ME382 COURSE PROFILE

DEGREE PROGRAM: Mechanical Engineering

<table>
<tr><td>COURSE NUMBER: ME382</td><td>COURSE TITLE: Mechanical Behavior of Materials</td></tr>
<tr><td>REQUIRED COURSE OR ELECTIVE COURSE: Required</td><td>TERMS OFFERED: Fall, Winter</td></tr>
<tr><td>OPTIONAL TEXTBOOKS: Mechanical Behavior of Materials by N. Dowling. Engineering Materials vols. 1 and 2 by M. F. Ashby and D.R.H. Jones</td><td>PRE / CO-REQUISITES: MECHENG 211. I, II (4 credits)</td></tr>
<tr><td>COGNIZANT FACULTY: V. Gavini</td><td rowspan="2">COURSE TOPICS:

1. Bonding, crystal structure, and defects
2. Phase diagrams, and equilibrium microstructures
3. 3-D elasticity, and introduction to orthotropy
4. Plasticity: multi-axial yield criteria and hardening mechanisms
5. Kinetics of phase changes
6. Metallic alloys: heat treatment and microstructures
7. Properties of polymers
8. Properties of composites
9. Fracture: linear-elastic fracture mechanics, Weibull statistics, and stress-corrosion cracking
10. Fatigue: fatigue life and crack growth
11. Creep: mechanisms and creep life</td></tr>
<tr><td>BULLETIN DESCRIPTION: Material microstructures, dislocations and defects; processing and mechanical properties of metals, polymers, and composites; heat treatment of metals; elastic, plastic, and viscoelastic behavior of materials, strain hardening; fracture, fracture mechanics, fatigue and multiaxial loading; creep and stress relaxation; materials-related design issues, materials selection, corrosion and environmental degradation of materials.</td></tr>
<tr><td colspan="2">COURSE STRUCTURE/SCHEDULE: Lecture: 3 days per week at 1.33 hours</td></tr>
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COURSE OBJECTIVES: for each course objective, links to the Program Outcomes are identified in brackets.	1. How atomic bonding and microstructure affect the properties of materials [1, 6] 2. How processing and composition affect the microstructures of materials [1, 6] 3. The mechanical properties of metals, polymers, ceramics, and composites [1] 4. How to determine the strength of engineering components [1, 2] 5. How to determine the life of engineering components [1, 2, 6] 6. How to select materials and use them in the design of engineering components [1, 2]
COURSE OUTCOMES: for each course outcome, links to the Course Objectives are identified in brackets.	1. Understand and explain how the properties of a material may be modified by processing and alloying [1, 2] 2. Understand and explain how the modulus and density of a material are affected by bonding and atomic or molecular structure [1] 3. Compare two or more competing failure mechanisms to determine which is design limiting [4, 5, 6] 4. Interpret mechanical test data, including tensile/compression curves, fatigue-life diagrams, and creep curves [3] 5. Interpret binary-phase diagrams to predict equilibrium microstructures [2] 6. Understand and explain the role of kinetics in the development of non-equilibrium microstructures [2] 7. Understand and explain the hardening mechanisms that occur in metallic alloys, and the heat treatments that allow these mechanisms to be realized [1, 2] 8. Use von Mises and Tresca yield criteria to analyze an engineering component subjected to multi-axial loading [4] 9. Use linear-elastic fracture mechanics to determine the *effect* that a crack wiII have on the structural integrity of components subjected to a static load [4, 6] 10. Use \Neibull statistics to calculate the probability of failure of brittle materials [3, 4, 6] 11. Determine the lifetime of a component containing a crack that is subjected to cyclic loading or environmental loading [5, 6] 12. Use a combination of S/N curves, Basquins Law, Goodman or Gerber relationship, and Miners' Law to predict fatigue life [5, 6] 13. Understand design and inspection procedures for components subjected to cyclic loading [6] 14. Determine the creep life of engineering components at elevated temperatures [5, 6] 15. Understand the physical origin of various models for creep of metallic components [1] 16. Use time-dependent properties of polymers in design calculations [4, 5, 6] 17. Understand and explain the origin of temperature and time-dependent properties of polymers [1]. 18. Analysis of composites, and an introduction to orthotropic elastic properties [3].
ASSESSMENT TOOLS: for each assessment tool, links to the course outcomes are identified	1. Regular homework problems 2. Exams

PREPARED BY: M. Thouless, ASO Staff
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