16.010/16.020 UNIFIED ENGINEERING I, II
Fall 2003

MATERIALS & STRUCTURES
Contents of Lectures

Block 1: Statics

Lecture	Contents	CDL
M1	Introduction: Why M&S? – 3 Great Principles	1.1-1.3
M2	Equilibrium of a particle, system of particles (freebody diagram)	1.4-1.6
M3	Planar force systems, equipollent forces	1.6,1.7
M4,M5	Support reactions, freebody diagrams, static determinance, other situations, determinate systems	1.8, 1.9
M6,M7	Trusses, truss analysis: method of joints, method of sections	1.9
M8,M9	Statically indeterminate systems: method of analysis, 3 Great Principles, examples; SUMMARY	2.1, 2.4, 1.10, 1.11, 2.7

Block 2: Stress and Strain

Lecture	Contents	CDL
M10	Indicial Notation, Rotation of coordinates	4.1
M11,M12	Definition of stress, extensional and shear stress, notation, plane stress, stress equilibrium	4.2,4.3,4.4
M12,	Stress transformation and Mohr's circle, principal stresses, extreme shear stress(es)	4.5, 4.6, 4.7
M13	Quiz solution session	
M14,M15	Definition of strain,extensional and shear strain, strain-displacement relations, compatibility	4.8,4.9,4.10
M15,M16	Transformation of strain, Mohr's circle for strain, principal strains, extreme shear strain(s) SUMMARY, indicial notation revisited	4.11, 4.12, 4.13, 4.15, additional info in 4.14
M16	Uniaxial stress-strain	5.1,5.2, what you can do--2.3

Block 3: Materials and Elasticity

Lecture	Contents	CDL	A&J
M17	Material properties, classes of materials	—	1,2
M18	Bulk material properties	5.3,5.4	3
M19	Origin of elastic properties, structures of materials: atomic bonding, packing of atoms, crystals, polymers	—	4,5
M20	Estimate of moduli, composites	5.10	6
M21	Modulus limited design, materials selection, measurment of elastic properties	—	7
M22,M23	Stress-strain relations, anisotropy, orthotropy, measurements	5.6	—
M24	Engineering notation	—	—
M25	General Hooke's Law and the equations of elasticity, boundary conditions, solution	—	—

Textbooks:

- Crandall, Dahl and Lardner, *An Introduction to the Mechanics of Solids*, SI version, McGraw-Hill, 1978 *(Referrred to as CDL).*

- M. F. Ashby and D. R. H. Jones, *Engineering Materials 1*, Pergamon Press, 1980. *(Referred to as A&J)*

The following books are also useful references:

M. F. Ashby and D. R. H. Jones, *Engineering Materials 2,* Pergamon Press, 1986. (Polymers, metal alloys)

M. F. Ashby, *Materials Selection in Mechanical Design*, Pergamon Press, 1992 (Materials selection and design)

Bickford, *Mechanics of Solids*, Irwin, 1993