Illinois Society of Professional Engineers - University of Illinois
College of Engineering
Professional Engineer On-Line Seminars

INSTRUCTIONS:

1. View the on-line seminar.
2. Complete the quiz below.
3. Complete the "Engineer Information" section.
4. Make a copy for your records.
5. Mail the quiz along with your $20 payment (credit card information or check payable ISPE) to: ISPE, 100 East Washington Street, Springfield, IL 62701.

If you score an 80% of better on the quiz, you will receive your certificate within 4 weeks. If you fail to earn an 80% score, the quiz will be returned to you and you will have the opportunity to retake it.

Each seminar/quiz is worth 1 Professional Development Hour.

QUIZ: **05-04**
Presenter: Ted Belytschko
Topic: Computational Fracture from the Nano-Scale to the Macro-Scale

1. Who is the head of the civil engineering department?
   a. Dr. Glaucio Paulino
   b. Dr. Ted Belytschko
   c. Dr. Robert Dodds
   d. Dr. Nathan Newmark

2. Dr. Belytschko has written a book on
   a. Nonlinear Finite Elements for Continua and Structures
   b. Fundamentals of Structural Mechanics
   c. Analytical Fracture Mechanics
   d. Quantum Mechanics with Engineering Applications

3. The extended finite element method (XFEM) is discussed with reference to the arbitrary growth of cracks through a finite element mesh.
   (circle) TRUE FALSE

4. A crucial difference in the XFEM formulation compared with standard finite element methods is a step function in the displacement field.
   (circle) TRUE FALSE

5. Which of the following has Dr. Belytschko *not* investigated with his meshless method?
   a. High speed impact of cylindrical containers
   b. Dynamic steady-state crack propagation
   c. Concrete subject to an explosive charge
   d. Fragmentation

6. In Dr. Belytschko's multiscale research, he has computationally studied material behavior on length scales from a nanometer to several millimeters.
   (circle) TRUE FALSE

7. To study carbon nanotubes, the following physical models were used (list all that apply):
   a. Quantum Mechanics
   b. Continuum Mechanics
   c. Electrodynamics
   d. General Relativity
   e. Molecular Mechanics

8. At the micromechanical level, parameter fitting is a trivial and unimportant task when modeling material response.
   (circle) TRUE FALSE

9. The scatter of data with respect to nanotube strength is similar to a Gauss distribution.
   (circle) TRUE FALSE

10. Which one of the following explanations is the major reason early predicted failure strengths for carbon nanotubes were vastly greater than the actual empirical values?
    a. The cutoff of the energy potential lead to physically unrealistic forces.
    b. The initial numerical simulations lacked sufficient refinement.
    c. There was insufficient understanding of the structure of nanotubes.

11. Differences in quantum mechanic methods lead to large differences in predicted fracture strength.
    (circle) TRUE FALSE

12. Which of the following ideas did Dr. Belyschko *not* find essential to simulate the fracture strength of nanotubes?
    a. The energy potential should not be truncated.
    b. The quantum mechanical model should be chosen carefully, much like the choice of a constitutive model.
    c. The entire model should be simulated with a large scale micromechanical model.
    d. The full knowledge of the procedure used to create, extract, and test the experimental nanotubes must be known, and any side effects from the procedure must be accounted for in the simulation.

13. The "Dirac Barrier" relates
    a. how the number of assumptions made in a model effects its predictive capacity.
    b. the value of a function at a point in time with respect to a test function.
    c. the principle of minimum virtual work to the third law of thermodynamics.

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