Information Form for SJTU Graduate Profession Courses

Basic Information				
Extended Information				

This course should give students both a basic understanding on the strength and fracture materials and Material Mechanics.

The course will begin by developing the theoretical framework for the fracture and strength of solids (e.g. theoretical cleavage strength, shear strength, Griffith theory) and then developing an understanding of brittle and ductile fracture. Then the techniques for the measurement of strength and fracture toughness will be presented, with a focus on the indentation technique, which is one important method for scientific research. In addition, this course will also present the basic concepts on the material strengthening and toughening (e.g. phase transformation toughening, composite approach, Eshelby theory, etc), as well as fractography. The course will also give students the recent research findings on the materials fracture or strength.

This course will use several engineering materials, such as high temperature superalloy, thermal barrier coatings for areoengine, fiber reinforced composites, nuclear fuel particles and light alloys, as examples, to introduce the knowledge of engineering fracture, for example, the creep, fatigue, stress corrosion and Hydrogen brittleness induced failure.

The course will be interactive and there will be periods for students to raise questions and discuss aspects of their own experimental work with the instructor.

1-3	**1.** 1.1 1.2 1.3 (Inglis Theory) 1.4 Griffith 1.5 1.6 1.7 1.8 -	6	/
4-5	**2.** 2.1 2.2 2.3 / 2.4 2.5 Webull 2.6	4	/
6-7	**4.** 4.1 4.2 4.3 4.4 4.5 4.6 Eshelby 4.7 4.8	4	/
8	**/**	2	/
9-10	**5.** 5.1 5.2	4	/

		5.3 5.4 5.5 5.6 5.7		
	11-14	**6.** 6.1 6.2 6.3 6.4 6.5 . 6.6	8	/
	15-16	**7.**	4	PPT
	Week	**Content**	**Hours**	**Format**
	1-3	**1. Fundamentals on Material Strength and Fracture** 1.1 Theoretical cleavage strength 1.2 Theoretical shear strength 1.3 Stress concentration (Inglis Theory) 1.4 Griffith Theory 1.5 Ductile fracture 1.6 Brittle fracture 1.7 Fracture toughness 1.8 Ductile to Brittle transformation	6	Online/class teaching
	4-5	**2. Techniques to measure the strength and fracture toughness** 2.1 Strength testing 2.2 Fracture toughness testing 2.3 Indentation fracture theory 2.4 Factors affecting the strength and fracture toughness 2.5 Failure statistics and Weibull Distribution 2.6 Examples	4	Online/class teaching
	6-7	**3. Fracture and Toughening** 3.1 Nucleation and formation of cracks 3.2 Fractography 3.3 Toughening mechanism 3.4 Phase transformation toughening 3.5 Composite Materials 3.6 Eshelby theory 3.7 Engineering design 3.8 Size effect in strength testing	4	Online/class teaching
	8	**Course Tutoring/Quiz**	2	/
	9-10	**4. Creep and Fatigue** 4.1 Plastic deformation 4.2 Dislocation density 4.3 Strengthen mechanism 4.4 Creep 4.5 Fatigue 4.6 Stress corrosion	4	Online/class teaching

		4.7 Hydrogen brittleness		
	11-14	**5. Case study** 5.1 Superalloy in gas turbine 5.2 Thermal barrier coatings for areoengine 5.3 Fibre reinforced ceramics 5.4 Nuclear cladding materials 5.5 TRISO particles for high temperature gas cooled reactors. 5.6 Metal foams	8	Online/class teaching
	15-16	**7. Final Examination**	4	Online/class PPT

Midterm test (30%)+final test (70%). The final test can be:

1. Presentation: the student can choose one topic related to this course and give talks (15 mins in class.
2. Essay: write a paper/literature review on one topic related to this course and submitted before the end of semester.

1. David. J. Green, An introduction to the mechanical properties of ceramics, Cambridge University Press, 1998, Chapter 8
2. B. R. Lawn, Fracture of Brittle Solids, Second Edition, Cambridge University Press, Cambridge, UK, 1993.
3. M.A. Meyers and K.K. Chawla, Mechanical Behavior of Materials, Prentice-Hall , 1999.
4. Mark L. Weaver, Mechanical Behavior of Materials, Course Notes, University of Alabama

Reference books

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