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10MT754

**Seventh Semester B.E. Degree Examination, Jan./Feb. 2021**  
**Mechanical Vibrations**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

**PART - A**

- 1 a.  $x_1$  and  $x_2$  are SHMs of same frequency. The sum of  $x_1$  and  $x_2$  is  $6.17 \sin(\omega t + 1.28)$ . If  $x_1 = 2 \cos(\omega t + 0.5)$ , find  $x_2$  analytically and also graphically. (10 Marks)
- b. A force  $25 \sin 20\pi t$  N acts on a body and results a displacement  $0.05 \sin(20\pi t - \pi/6)$  m. Find the work done during the first second. (06 Marks)
- c. What is Fourier series? Explain in brief. (04 Marks)
- 2 a. Find an expression for the natural frequency of a spring mass system considering mass of spring also. (10 Marks)
- b. For the system shown in Fig.Q.2(b), AB is massless rigid bar and 'm' is point mass attached at 'O'. Find the natural frequency by finding equivalent spring stiffness. (10 Marks)

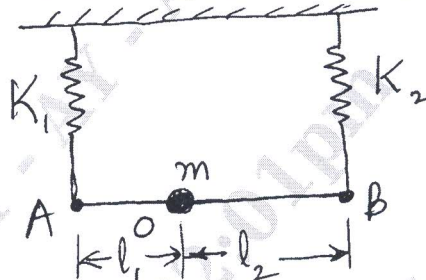


Fig.Q.2(b)

- 3 a. Explain in brief various types of damping. (05 Marks)
- b. Assuming an expression for the displacement of mass, of an under damped spring-mass-dashpot system, obtain expression for logarithmic decrement. (05 Marks)
- c. The disc of a torsional pendulum has a moment of inertia of  $600 \text{ kg-cm}^2$  and is immersed in a viscous fluid. The brass shaft attached to disc is 0.1m diameter and 400mm long. For free vibrations amplitudes on the same side of mean position for successive cycles are  $9^\circ$ ,  $6^\circ$  and  $4^\circ$ . Find: i) Logarithmic decrement; ii) Damping torque at unit velocity and iii) Time period of free vibrations. (10 Marks)
- 4 a. The springs of an automobile trailer are compressed 0.1m under its own weight. Find the critical speed in kmph of the automobile when it is travelling over a road with a profile approximated by a sine wave of amplitude 0.08m and wavelength of 14m. Also find the amplitude of vibration at 60 kmph. (10 Marks)
- b. Define 'Transmissibility'. State the expression for the same. How do you achieve effective transmissibility when  $\omega \gg \omega_n$ ? Explain in brief with the help of transmissibility versus  $\frac{\omega}{\omega_n}$  curves. (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.

**PART – B**

- 5 a. With the help of a neat sketch, explain in brief 'seismic instrument'. State typical values of 'natural frequency' and 'damping ratio' for this instrument to use it as i) Vibrometer and ii) accelerometer. (10 Marks)
- b. A disc of mass 4kg is mounted midway between bearings which may be assumed as simple supports. The bearing span is 0.48m. The horizontal steel shaft is 9mm in diameter having Young's modulus of elasticity of 196 GPa. The equivalent viscous damping at the centre of the disc-shaft may be taken as 49 N-s/m. If the shaft rotates at 760 rpm find: i) Critical speed; ii) dynamic load on a bearing; iii) maximum load on a bearing. (10 Marks)
- 6 Two masses  $m_1$  and  $m_2$  are fixed on a tight spring having tension  $T$  as shown in Fig.Q.6.
- Obtain differential equations of motion.
  - If  $l_1 = l_2 = l_3 = l$  and  $m_1 = m_2 = m$ , find two natural frequencies and corresponding amplitude ratios.
  - Draw mode shapes.
- (20 Marks)

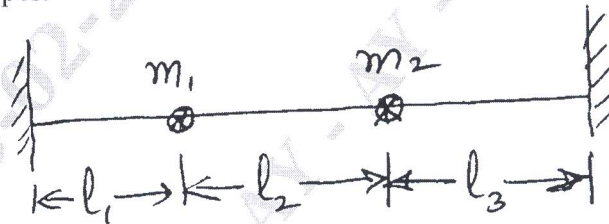


Fig.Q.6

- 7 Write short notes on:
- Maxwell's reciprocal theorem.
  - Influence coefficients.
  - Dunkerly's method.
  - Orthogonality of principal modes.
- (20 Marks)
- 8 a. Explain the role of i) Exciter; ii) Transducer; iii) Signal conditioner and iv) Analyzer used in experimental modal analysis. (12 Marks)
- b. Explain in brief 'methods of condition monitoring'. (08 Marks)

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