Graphic Era HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Even) Semester Examination May-June 2025

Roll no.....

Name of the Program and semester: B.Tech Mechanical 6th Sem
Name of the Course: Mechanical Vibrations
Course Code: TME 610

Time: 3 hour

Maximum Marks: 100

Note:

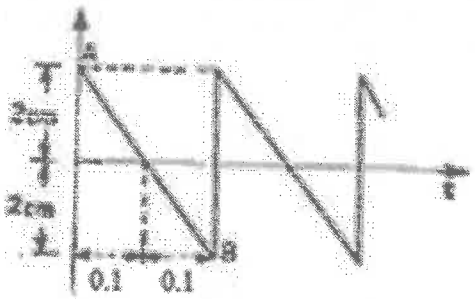
(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks) **(CO1)**

a. Add the following two motions analytically and check the solution graphically.
$x_1 = 8 \sin(\omega t+30°)$
$x_2 = 10 \cos(\omega t-60°))$

b. i. Express the complex number 3+j4 in exponential form.
ii. Express the exponential number $9e^{j0.3}$ in complex form.

c. Represent the periodic motion shown in figure by Harmonic series

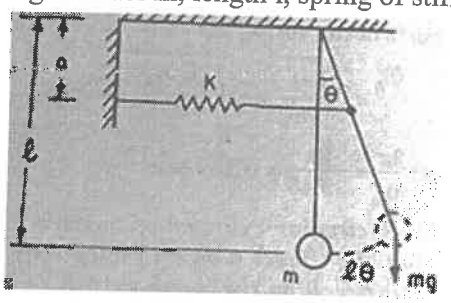


Q2. (2X10=20 Marks) **(CO2)**

a. Give Examples of following by a neat sketch
i. Longitudinal undamped free vibrations ii. Transverse undamped free vibrations
iii. Torsional damped free vibrations

b. Define the following terms related to vibrations
i. Natural frequency ii. Period iii. Resonance iv. Degree of freedom v. Simple Harmonic Motion

c. Determine the equations of the motions and natural frequency of the Simple pendulum shown in Figure mass m, length l, spring of stiffness k attached at distance a, from hanging point.



Q3. (2X10=20 Marks) **(CO3)**

a.
i. Define Logarithmic decrement with a mathematical expression.
ii. Describe Eddy current damping with Figure.

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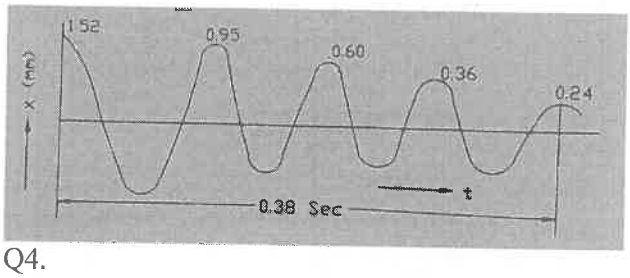
b. A body vibrating with viscous damping makes five complete oscillations per second, and in 50 cycles its amplitude diminishes to 10 percent. Determine the logarithmic decrement and damping ratio. What will be the effect on period of vibration if damping is removed?

c. A machine has 200 kg mass. It is placed on an isolator and vibration record obtained is shown in the figure. Determine the suspension characteristics of the system i.e. k, c and ζ.



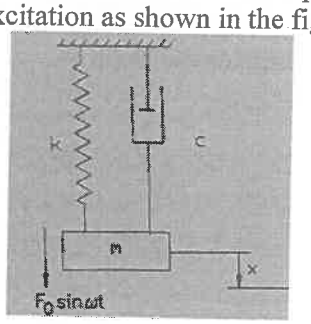
Q4. (2X10=20 Marks) **(CO4)**

a. Define the following terms.

i. Force transmissibility (with mathematical expressions).
ii. Frahms reed tachometer

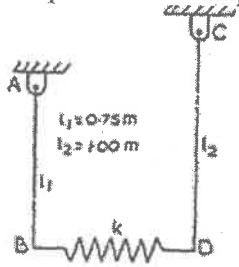
b. A radio set of 20 kg mass must be isolated from a machine vibrating with an amplitude of 0.05 mm at 500 RPM. The set is mounted on four isolators, each having a spring scale of 31400 N/m and damping factor of 392 N-sec/m. What is the amplitude of vibration of the radio? What is the dynamic load on each isolator due to vibrations?

c. Derive the expression of magnification factor and phase difference for spring, mass, damper system subjected to harmonic excitation as shown in the figure.



Q5. (2X10=20 Marks) **(CO5, CO6)**

a. Two uniform rods AB and CD are pivoted at their upper end as shown in Figure. Their lower ends are at the same level and are connected by a spring. Each rod weighs 5 kg/m and is vertical in equilibrium position with the spring unstrained. The spring has a stiffness of 3 kg/cm. Determine the natural frequencies and amplitude ratio of the system.



b. Explain the theory of dynamic vibration absorber with neat sketch and suitable expressions.

c. Explain the principle mode of vibrations with a suitable example.