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10AE65

Sixth Semester B.E. Degree Examination, July/August 2021
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain different types of vibration. **(08 Marks)**

b. Find the Fourier series for the saw tooth curve as shown in the Fig Q1(b).

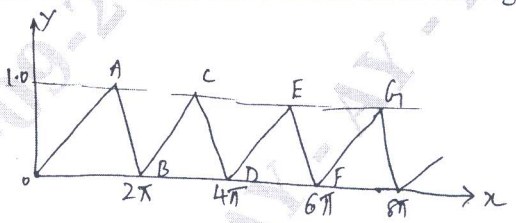

Fig Q1(b) **(12 Marks)**

2 a. Derive an expression for natural frequency of torsional vibration with usual notation. **(10 Marks)**

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

3 a. Derive the equation for damped free vibration and solve for critical damping system. **(10 Marks)**

b. Derive an expression for logarithmic decrement of an under damped system. **(06 Marks)**

c. For the system shown below Fig Q3(c), the characteristic of the dash pot is such that when a constant force of 60N is applied to the piston, its velocity is found to be constant at 0.12m/s. Determine : i) Damping co-efficient ii) Check whether the system is periodic iii) aperiodic.

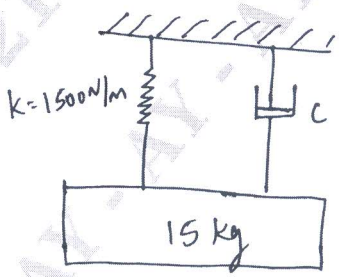

Fig Q3(c) **(04 Marks)**

4 a. With usual notation derive an expression for maximum displacement for a forced vibration of undamped single degree freedom system. **(10 Marks)**

b. A machine of a total mass 68kg mounted on springs of stiffness K = 11,000N/cm. With an assumed damping factor $\xi = 0.2$. A piston within the machine has a mass of 2kg has a reciprocating motion with stroke 7.5cm and a speed of 3000rpm. Assuming the motion of piston to be SHM. Determine :

i) Amplitude ii) Phase angle with respect to exciting force iii) Transmissibility and force transmitted to foundation iv) Phase angle of transmitted force with respect to exciting force. **(10 Marks)**

5 a. With a neat sketch, explain the working of seismic instrument. **(08 Marks)**

b. A Frahm's Reed technometer is used for measuring the frequency of vibration of a system. The Reed is at the resonance frequency of 30Hz when a mass of 0.025kg is placed at its end. The length and the thickness of the reed are 60mm and 0.6mm respectively. Determine its width if the Young's modulus of the reed material is 2.1×10^{11} N/m. **(06 Marks)**

c. 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. **(06 Marks)**

6 a. Shows Fig.Q6(a) a torsional geared system. Determine:

i) Stiffness of equivalent shaft

ii) Torsional frequency.

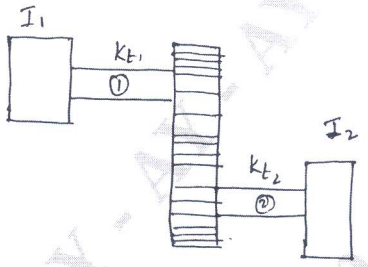

Fig Q6(a) **(10 Marks)**

b. Derive an expression for the amplitudes of vibration of the two masses shown in Fig Q6(b)

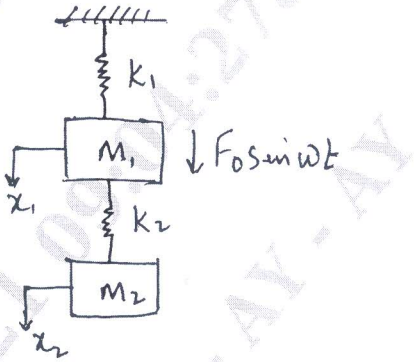

Fig Q6(b) **(10 Marks)**

7 a. Derive an expression for the free longitudinal vibration of a uniform bar of length L, one end of which is fixed and the other end free. **(10 Marks)**

b. Find the longitudinal forced vibration of a uniform cross section bar subjected to a sinusoidal force F_0Sin wt as shown in the Fig Q7(b).

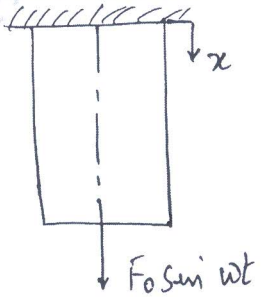

Fig Q7(b) **(10 Marks)**

8 a. Use Stodola method, find the fundamental frequency and mode for the system shown in Fig Q8(a).

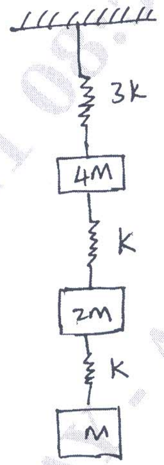

Fig Q8(a) **(12 Marks)**

b. A shaft of 50mm diameter and 3 long is supported at the ends and carrying 3 weights of 1000N, 1500N and 750N at 1m, 2m and 2.5m from left support. Taking E = 200GPa. Find the frequency of transverse vibration. **(08 Marks)**

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