Hall Ticket Number:

Code No.: 32414 AS

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, HYDERABAD

B.E. (Mech. Engg.) III Year II-Semester Advanced Supplementary Examinations, June/July-2017

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. Derive the equation of motion of a single degree freedom (SDOF) spring-mass damper system under harmonic load?
2. Define sharpness of resonance (Q) and write expression for damping coefficient in terms of Q?
3. Define generalized coordinates?
4. What is System Matrix?
5. Define the Orthogonality conditions of Eigen vectors?
6. Define Principle coordinates?
7. What are the causes for non-linear vibrations?
8. Define random vibration with an example?
9. What is aliasing and explain with an example?
10. How to define Frequency Response Function (FRF) and its use in Vibration measurements?

Part-B (5 × 10 = 50 Marks)

11. a) Derive the general solution of non-oscillatory motion of SDOF damped system? [4]

    b) A mass m_1 hangs from a spring k (N/m) and is in static equilibrium. A second mass m_2 drops through a height h and sticks to m_1 without rebound, as shown in Figure 1. Determine the subsequent motion. [6]

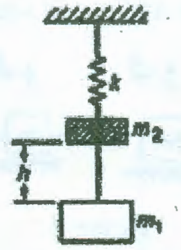

Figure 1

12. a) Explain the concept of vibration absorber with the help of mathematical expressions. [4]

    b) Determine the natural frequency and modeshape of the spring mass sytsem as shown in Figure 2 for given $m_1 = m_2 = m$. [6]

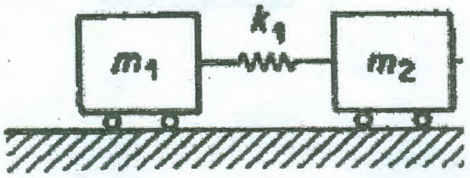

Figure 2

Contd... 2

13. a) "Upper bound and lower bound to the fundamental frequency can be obtained by Rayleigh method and Dunkerly's method, respectively". Prove the above statement with an appropriate mathematical expression. [5]

b) Derive the principle co-ordinates for the vibrating system shown in Figure 3. [5]

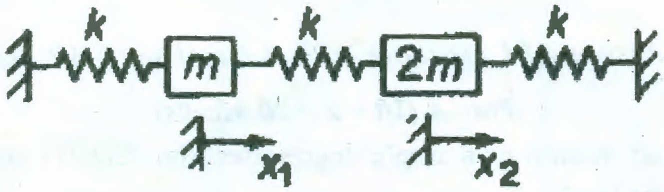

Figure 3

14. a) Derive the differential equation of motion for the torsional vibration of rods and write the the general solution for the derived differential equation with proper assumptions. [5]

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

15. a) Explain the working principle of an accelerometer with appropriate mathematical expressions? [7]

b) A vibration pickup has a sensitivity 40 mV/cm/s between f = 10 Hz to 2000 Hz. If 1 g acceleration is maintained over this frequency range, what will be the output voltage at (a) 10 Hz and (b) 2000 Hz? [3]

16. a) Define Normal mode vibration with an example? [3]

b) The door closer exerts a critical damping of 24 N-m-s/rad and it is provided with a torsional spring which exerts a resisting torque proportional to the door opening angle θ. The door is swung open by 60^0. Determine the maximum angular velocity with which the door can be swung back so as not to hit the frame. The uniform rectangular door has a mass 48 kg, a height 2 m, and a width 1m. [7]

17. Answer any *two* of the following:

a) Determine the natural frequencies and mode shapes of the system shown in Figure 4. [5]

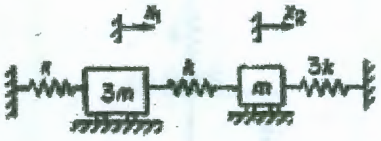

Figure 4

b) Derive the Equation of motion for longitudinal vibration of rod? [5]

c) Explain the various accelerometer mounting options and its effect on sensor usable frequency range? [5]

ઊઊઊ