CBCS SCHEME

15AE553

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

Time: 3 hrs. Max. Marks:80

Note: *Answer any FIVE full questions.*

1 a. Explain the phenomenon of beats. **(06 Marks)**
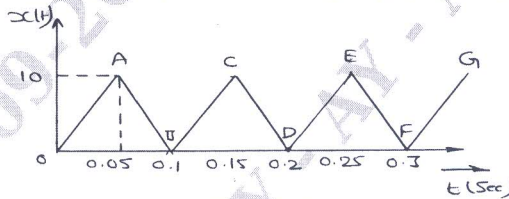   b. Represent the periodic motion given by the following Fig.Q1(b) by harmonic series.

Fig.Q1(b) **(10 Marks)**

2 a. Derive an expression for workdone by a harmonic force. **(06 Marks)**
   b. Add the following harmonic motion analytically and check the solution graphically.
   $x_1 = 4\cos(\omega t + 10°)$; $x_2 = 6\sin((\omega t + 60°)$. **(10 Marks)**

3 a. Determine the natural frequency of the simple pendulum by neglecting the mass of the rod by Newton method. **(06 Marks)**
   b. Determine the natural frequency of the system shown in Fig.Q3(b) neglecting the mass of the rod by : i) Newton method ii) Energy method.
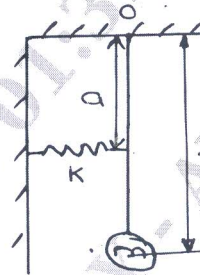

Fig. Q3(b) **(10 Marks)**

4 a. Explain logarithmic decrement and derive an expression for logarithmic decrement. **(06 Marks)**
   b. A pendulum is pivoted at point 0 as in fig.Q4(b). If the mass of the rod is negligible and for small oscillation find : i) critical damping co-efficient ii) damped natural frequency.
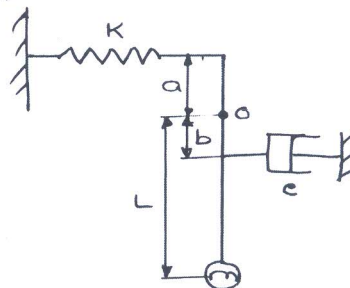

Fig.Q4(b) **(10 Marks)**

5 a. A machine of mass one tone is acted upon by an external force of 2450N at a frequency of 1500rpm. To reduce the effects of vibration isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping factor at 0.2 are used. Determine :
    i) Force transmitted to the foundation
    ii) Amplitude of vibration of the machine. **(08 Marks)**

   b. A machine of mass 100kg operating at 600rpm has a rotating unbalance of 100kg-mm. The machine is mounted on spring having stiffness 85 kN/m and negligible damping. The system is constrained to move vertically.
    i) Determine the steady state amplitude
    ii) If the damping is introduced to reduce the amplitude by 50%, what should be the damping co-efficient? Also find damping factor. **(08 Marks)**

6 a. Discuss the principle of operation of vibrometer and an accelerometer. **(08 Marks)**
   b. A rotor of mass 10kg mounted on a 20mm diameter horizontal shaft supported at the ends by two bearings. Rotor is mounted in the middle of span of 500mm. The center of gravity of rotor is 0.03mm away from the geometric center. If the system rotates at 2500rpm, neglecting mass of the shaft and damping, find :
    i) Whirling or critical speed   ii) Amplitude and steady state vibration. **(08 Marks)**

7 a. Explain briefly the dynamic vibration absorber with diagram and equation. **(08 Marks)**
   b. Derive expression for amplitude of vibrations of the two mass as shown in Fig.Q7(b).
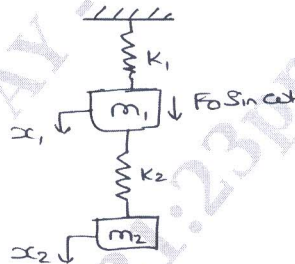

Fig.Q7(b) **(08 Marks)**

8 a. Derive one dimensional wave equation for lateral vibration of string. **(08 Marks)**
   b. 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. **(08 Marks)**

9 Find the natural frequency by Holzon method for the four mass system shown in Fig.Q9, if $k = 1$N/m and $m = 1$kg.

Fig.Q9 **(16 Marks)**

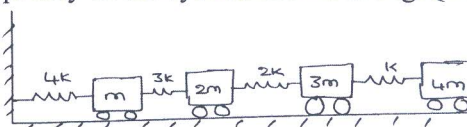10 Find the lowest natural frequency of the system shown in Fig.Q10 by Stodola's method.

Fig.Q10 **(16 Marks)**

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