CBCS SCHEME

USN | | | | | | | | | | 15AE553

Fifth Semester B.E. Degree Examination, Feb./Mar.2022
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Add the following harmonic motions analytically and check the solution graphically, $x_1(t) = 10\cos\omega t$, $x_2(t) = 15\cos(\omega t + 2)$ **(10 Marks)**

b. What is vibration? Enumerate the causes and effects of vibrations. **(06 Marks)**

OR

2 a. Represent the periodic motion given in the following Fig. Q2 (a) by Harmoic series. **(10 Marks)**

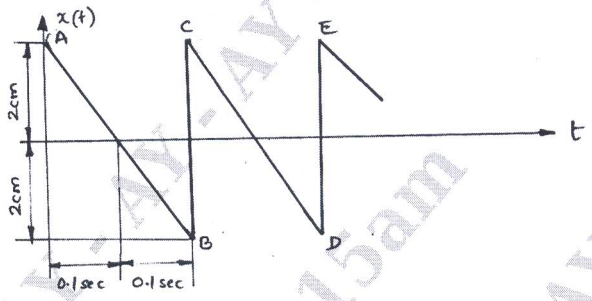

Fig. Q2 (a)

b. Define the following terms :
(i) Degree of freedom
(ii) Resonance
(iii) Phase difference. **(06 Marks)**

Module-2

3 a. Determine the natural frequency of a compound pendulum. **(08 Marks)**

b. The ratio K/m of a spring mass system is given as 4. If the mass is deflected 20 mm down measured from its equilibrium position and given an upward velocity of 80 mm/sec, determine its amplitude and maximum acceleration. **(08 Marks)**

OR

4 a. Derive an expression for logarithmic decrement for an underdamped system. **(08 Marks)**

b. The torsional pendulum with a disc of momentum of inertia 0.1 kg m^2 immersed in a viscous fluid. During the vibrations of pendulum, the observed amplitudes on the same side of the neutral axis for successive cycles are found to be decreased by 50% of the initial value. Determine
(i) Logarithmic decrement.
(ii) Damping torque per unit velocity.
(iii) Periodic time of vibration.
(iv) Frequency, when the disc is removed from the fluid.
Take G = 4.4×10^{10} N/m^2, length ℓ = 1m diameter, d = 100 mm of the disc. **(08 Marks)**

Module-3

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

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

OR

6 a. Explain with a neat sketch, the vibrometer. **(06 Marks)**

b. A disc of mass 4 kg is mounted midway between bearings, which may be assumed to be simple support. The bearing span is 480 mm. The steel shaft which is horizontal is 9 mm in diameter. The centre of gravity of the disc is displaced 3 mm from the geometric centre. The equivalent viscous damping at the centre of the disc shaft may be taken as 49 NS/m. If the shaft rotates at 760 rpm, find the maximum stress in the shaft and compare it with dead load stress in the shaft. Take for shaft, $E = 2\times10^{11}$ N/m^2. **(10 Marks)**

Module-4

7 a. Explain the principle of dynamic vibration absorber with necessary equations. **(10 Marks)**

b. Derive expression for amplitudes of vibration of the two masses shown in Fig. Q7 (b). **(06 Marks)**

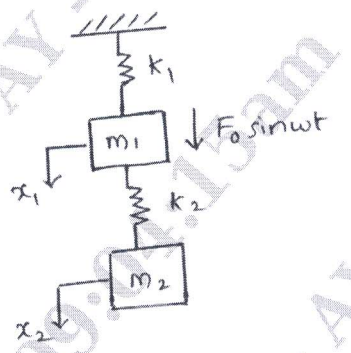

Fig. Q7 (b)

OR

8 a. Explain briefly about the principal coordinates. **(06 Marks)**

b. Determine the principal co-ordinates for the spring mass system shown in Fig. Q8 (b). **(10 Marks)**

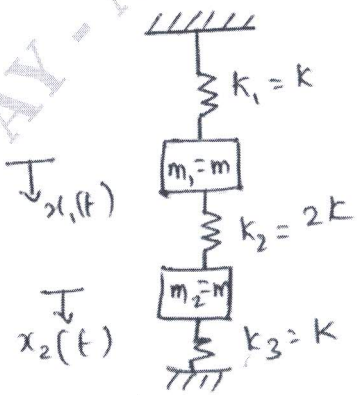

Fig. Q8 (b)