3

5 a. Define transmissibility. Derive an expression for motion transmissibility. **(08 Marks)**

b. A machine of total mass 17kg is mounted on springs having stiffness K = 11.000N/cm. A piston within the machine has a mass of 2kg has a reciprocating motion with stroke 7.5cm and speed 6000rpm. Assuming the motion to be SHM. Determine.
i) Amplitude of machine
ii) Transmissibility
iii) Force transmitted to the ground. Take $\xi = 0.2$. **(08 Marks)**

OR

6 a. Derive the expression for absolute motion of a system excited by base or support. **(08 Marks)**

b. A mass of 10kg suspended from one end of helical spring, the other end is fixed. The stiffness of spring is 10N/mm. The viscous Damping causes the amplitude to decrease $1/10^{th}$ of initial value in 4 complete oscillations. If a periodic force of 150cos 50t N is applied at the mass with vertical. Direction. Find the amplitude of forced vibration. What is its value at resonance? **(08 Marks)**

Module-4

7 a. A two degrees of freedom vibrating system is shown in Fig Q7(a). Determine the two natural frequencies of vibrations in system.
Given : $m_1 = 1.5kg$, $m_2 = 0.80kg$, $K_1 = K_2 = 40N/m$.

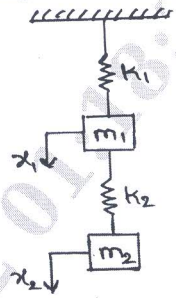

Fig Q7(a) **(08 Marks)**

b. Consider two pendulum of length 'L' as shown in Fig Q7(b). Determine the natural frequency of each pendulum. If $K = 100N/m$, $m_1 = 2kg$. $m_2 = 5kg$, $L = 20m$, $a = 0.10m$.

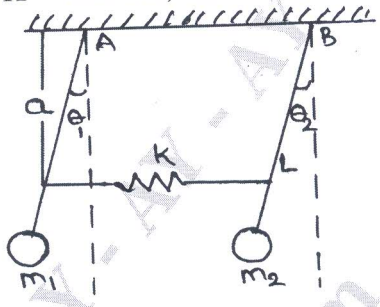

Fig Q7(b) **(08 Marks)**

OR

8 a. With a neat sketch, explain the concept of Fullarton Techometer. **(06 Marks)**

b. An accelerometer with a damped natural frequency of vibration of 160Hz has a suspended mass of 0.02kg. When it is mounted on an engine. Which is going an acceleration of $10m/sec^2$ at an operating speed of 6500rpm the acceleration recorded in the instrument is $9.75m/sec^2$, determine damping constant and spring stiffness of the accelerometer. **(06 Marks)**

c. A vibrometer gives a reading of relative displacement 0.5mm. The natural frequency of vibration is 600rpm and the machine runs at 200rpm. Determine magnitude of displacement velocity and acceleration of the vibrating machine part. **(04 Marks)**

Module-5

9 a. State and prove Maxwell's reciprocal theorem. **(06 Marks)**

b. Find the influence of coefficients for system shown in Fig Q9(b).

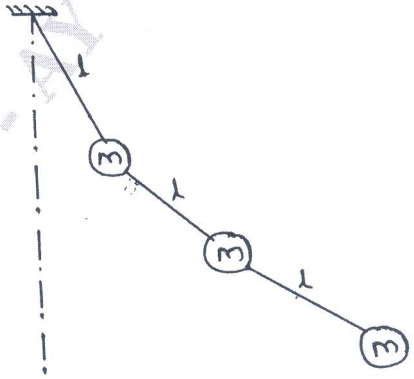

Fig Q9(b) **(10 Marks)**

OR

10 a. Using Stodola's method. Find the fundamental mode of vibration and its natural frequency of the spring mass system shown in Fig Q10(a).
For $k_1 = k_2 = k_3 = 1$N/m and $m_1 = m_2 = m_3 = 1$kg.

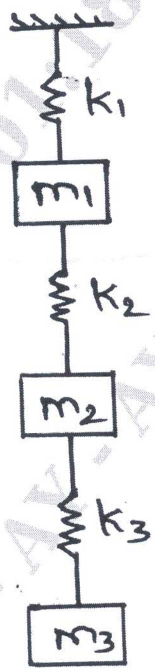

Fig Q10(a) **(10 Marks)**

b. A shaft carries 3 discs of mass 15kg, 25kg and 35kg. The deflection of shaft under each disc when all the 3 discs are in position is 1.75×10^{-5}m, 3.25×10^{-5}m and 3×10^{-5}m respectively. Determine the fundamental natural frequency of transverse vibration. **(06 Marks)**

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