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10ME72

Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Draw neat sketches wherever required.***

PART – A

1 a. What is vibration? Enumerate the causes and effects of vibrations. **(05 Marks)**

b. With a neat sketch, explain the pheonomenon of beats. **(05 Marks)**

c. Represent the periodic motion shown in Fig. Q1 (c) by a harmonic series. **(10 Marks)**

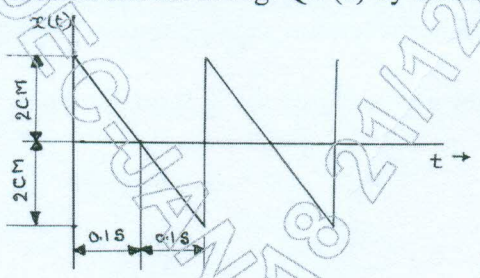

Fig. Q1 (c)

2 a. Determine the natural frequency of a spring-mass system in which the mass of the spring is not negligible. **(10 Marks)**

b. Determine the natural frequency in CPS of a string in tension with a mass as shown in Fig. Q2 (b). **(10 Marks)**

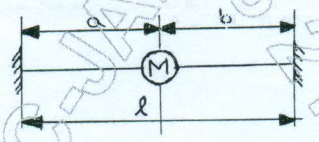

Fig. Q2 (b)

3 a. Define logarithmic decrement. Show that logarithmic decrement δ is given by $\frac{2\pi\xi}{\sqrt{1-\xi^2}}$ for an underdamped system. **(08 Marks)**

b. A spring mass damper system has a mass of 10 kg, spring stiffness 250 N/m and damping coefficient of 15 N-S/m. Determine the natural frequency, critical damping coefficient, damping factor, damped natural frequency, period of vibration, logarithmic decrement, ratio of two successive amplitudes and number of cycles after which the original amplitude is below 15%. **(12 Marks)**

4 a. Define transmissibility. Show that damping in vibration isolation is useful, when the frequency ratio is greater than $\sqrt{2}$ only. **(05 Marks)**

b. A 40 kg fan has a rotating unbalance of magnitude 0.1 kg-m. The fan is mounted at the free end of a Cantilever beam of length 1.2 m. Find the steady state amplitude of the fan when it operates at 1000 rpm. The beam is specially treated to add viscous damping of $\xi = 0.0617$ Take E = 200 GPa and $I = 1.3 \times 10^{-6}\ m^4$. **(07 Marks)**

c. A flywheel of mass Moment of Inertia 0.1 kg-m^2 is suspended from a thin wire of stiffness 1.2 N-m/rad. A periodic torque having maximum value of 0.6 N-m at 4 rad/s is impressed upon the flywheel. A damping couple of 0.8 N-m at an angular velocity of 2 rad/s is applied by a viscous dashpot. Determine (i) Maximum angular displacement. (ii) Maximum couple applied to the dashpot. **(08 Marks)**

PART – B

5 a. Plot Z/Y v/s frequency ratio and phase angle v/s frequency ratio graph and enumerate the salient features from it. **(06 Marks)**

b. With a neat sketch, explain Fulltron Tachometer. **(05 Marks)**

c. A vertical shaft of diameter 20 mm rotates in long bearings and a disc of mass 18 kg is attached to the shaft at midspan. The span of the shaft is 0.8 m with an eccentricity of the disc from the shaft axis of 0.5 mm. Neglecting the mass of the shaft and considering the shaft fixed-fixed, find the critical speed. Also determine the range of speed for which the stress in the shaft due to bending exceeds 150 MPa. Take E = 210 GPa. **(09 Marks)**

6 a. Determine the natural frequency of oscillation of the double pendulum. **(12 Marks)**

b. What are vibration absorbers? Show that the spring force of absorber system is equal and opposite to exciting force when the main system is stationary. **(08 Marks)**

7 a. Find the fundamental frequency of the system shown in Fig. Q7 (a) using Stodola method (3 trails). **(08 Marks)**

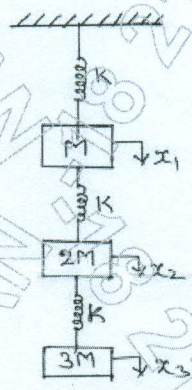

Fig. Q7 (a)

b. Find the natural frequencies of the 3 DOF system using Holzer's method shown in Fig. Q7 (b). Neglect friction. **(12 Marks)**

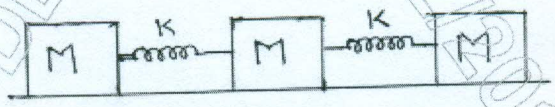

Fig. Q7 (b)

8 a. What is experimental modal analysis? Explain the two basic ideas and the necessary equipment for the measurement of vibration. **(10 Marks)**

b. With necessary graphs, explain the different maintenance techniques. **(10 Marks)**

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