CBCS SCHEME

USN | | | | | | | | | | |

18MR71

Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Explain the following:
(i) Beats phenomenon (ii) Types of vibrations **(10 Marks)**

b. Split the harmonic motion $x = 5\sin\left(\omega t + \frac{\pi}{4}\right)$ into two harmonic motions one having phase of zero and the other of 60°. Check the solution graphically. **(10 Marks)**

OR

2 a. Define the following:
(i) Degrees of freedom (ii) Simple harmonic motion
(iii) Natural frequency (iv) Resonance **(08 Marks)**

b. Find the Fourier series for the saw-tooth curve as shown in Fig.Q2(b).

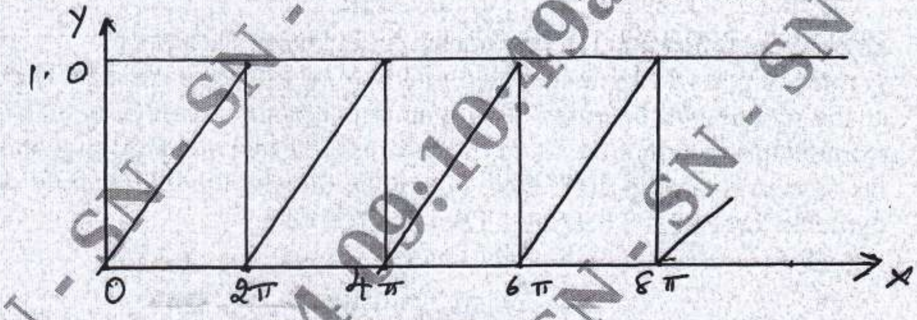

Fig.Q2(b) **(12 Marks)**

Module-2

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

b. Determine the natural frequency of the system shown in Fig.Q3(b).

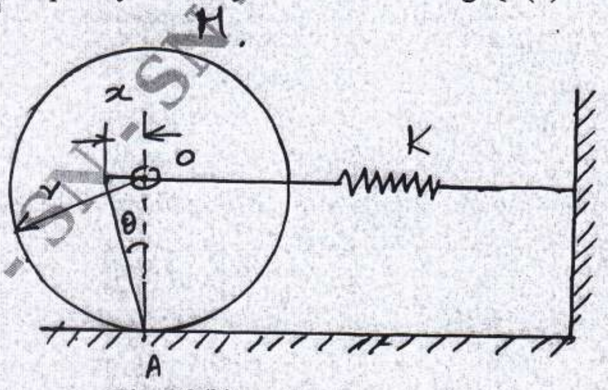

Fig.Q3(b) **(10 Marks)**

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.

OR

4 a. Define logarithmic decrement and show that it can be expressed as $\delta = \frac{1}{n}\log\left(\frac{x_0}{x_n}\right)$, where 'n' is the number of cycles, x_0 is the initial amplitude and x_n is the amplitude after 'n' cycles. **(08 Marks)**

b. A mass of 2 kg is supported on an isolator having a spring scale of 2940 N/m and viscous damping. If the amplitude of free vibration of the mass falls to one half its original value in 1.5 seconds, determine the damping coefficient of the isolator. **(12 Marks)**

Module-3

5 a. Define magnification factor and transmissivity ratio. Show the plots of TR against frequency ratio $\frac{\omega}{\omega_n}$ and phase angle of the transmitted force against frequency $\frac{\omega}{\omega_n}$ for various values of damping factor. **(10 Marks)**

b. A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19,600 N/m and damping coefficient of 100 N-sec/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine :

(i) Amplitude of vibration of mass
(ii) Phase difference between force and displacement
(iii) Force transmissibility ratio **(10 Marks)**

OR

6 a. Explain the following: (i) Vibrometer (ii) Frahm Tachometer **(10 Marks)**

b. A rotor of mass 12 kg is mounted mid way on a 25 mm diameter horizontal shaft supported at the end of two bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the C_g of the rotor is 0.02 mm away from geometric centre of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200 GPa. **(10 Marks)**

Module-4

7 a. A shaft 100 mm diameter is supported in short bearings 3 m apart and carries 3 discs weighing 900 N, 1400 N, 700 N, situated in 1 m, 2 m and 2.5 m from one of the bearings respectively. Assuming E = 200 GPa and density of shaft material = 7800 kg/m^3, calculate the frequency of transverse vibration, by Dunkerley's method. **(08 Marks)**

b. Use Stodola method to find the fundamental mode of vibration of the system shown in Fig.Q7(b). Given m = 2, k = 20.

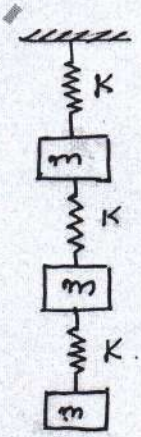

Fig.Q7(b) **(12 Marks)**

OR

8 By the Holzer method, find the natural frequencies of the system shown in Fig.Q8. Assume K = 1 N/m; m = 1 kg.

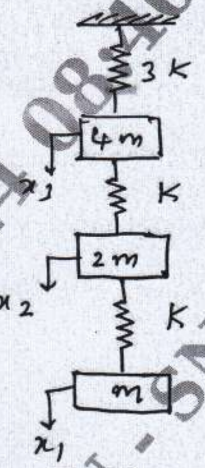

Fig.Q8 **(20 Marks)**

Module-5

9 a. Sketch and explain the arrangement for experimental model analysis. **(10 Marks)**

b. Explain the various techniques for machine condition monitoring. **(10 Marks)**

OR

10 Explain the following:

a. Dynamic testing of machines

b. Spectrum analyzers

c. Sound level meters

d. Microphones **(20 Marks)**

* * * * *