EMA 6715 Fracture of Brittle Materials

1. Catalog Description (3 credit hours) – Latest concepts in deformation, fracture and toughening of brittle materials. Application of fracture mechanics and fractals to failure in brittle materials. Development of an approach to failure analysis for brittle materials.

2. Pre-requisites and Co-requisites – EMA 4223 and EGM 3520, or equivalent
Course Objectives – To familiarize the student with the application of fracture mechanics to the fracture of brittle materials; the use of quantitative fractography in failure analysis, of scaling concepts in fracture and the effect of microstructure on the application of fracture mechanics and quantitative fractography. The intention is to enable the student to apply these concepts to their projects.

3. Instructor – Professor J. J. Mecholsky, Jr., Ph.D
    a. Office location – 100D Rhines Hall
    b. Telephone – 352 846 3306
    c. E-mail address – jmech@mse.ufl.edu
    d. Web site - http://mecholsky.mse.ufl.edu
    e. Office hours – M-9; W,R-6

4. Meeting Times – T,R: 4,4-5

5. Meeting Location – CSE E118

6. Textbooks Required - D. J. Green, An Introduction To The Mechanical Properties of Ceramics, 1998; Class Notes, J. J. Mecholsky, Jr., distributed.

7. Course Outline
    1. Background – Structural Ceramics.
    2. Elastic Deformation – Hooke's Law.
    3. Elasticity – Stress, strain and tensor transformations
    4. Generalized Hooke's Law, elastic constants, anisotropic elasticity, single crystals, and mixing rules.
    5. Atomic bonding, structure and structural behavior.
    6. Elasticity problems.
    3. Fracture - fracture mechanics (LEFM) principles, mixed mode fracture, measurements of fracture toughness, fracture surface analysis (FSA) fractography and relationship between FSA and LEFM.
    4. Stress corrosion - Wiederhorn stress intensity approach, Michalske-Freiman theory, application of fractography and measurement techniques.
    5. Reliability (statistical theories of fracture) - Weibull statistics, proof testing and lifetime predictions.
    6. Mechanisms of Toughening - transformation toughening, crack deflection, crack bridging and shielding, particulate and fiber reinforcement.

7. Effects of microstructure on fracture.
8. Fractal processes in fracture
9. Contact damage, indentation and impact.
10. Viscosity & Viscoelasticity.

8. Attendance and Expectations - Attendance is required. I expect the students to read any assigned papers /notes and be ready to discuss details concerning these papers/notes.

9. Grading – Class Participation (20%); Mid-Term (20%); Final (40%); Written Technical Proposal or Paper (20%).

10. Grading Scale –

≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E

11. Make-up Exam Policy – Instructor should be contacted prior to missed examination, except for emergencies.

12. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

13. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

14. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
    - University Counseling Center, 301 Peabody Hall, 392-1575, Personal and Career Counseling.
    - SHCC mental Health, Student Health Care Center, 392-1171, Personal and Counseling.
    - Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling.
    - Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

15. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.