Des Moines Area Community College

COURSE INFORMATION

Acronym/Number CADT 428

Title Introduction to Finite Element Analysis (FEA)

Credit breakout

3	2	2	0	0
(credit	lecture	lab	practicum	work experience)

PREREQUISITE(S): CADT 411, CADT 412, CADT 426, MATH 411

COURSE DESCRIPTION:
This course will introduce CAD students to analysis of simple structures. Analysis shall be examined then verified using computer analysis software in conjunction with CAD. Basic engineering statistics will be taught.

COURSE COMPETENCIES:
During this course, the student will be expected to:

1. Examine forces.
   - 1.1 Differentiate between internal and external forces.
   - 1.2 Discuss compressive forces.
   - 1.3 Discuss tensile forces.
   - 1.4 Identify gravitational forces.
     - 1.4.1 Calculate ISO gravitational forces.
   - 1.5 Discuss force translations.
   - 1.6 Calculate resultant force.
     - 1.6.1 Calculate CAD graphical model.
     - 1.6.2 Discuss location of resultant force on model.
   - 1.7 Discuss concurrent forces.
   - 1.8 Discuss co-planer forces.
   - 1.9 Create free-body diagram.
   - 1.10 Discuss equilibrium of forces.
   - 1.11 Examine forces on inclined planes.

2. Determine three dimensional resultants.
   - 2.1 Discuss force system theorems.
   - 2.2 Create CAD vectors.
     - 2.2.1 Calculate vectors.

3. Examine simple (direct) stress.
    - 3.1 Discuss tension.
    - 3.2 Discuss compression.
    - 3.3 Discuss shear.
    - 3.4 Discuss bearing.

4. Discuss friction.
    - 4.1 Define static friction.
        - 4.1.1 Calculate maximum static friction.
    - 4.2 Discuss friction on an inclined plane.
    - 4.3 Discuss wedge action.
    - 4.4 Discuss journal friction.

5. Examine moments.
    - 5.1 Define moment arm.
    - 5.2 Discuss sign of moment.
    - 5.3 Discuss uniform loading.
        - 5.3.1 Calculate the centroid of the load.
    - 5.4 Identify couples.

6. Discuss basic constraints.
    - 6.1 Define six degrees of freedom.
    - 6.2 Discuss applying basic constraints.

7. Create element mesh.
    - 7.1 Examine mesh types.
        - 7.1.1 Discuss 2D mesh generation.
        - 7.1.2 Describe triangular meshes.
        - 7.1.3 Describe polygon meshes.
        - 7.1.4 Discuss 3D mesh generation.
        - 7.1.5 Describe tetrahedral meshes.
        - 7.1.6 Discuss polynomial generated meshes.
    - 7.2 Define nodes.
        - 7.2.1 Discuss nodal data.
    - 7.3 Create 2D mesh.
    - 7.4 Create 3D mesh.

8. Analyze trusses.
    - 8.1 Calculate resultants in truss forces.
    - 8.2 Discuss truss structures.
    - 8.3 Examine forces.
        - 8.3.1 Discuss truss connections.
        - 8.3.2 Discuss method of joints.
        - 8.3.3 Discuss method of sections.
    - 8.4 Construct truss CAD model.
    - 8.5 Apply forces to model.
    - 8.6 Apply constraints.

9. Examine material properties.
   - 9.1 Define stress.
   - 9.2 Define strain.
   - 9.3 Discuss material terms.
   - 9.4 Define modulus of elasticity.
   - 9.5 Discuss ductility.
   - 9.6 Calculate allowable stresses.
   - 9.7 Calculate safety factors.
   - 9.8 Define Poison's ratio.
   - 9.9 Discuss thermal stress.
     - 9.9.1 Define coefficient of thermal expansion.
   - 9.10 Analyze composites.

10. Determine mass properties.
    - 10.1 Discuss center of gravity.
    - 10.2 Examine centroids.
    - 10.3 Determine moment of area.
    - 10.4 Calculate centroid of a composite.
      - 10.4.1 Compare calculated centroid to CAD model.
    - 10.5 Discuss moment of inertia.

11. Discuss CAD model creation.
    - 11.1 Define wireframe entities.
    - 11.2 Discuss nodal entities.
    - 11.3 Discuss mesh generation.
    - 11.4 Discuss thermal applications.
    - 11.5 Discuss dithering model.

12. Analyze joint designs.
    - 12.1 Examine bolted joints.
      - 12.1.1 Discuss bolted joint failure.
      - 12.1.2 Discuss bolted joint terms.
    - 12.2 Compare rivet joints to bolted joints.
    - 12.3 Calculate allowable loads for welded joints.

13. Examine simple beams.
    - 13.1 Examine supported beam.
    - 13.2 Examine overhanging beam.
    - 13.3 Examine cantilever beam.

14. Discuss data decoder operations.
    - 14.1 Discuss the analysis process of a model.
      - 14.1.1 Examine finite element decoding software.
    - 14.2 Examine the data that is required to analyze the model in a decoder.
      - 14.2.1 Discuss data libraries.
    - 14.3 Analyze a model.
    - 14.4 Examine the results of a model.
    - 14.5 Discuss the differences between a finite element modeling and mass properties.

CADT 428

INSTRUCTIONAL MATERIALS:

Textbook(s): For each text used in this course, identify the minimum chapters to be covered in this course.
Applied Statistics and Strengths of Materials - Spiegel - Merrill - chapters 1 thru 11, 13, 15 and 19

Introduction to Computer-Aided Design Analysis - Leetch - All chapters

Machinery's Handbook - referred to as needed.

Study guide

Transparencies

Test banks

Computer hardware/software
ALGOR software
AutoCAD, MicroStation or Pro/Engineer software

Other (example: Laboratory equipment for biology/chemistry class)

Computer Laboratory
3E-102/3E-104

Effective date: August, 2004

by: J. Leetch

Campus: A B C U N W OC

extension: 6377

Revision(s): 7/96

Competencies are reviewed annually.