Ph.D. Qualifying Exam: Mechanics of Materials

Department of Mechanical Engineering University of Utah

Exam Description:

This qualifying exam will test the student's graduate-level knowledge of mechanics of materials. The reference textbooks and course material that serve as a basis for this exam are taken from ME EN 3310 and ME EN 6300. The exam is focused on testing concepts learned in mechanics of materials, along with survey of advanced topics.

Students should be able to:

- Evaluate complex states of stress and strain for a variety of loading scenarios
- Analyze the mechanical behavior of linear elastic materials, including the predict of failure for complex states of loading
- Identify limitations of traditional mechanics of materials, or elementary, techniques
- Utilize (not derive) solutions from Theory of Elasticity to solve complex problems that can't be accurately addressed using traditional mechanics of materials techniques (e.g. torsion and bending of non-circular cross-sections, concentrated loads, etc)
- Apply energy methods to predict multiaxial structural deformation under complex loading
- Apply fundamental principles of plasticity to predict structural deformation beyond the elastic regime

Recommended References:

Advanced Mechanics of Materials and Applied Elasticity, 5th Ed., A.C. Ugural & S.K. Fenster, Prentice Hall, 2012. (Note that a free online version of this text is available through the Marriott Library website; search for the text, click the "View It" tab, and sign into the service with your university email.)

Exam Materials:

See recommended references and/or ME EN 6300 class notes

Topics:

Topics covered include:

- Advanced analysis of stress and strain
- Properties of linear elastic materials
- Failure criteria, including fatigue
- Concentrated loads, including contact stress
- Asymmetric beam bending
- Torsion, including non-circular cross sections and thin-walled tubes
- Axisymm loading, including pressure vessels and rotating disks
- Structural displacement – energy methods
- Elastic stability – columns
- Plasticity and residual stress in axial loading, bending, and torsion