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eventh Semester B.E. Degree Examination, July/August 2021 Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Define the terms: i) Simple harmonic motion ii) Amplitude iii) Natural frequency iv) Resonance v) Degree of freedom. (10 Marks)
 - b. Describe the causes of vibration and elimination of vibration. (04 Marks)
 - c. Show that "A simple harmonic motion may be viewed as a projection of a uniformly rotating vector on a reference axis". (06 Marks)
- 2 a. Model the system shown in Fig Q2(a) as a mass attached to a single equivalent spring. Write the equation of motion and find the natural frequency.

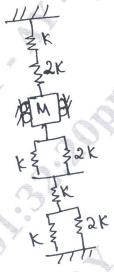


Fig Q2(a)

(10 Marks)

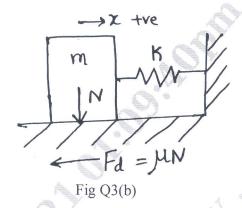
b. A circular cylinder of radius R and mess M is held by a spring as shown Fig Q2(b). If the body rolls on the horizontal surface, write the equation of motion using energy method.



Fig Q2(b)

(10 Marks)

- a. A mechanical system has a weight of 2kg and a spring of stiffness 15N/m. It is damped such that two conservative peaks are in the ratio 1:0.98. Find: i) damped natural frequency ii) logarithmic decrement iii) damping constant 'C' of the system. (10 Marks)
 - b. Find the equivalent viscous damping coefficient η_{eq} of the system under dry friction as shown in Fig Q3(b). Tke 'N' as the normal force at the interface and μ as the coefficient of friction.



(10 Marks)

- A periodic torque having a maximum value of 0.588Nm at a frequency of 4rad/s is impressed upon a flywheel suspended from a wire. The wheel has a moment of inertia 0.12kg-m² of wire has a stiffness 1.176 N/rad/m a viscous dashpot applies a damping couple of 0.392Nm at an angular velocity of /rad/s. Calculate:
 - i) Maximum angular displacement from rest position
 - ii) Maximum couple applied to dashpot
 - iii) The angle by which the angular displacement lags the torque
 - iv) Critical damping co-efficient

(20 Marks)

5 a. Explain the working of vibrometer with an example.

(08 Marks)

- b. A rotor of mass 4kg is mounted midway on a 10mm diameter, horizontal shaft simply supported on a span of 0.5m the outer of gravity of the rotor is 0.025mm away from the geometric centre of the rotor. The shaft rotates at 2500rpm. Find the amplitude of steady state vibration and dynamic force transmitted to the bearings. Take E = 205GPa. (12 Marks)
- 6 a. In the 2-DOF system shown in Fig Q6(a), if $m_1 = m$ and $m_2 = 2m$ and $k_1 = k_2 = k_3 = k$. Find the natural frequencies and mode shapes.

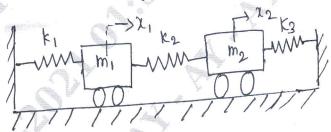


Fig Q6(a)

(10 Marks)

b. Write the equations of motion for the spring mass pendulum system shown in Fig Q6(b). For the case $m_1 = m_2 = m$, find the natural frequencies.

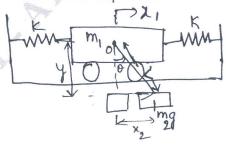


Fig Q6(b)

(10 Marks)

- 7 a. A car and its suspension system all idealized as a damped spring mass system, with natural frequency 0.5Hz and damping coefficient 0.2. Suppose the car drives at speed V over a road with sinusoidal roughness. Assume the roughness wavelength is 10m and its amplitude is 20cm. At what speed does the maximum amplitude of vibration occur and what is the corresponding vibration amplitude? (12 Marks)
 - b. Explain the predominant sources of vehicle vibration.

(08 Marks)

8 Consider the system shown in Fig Q8, write the equations of motion using influence coefficient. Find the natural frequencies and mode shape by matrix iteration.

3K = 21 2K = 21 2K = 21 2M = 242 3m = 242

Fig Q8

(20 Marks)

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