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10ME72

Seventh Semester B.E. Degree Examination, June/July 2019
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms: i) Amplitude ii) Resonance **(02 Marks)**

b. Split the harmonic motion $x = 10\sin\left(\omega t + \frac{\pi}{6}\right)$ into 2 harmonic motions on having a phase angle of zero and the other of 45°. Use graphical method and analytical methods. **(08 Marks)**

c. A periodic motion is observed on the oscilloscope is illustrated in Fig.Q1(c). Represent this motion by harmonic series.

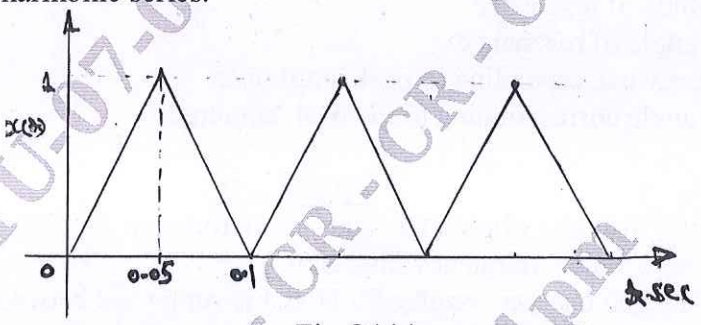

Fig.Q1(c) **(10 Marks)**

2 a. Determine the natural frequency of a simple spring mass system:
i) Newton's second law method
ii) Energy method **(06 Marks)**

b. Determine the natural frequency of a simple pendulum shown in Fig.Q2(b).

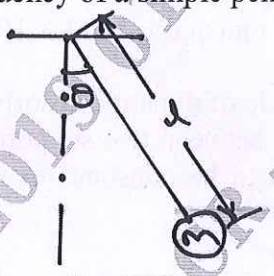

Fig.Q2(b) **(04 Marks)**

c. Use the energy method to find the natural frequency of oscillation of the homogeneous cylinder shown in Fig.Q2(c).

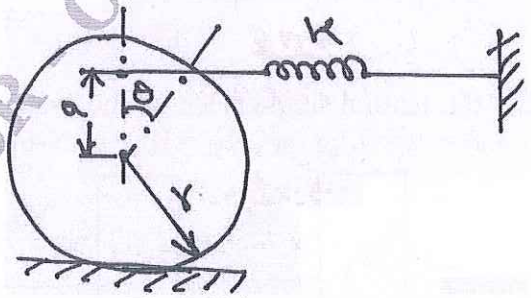

Fig.Q2(c) **(10 Marks)**

3 a. Set-up the differential equation for a spring-mass-damper system and obtain the complete solution for the undamped condition. **(12 Marks)**

b. Determine:
i) Critical damping coefficient
ii) Damping factor
iii) Natural frequency of damped vibrations
iv) Logarithmic decrement
v) Ratio of a consecutive amplitudes of vibrating system
Which consists of mass of 100 kg a spring of stiffness 30 kN/mt and a damper? The damping provided is only 25% of the critical value. **(08 Marks)**

4 a. Define transmissibility and derive an expression for the transmissibility ratio. **(12 Marks)**

b. A mass of 6 kg suspended of a spring of stiffness 1180 N/mt is forced to vibrate by the harmonic force 10 N. Assuming dampling coefficient of 85 N-S/mt. Determine:
i) The resonant frequency
ii) Amplitude of resonance
iii) Phase angle of resonance
iv) Frequency corresponding to peak amplitude
v) Phase angle corresponding to the peak amplitude **(08 Marks)**

PART – B

5 a. Explain and discuss vibrometer and accelerometer devices with the help of relative amplitude ratio versus frequency ratio plot. **(08 Marks)**

b. A rotor of a turbo charger weigh's 70 N and is supported between bearings which are 40 cm apart. The bearing can be considered as of shorter width. The center of gravity of the disc is at a distance of 0.25 cm from the geometrical center. Determine:
i) The critical speed of the disc
ii) Max deflection of the shaft at a speed of 3000 rpm
iii) The dynamic force transmitted to the bearing
iv) The maximum and minimum bending stress induced in the shaft.
Take a diameter of shaft 20 mm and $E = 2.1 \times 10^{11}$ N/mt. **(12 Marks)**

6 a. Explain the working principle of dynamic absorber. **(08 Marks)**

b. A string is tightly stretched between two supports as shown in Fig.Q6(b). The tension 'T' in the string may be assumed to be constant for small displacement. Obtain the two natural frequencies for the system.

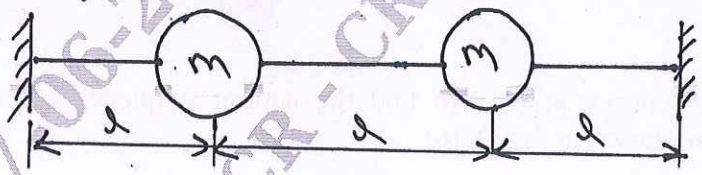

Fig.Q6(b) **(12 Marks)**

7 a. Determine the natural frequencies of the system shown in Fig.Q7(a) by Holzers method. Given $J_1 = J_2 = J_3 = 1$ kg mt^2, $Kt_1 = Kt_2 = 1$ N-mt/rad.

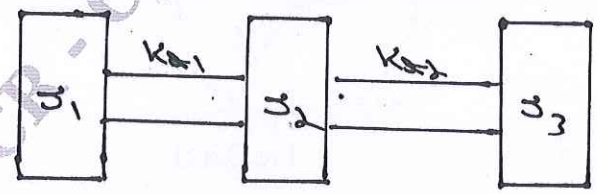

Fig.Q7(a) **(10 Marks)**

b. Calculate the natural frequency of the system shown in Fig.Q7(b) by matrix iteration method.

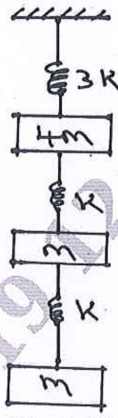

Fig.Q7(b) **(10 Marks)**

8 a. Explain machine condition monitoring techniques. **(10 Marks)**
b. Write a note on dynamic testing of machines. **(10 Marks)**

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