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B.TECH. VI SEM MAIN/BACK EXAM AUGUST-2023

MECHANICAL ENGINEERING

(6ME4-03) - MECHANICAL VIBRATIONS

Time : 3 Hours]

[Max. Marks : 120

[Min Passing Marks :

Instructions to Candidates : Part – A : Short answer type questions (up to 25 words) 10 × 2 marks = 20 marks. All ten questions are compulsory.

Part – B: Analytical/Problem Solving questions 5 × 8 marks = 40 marks. Candidates have to answer 5 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 4 × 15 marks = 60 marks. Candidates have to answer 4 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1_____ 2_____

PART A

1. Define w.r.t. vibrations : (10)
   (a) Time period
   (b) Frequency
   (c) Resonance .
2. Write about the terms: free vibrations, forced vibrations and damped vibrations.
3. What are the causes of vibrations ?
4. What are the principle differences between viscous damping and Coulomb damping ?

5. Define degree of freedom of a vibratory system.

6. Define damped, undamped and free vibrations

7. Define logarithmic decrement with its mathematical expression.

8. Define critical speed of a shaft. Why is critical speed encountered ?

9. Explain briefly, the longitudinal, transverse and torsional free vibrations

10. What is node ?

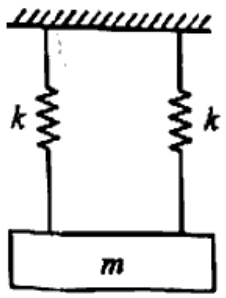
PART B

1. Explain the terms Periodic motion, Time period, Frequency, Amplitude of motion, Resonance and Cycle

2. Develop the equation of motion for spring-mass system (single degree of freedom) using Lagrange principle.

3. Develop the equation of motion for spring-mass system (single degree of freedom) using Newton's method.

4. A mass m is attached to two identical springs having spring constant k as shown below. Find the natural frequency of the system.

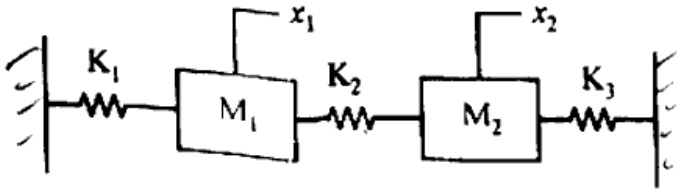


5. Explain the critically damped system with an example ?

6. Explain the term "Magnification Factor" with its characteristics curve

7. Find natural frequencies and mode shapes of the following system :

$K_1 = 2K_2 = 3K_3 = 10$ N/m ; $M_1 = 2M_2 = 10$ kg

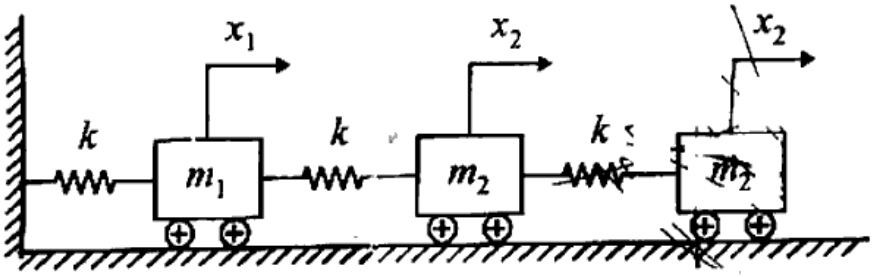


PART C

1. Explain torsional vibration absorber system in details.

2. Discuss in detail the Dunkurley's method for finding the natural frequency of a shaft carrying several loads.

3. Three rail bogies are connected by two springs of stiffness 40×10^5 N/m each. The mass of each bogey is 20×10^3 kg. Determine the frequencies of vibration. Neglect friction between the wheels and rails. A shaft of negligible weight 6 cm diameter and 5 meters long is simply supported at the ends and carries four weights 50 kg each at equal distance over the length of the shaft. Find the frequency of vibration by Dunkerley's method. Take $E = 2 \times 10^6$ kg/cm^2.



4. A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes vertical static deflection of 2 mm. The reciprocating parts of the engine have a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 KN per meter per second. Considering that steady state of vibration is reached; determine :

   (i) The amplitude of forced vibration, when the driving shaft of engine rotates at 480 rpm.

   (ii) The speed of the driving shaft at which resonance will occur.

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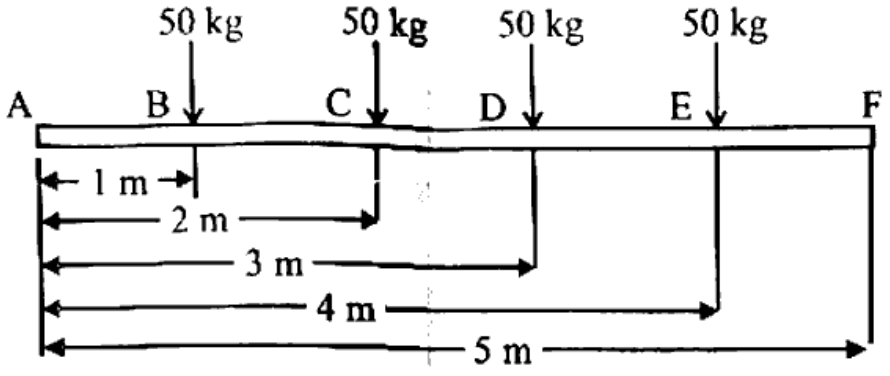

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