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VASAVI COLLEGE OF ENGINEERING (Autonomous), HYDERABAD

M.E. (Mech. Engg.: CBCS) II-Semester Make Up Examinations, September-2017

(Advanced Design & Manufacturing)

Mechanical Vibrations

Time: **3** hours Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from Part-B*

Part-A (10 × 2 = 20 Marks)

1. Differentiate static and dynamic coupling.
2. Define Maxwell's reciprocity theorem.
3. Briefly describe mode summation method.
4. Write the expression of a mode participation factor.
5. Describe the essential features of peak amplitude method.
6. Explain residue with an example.
7. Interpret the significance of coherence function in vibration testing.
8. Define Rayleigh damping.
9. Define cross correlation.
10. Explain the non-linear vibrations with an example.

Part-B (5 × 10 = 50 Marks)

11. a) Prove that normal modes are orthogonal with respect to the mass and stiffness matrices. [4]

    b) Using Rayleigh method, determine the lowest vibration frequency from the system with point masses m_1 and $m_2 = 2m_1$ shown in Figure 1. The beam mass may be neglected. Take the supports as fixed (left) and free (right). [6]

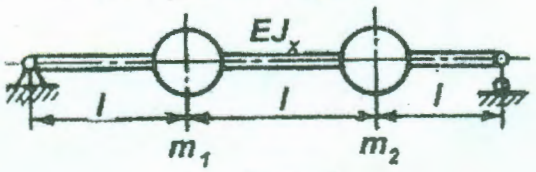

Figure 1

12. a) A thin rod of L is elevated using magnetic levitation bearings. Derive the frequency equation for longitudinal vibration of the rod and obtain the natural frequencies. Sketch the first four mode shapes and interpret the results. [5]

    b) Determine the natural frequency of a simply supported beam. Sketch the first three mode shapes. [5]

13. a) Prove that mobility FRF has a circularity property with origin $(0.5/C, 0)$ and radius $0.5/C$, where C is damping coefficient. [4]

    b) Calculate the Receptance FRF (α_{11}) and (α_{21}) of a two DOF system shown in Figure 2. [6]

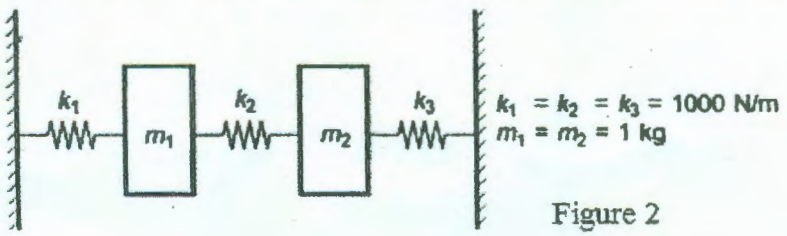

Figure 2

Contd... 2

14. a) What factors need to be considered to avoid double impact in modal testing? [3]

    b) A compressor unit having a mass of 50 kg is to be supported on four springs, each having a stiffness of k. The unit operates at 500 rpm. Find the value of the stiffness k if only 12% of the shaking force is allowed to be transmitted to the supporting structure. [7]

15. a) Using the nonlinear equation $x + x^3 = 0$ show that x_1 and x_2 are solutions satisfying the differential equations, their superposition $(x_1 + x_2)$ is not a solution. [4]

    b) The RMS meter reads the vibration within 200 Hz band and it shows a reading of 10g. Calculate the spectral density. If the pass band range changes to 100 Hz, what is the value of RMS meter reading? [6]

16. a) Write the point matrix of rotating mass with polar moment of inertia is J_n. [4]

    b) Derive the Equation of motion for lateral vibrating string and write the general solution. [6]

17. Answer any ***two*** of the following:

    a) Explain modal parameter extraction procedure using Inverse FRF method. [5]

    b) Describe the working principle of a vibration absorber with appropriate diagrams and equations. [5]

    c) Explain the random vibrations with an example. [5]