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**Question Paper Code : 60563**

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

First Semester

Computer Aided Design

ED 4154 – VIBRATION ANALYSIS AND CONTROL

(Common to M.E. Engineering Design/M.E. Product Design and Development)

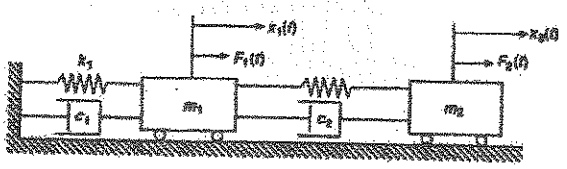
(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the equation of motion for the following cases :
   (a) Single degrees of freedom longitudinal forced vibrating system,
   (b) Single degrees of freedom free torsional vibrating system.
2. Define the transient vibration and specify the effects.
3. Draw the free body diagram of a two degree of freedom system shown in Fig. and specify all force acting on each mass.




4. Define the term 'coordinate coupling'.
5. Define the flexibility influence co-efficient in a multi degree of freedom system.
6. What are the significance of eigen values and eigen vectors in vibration analysis of continuous mass system?
7. What is dynamic vibration absorber? Illustrate with a schematic example.
8. List any four industrial noise sources and control strategies.

9. Illustrate the basic vibration measurement scheme with a block diagram.

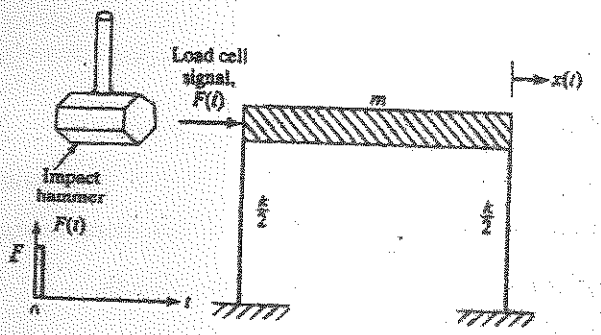
10. Specify any two methods that are used to convert the time domain vibration data in to the frequency domain data.

PART B — (5 × 13 = 65 marks)

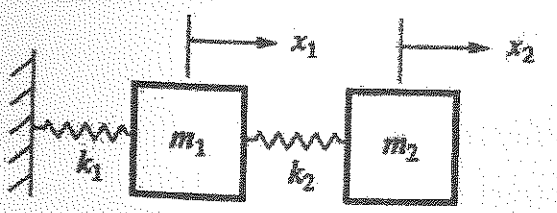
11. (a) A centrifugal fan of mass 5 kg has a rotating unbalance of 0.25 kgm. When dampers having damping factor 0.2 are used, specify the springs for mounting such that only 10% of the unbalance force is transmitted to the floor and find the force transmitted. The fan is running at a constant speed of 1000 rpm.

Or

(b) In vibration testing of a structure, an impact hammer with a load cell to measure the impact force is used to cause excitation as shown in Fig. Assuming, m = 5 kg, K = 2000 N/m, C = 10 N/m/s and F = 20 Ns. Find the response of the system.

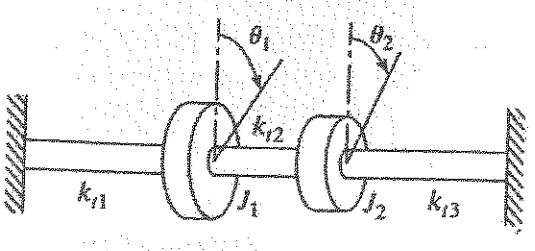



12. (a) The following Fig. shows a vibrating system having two degrees of freedom. Determine all the natural frequencies of vibrating system and the ratio of amplitude of vibrations in two modes of the system. $m_1 = 1.5$kg, $m_2 = 0.8$ kg and $K_1 = K_2 = 40$ N/m.

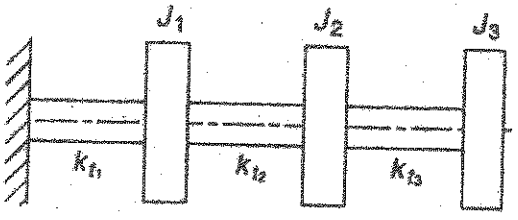



Or

(b) Find the natural frequencies and the mode shape as a function of torsional stiffness, $K_t$ and moment of inertia, J of the torsional vibrating system shown in Fig. Also find the amplitude ratio.




13. (a) Find the natural frequencies of the system shown in Fig. using Holzer method. $J_1 = 400$ kgm$^2$, $J_2 = 800$ kgm$^2$, $J_3 = 1200$ kgm$^2$, $K_{t1} = 1 \times 10^6$ Nm/rad, $K_{t2} = 2 \times 10^6$ Nm/rad, and $K_{t3} = 3 \times 10^6$ Nm/rad.

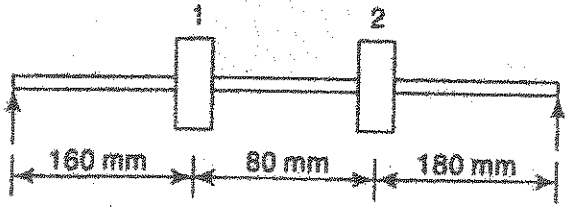



Or

(b) Find the natural frequency of the system shown in Fig using.

(i) Rayleigh method,

(ii) Dunkerley's method. E = 196 GPa., I = $10^{-6}$ m$^4$, $m_1$ = 40 kg, $m_2$ = 20 kg.




14. (a) Explain the steps in two plane balancing of large turbine rotor using vibration measurements with an example.

Or

(b) Brief about the noise survey techniques standards and different measurement methods of vehicle noise.

15. (a) Brief about the factors that are to be considered while selecting a sensor to measure the vibrations in automotive. Also, brief about the different mountings of accelerometer with simple sketch.

Or

(b) Explain the working principle of accelerometer with schematic illustrations. Also, brief about electra dynamic exciters that are used to simulate the different vibration environments.

PART C — (1 × 15 = 15 marks)

16. (a) Discuss the modal behavior of continuous mass system and concentrated mass system Also, find the two lowest natural frequencies of a uniform fixed-fixed beam using Rayleigh-Ritz method. Use the following trail functions which satisfy all boundary conditions : $\varphi_1(x) = x^4 - 2Lx^3 + L^2x^2$; $\varphi_2 = x^5 - 3L^2x^3 + 2L^3x^2$.

Or

(b) Enumerate the steps in extracting the first five fundamental modal frequency mode shape and damping ratio of a CNC lathe bed in free-free condition using experimental modal analysis. The steps should highlight the excitation method, sensor used, measurement technique and boundary conditions.

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