Continuing Education Course #348
Computer Aided Design and Finite Element Analysis
An Overview

1. Which of the following is an advantage of 3D software compared to 2D software?
- a. 3D solid modeling software allows for a more complete analysis and greater flexibility
- b. It is generally easier to visualize complex parts in 3D
- c. 3D software allows the user to combine individual part files into an assembly to see how parts will work together and check for interferences between parts
- d. All of the above

2. Three-dimensional software can automate development of drawing sets such as automation of calling out hole size and features, bolt information, and bill of material tables.
- a. True
- b. False

3. Ivan Sutherland is known as the father of CAD/CAM.
- a. True
- b. False

4. Which of the following statements about the finite element method is not true?
- a. The method can determine a system's response to combinations of complex loading types
- b. The method cannot perform analysis for large deflections
- c. The method can be used to determine mode shapes and natural frequencies
- d. The method can predict behavior of components with very complex geometry and complex restraints

5. Finite element analysis is a numerical method used to approximate solutions and predict behavior of components.
- a. True
- b. False

6. In solid modeling software, 2D sketches are used to create a 3D solid volume. Which of the following statements is not true about 2D sketches and the generation of 3D volumes?
- a. The sketch must be a closed region in order to develop a 3D solid
- b. Once a solid is created from a sketch, any changes made to the sketch will automatically adjust the solid to fit the new sketch
- c. Sketches can only be generated on the global XY plane, XZ plane, or YZ plane
- d. None of the statements are true

7. Which of the following statements is not true about parametric modeling?
- a. Users input dimensions as numbers, which are then stored in the software as a parameter that can be used in very complex equations to define other dimensions
- b. If the user makes changes to a sketch, any set geometric constraints will automatically be removed

○ c. Global variables can be used when multiple dimensions use a common dimension
○ d. Parametric modeling is an extremely useful feature of solid modeling programs that simplifies design changes

8. Which of the following statements is true?
○ a. Solid modeling software can calculate mass properties for the part
○ b. Solid modeling software can calculate properties such as center of mass and moments of inertia
○ c. Solid modeling software will allow the user to define the material used for parts
○ d. All statements are true

9. Autodesk Inventor includes a built-in design tool to design and generate springs.
○ a. True
○ b. False

10. In FEA, structural elements can be modeled as springs using _____, which defines how deflection is proportional to the applied force.
○ a. Hooke's law
○ b. Impulse
○ c. Poisson's ratio
○ d. Von Mises stress

11. The free body diagrams shown in Figure 21 on page 26 of the course do not include a free body diagram for mass 3 because mass 2 is held stationary not allowed to move so no force is applied to mass 3.
○ a. True
○ b. False

12. The matrix form of Hooke's law, similar to that shown in Equation 9, will have a stiffness matrix that
○ a. will have the size of a 1xn matrix, where n is the number of degrees of freedom
○ b. consists of the applied force values
○ c. will be symmetric and will have a size nxn based on the degrees of freedom of n
○ d. none of the statements are true

13. In using FEA for heat transfer applications, we can still consider the equations like Hooke's law with force being replaced with
○ a. Time
○ b. Temperature
○ c. Heat flux
○ d. Heat transfer applications cannot be solved in FEA

14. Which of the following steps of the FEA process involves defining the geometry, mesh generation, and applying loads and constraints?
○ a. Preprocessing
○ b. Computation
○ c. Post processing

15. A finite element analysis is needed for a loading that is applied slowly and the relationship between applied loading and deformation should be linear. What type of analysis is this?
○ a. A static non-linear analysis
○ b. A dynamic non-linear analysis
○ c. A static linear analysis
○ d. A dynamic linear analysis

16. Modal analysis is used to

- a. model material nonlinearities such as creep
- b. determine if static analysis is appropriate
- c. identify natural frequencies
- d. none of the above

17. Thin-walled structures, such as a cylindrical tank, is a good application for
- a. One-dimensional beam elements
- b. Two-dimensional shell elements
- c. Three-dimensional solid elements

18. Which of the following statements is not true about convergence error?
- a. Convergence error is the percent difference between consecutive iterations after making changes to the mesh
- b. The H-element method reduces the size of the elements to check for convergence
- c. The P-element method decreases the order of the polynomials to check for convergence
- d. The P-element method uses a constant mesh

19. In a convergence study, all of the following statements are true except
- a. The steps include building the model, solving the model, and refining the mesh and resolving
- b. As the mesh is refined, the stress at the same point is recorded and compared to previous values
- c. Convergence is based on a stress value being similar to the previous value
- d. All statements are true

20. Two-dimensional FEA applications include
- a. structural trusses
- b. cases where the member to be analyzed is thin and the loads act only in the plane
- c. a large part where the length, width, and height dimensions are all similar
- d. all cases listed

21. In Autodesk Inventor's convergence settings, setting the H refinement threshold at 0.75 would result in the elements with equivalent errors at the top 75% being subject to refinements.
- a. True
- b. False

22. The mesh refinement method where only some regions of interest experience mesh refinement while other areas are left unrefined is known as
- a. distortion refinement
- b. polynomial refinement
- c. global refinement
- d. localized refinement

23. Using incorrect constraints in a model is an example of
- a. user error
- b. modeling error
- c. discretization error

24. The best mesh refinement for fixing modeling errors is
- a. H-element method
- b. P-element method
- c. Either H-element method or P-element method
- d. Mesh refinement cannot fix modeling errors

25. Which of the following statements is true about modeling errors?

- ○ a. Distortion in an element shape has no effect on model accuracy
- ○ b. High aspect ratios of elements should be used when possible
- ○ c. A common source of errors would be a mesh that is too coarse
- ○ d. All statements are true