Continuing Education Course #013
Modal Analysis
Vibration

1. Modal analysis of structures is used to validate the predictions of:
- ○ a. CAM (computer aided manufacturing) software
- ○ b. FEA (finite element analysis) software
- ○ c. CFD (computational fluid dynamics) software
- ○ d. CAD (computer aided design) software.

2. The oscillating frequency for systems experiencing forced vibration is equal to the:
- ○ a. natural frequency
- ○ b. spring constant
- ○ c. forcing frequency
- ○ d. mass ratio.

3. The characteristic equation for a dynamic system is obtained from:
- ○ a. finite element analysis
- ○ b. the frequency response function
- ○ c. the equation of motion
- ○ d. the real and imaginary parts of the response.

4. The energy dissipation in a shock absorber is best described as:
- ○ a. viscous damping
- ○ b. solid damping
- ○ c. Coulomb damping
- ○ d. hysteretic damping.

5. Most mechanical systems are:
- ○ a. overdamped
- ○ b. critically damped
- ○ c. underdamped
- ○ d. undamped.

6. The frequency response function is described as complex because:
- ○ a. it has both a real and imaginary part
- ○ b. it has both a magnitude and phase
- ○ c. it is difficult to visualize
- ○ d. both a. and b.

7. The magnitude of a system's frequency response function depends on:
- ○ a. the stiffness, k
- ○ b. the damping ratio, ζ

○ c. the forcing frequency
○ d. all of the above.

8. A two degree of freedom systems has:
○ a. one natural frequency
○ b. two natural frequencies
○ c. an infinite number of natural frequencies
○ d. any number of natural frequencies.

9. Mode shapes represent:
○ a. the relative magnitude and direction of vibration between coordinates
○ b. the ratio of natural frequencies
○ c. neither a. or b.
○ d. both a. and b.

10. By transforming to modal coordinates, the system equations of motions are:
○ a. simplified
○ b. uncoupled
○ c. normalized
○ d. joined.

11. A fundamental assumption in the application of modal analysis is:
○ a. solid damping
○ b. viscous damping
○ c. Coulomb damping
○ d. proportional damping.

12. A cross frequency response function means that:
○ a. the response was measured at the same location that the force was applied
○ b. the response was measured at a different location than where the force was applied
○ c. the force was applied in a direction perpendicular to the measurement direction
○ d. the data cannot be trusted.

13. A direct frequency response function is:
○ a. equal to the sum of the modal contributions
○ b. obtained from numerical, not experimental, analysis
○ c. scaled by the eigenvalues
○ d. all of the above.

14. Complex matrix inversion:
○ a. requires proportional damping
○ b. does not require proportional damping
○ c. is used to calculate the mass, damping, and stiffness matrices for a system
○ d. is an approximate solution method for free vibration of complicated systems.

15. Reciprocity in modal analysis means that:
○ a. cross FRFs are equal
○ b. cross FRFs are unequal
○ c. direct FRFs are equal
○ d. direct FRFs are unequal.

16. In practice, modal analysis is most often used to:
- a. solve equations of motion for numerical models
- b. define a numerical model using experimental data
- c. verify that damping exists in structures
- d. analyze self-excited vibrations.

17. “Peak picking” is used to:
- a. estimate proportional damping constants
- b. exclude unimportant data
- c. correlate one measurement to another on the same structure
- d. identify modal parameters.

18. To determine mode shapes from experimental data:
- a. only direct FRFs are required
- b. only cross FRFs are required
- c. both direct and cross FRFs are required
- d. mode shapes cannot be determined from experimental data, only from numerical analysis.

19. The natural frequencies for a system can be estimated from measured data using:
- a. the peaks of the imaginary part of the frequency response function
- b. the peaks of the real part of the frequency response function
- c. the ratio of the imaginary part to real part of the frequency response function
- d. none of the above.

20. For a measured frequency response function, the number of modes is determined by:
- a. complex matrix inversion
- b. finite element analysis
- c. identifying the number of dominant peaks
- d. dividing the frequency range by the frequency resolution.

21. If the number of modes for a measured frequency response function is three, then:
- a. the modal matrices will have dimensions of 3x3
- b. the modal matrices will have dimensions of 6x6
- c. the modal matrices will have dimensions of 9x9
- d. not enough information is provided to determine the size of the modal matrices.

22. Because elastic bodies possess an infinite number of degrees of freedom, all measurements exhibit:
- a. damping
- b. finite stiffness
- c. proportional damping
- d. modal truncation.

23. The term DC compliance refers to:
- a. the inverse of stiffness
- b. the level of damping
- c. calibration of voltage measurement signals
- d. the choice to neglect high frequency modes.

24. A dynamic signal analyzer computes:
- a. the Fourier transform of force and vibration signals
- b. the mode shapes of dynamic systems

○ c. the type of damping in a structure
○ d. the equations of motion for dynamic systems.

25. A mobility frequency response function is the ratio of _____ to force.
○ a. displacement
○ b. velocity
○ c. acceleration
○ d. all of the above.

26. In experimental modal testing, a sine sweep test uses a _____ for force input.
○ a. hammer
○ b. shaker
○ c. either a. or b.
○ d. neither a. or b.

27. When using an impact hammer, the bandwidth (frequency range) of the force excitation depends on:
○ a. the hammer mass
○ b. stiffness of the hammer tip
○ c. both a. and b.
○ d. neither a. or b.

28. Identify the non-contact vibration measurement transducers.
○ a. laser vibrometer
○ b. capacitance probe
○ c. accelerometer
○ d. both a. and b.

29. To convert from inertance to receptance, divide by the:
○ a. frequency
○ b. frequency squared
○ c. calibration constant
○ d. relative sensitivity.

30. A stinger is used to:
○ a. transmit shear and bending loads only in shaker tests
○ b. transmit bending loads only in shaker tests
○ c. transmit axial load only in shaker tests
○ d. measure force in shaker tests.