UNIFIED HANDOUT

MATERIALS AND STRUCTURES - #M-10

Fall, 2008

Learning Objectives Summary Sheet

(Units U-A, U-B, M1.1-M1.5, M2.1-2.4, M3.1-3.4)

Through participation in the lectures, recitations, and work associated with each noted Unit, it is intended that you will be able to…….

Unit U-A

- ….**apply** the language of engineering systems (units, dimensions, coordinates)
- ….**describe** systems in different coordinate systems **using** transformations and other concepts

Unit U-B

- ….**utilize** the basic concepts associated with forces and moments
- ….**determine** moments about any location as caused by forces
- ….**utilize** the concept of a couple

Unit M1.1

- ….**describe** what engineering is about in general
- ….**explain** the basic concepts, limitations, and utility associated with modeling and a model
- ….**describe** a structure, its functions, and associated objectives and tradeoffs
- ….**list** the "Three Great Principles" of solid mechanics

Unit M1.2

- ….**apply** the principle/concept of equilibrium to **determine** the applied and transmitted forces and moments, and related motion, for a particle, set of particles, or body
- ….**model** a body/system and external forces and moments acting on such
- ….**apply** the concept of equipollent force systems to **model** a set of forces

Unit M1.3

- ….**represent** the boundary conditions of a body via the use of the idealizations of supports
- ….**model** a body/system and forces and moments acting on such through the use of a Free Body Diagram
- ….**classify** mechanical systems into three categories
- ….**calculate** the reaction forces in a statically determinate system

Unit M1.4
- ….**model** a truss structure through the use of a Free Body Diagram
- ….**calculate** the reaction forces for a statically determinate truss structure
- ….**determine** the loads carried in each bar of a truss through the **use** of the Method of Joints and the Method of Sections

Unit M1.5
- ….**explain** the basic components of a constitutive relationship
- ….**apply** the compatibility of displacement concept for a variety of structural configurations
- ….**employ** the "Three Great Principles" to **determine** the forces and deflections of a statically indeterminate structural configuration

Unit M2.1
- ….**employ** the tensor/indicial notation to express equations and relations
- ….**recognize, explain,** and **apply** two special parameters (Kronecker delta, permutation tensor)

Unit M2.2
- ….**explain** the concept and types of stress and how such is manifested in materials and structures
- ….**use** the various ways of **describing** states of stress
- ….**apply** the concept of equilibrium to the state of stress

Unit M2.3
- ….**explain** the concept and types of strains and how such is manifested in materials and structures
- ….**use** the various ways of **describing** states of strain
- ….**describe** the relationship between strain and displacement in a body
- ….**apply** the concept of compatibility to the state of strain

Unit M2.4
- ….**explain** the bases for the transformations of the states of stress, strain, and deformation
- ….**cite** the equations for 3-D transformations of stress, strain, and deformation
- ….**transform** the states of stress, strain, and deformation for any 2-D configuration
- ….**apply** the concepts associated with principal stress/strain/axes

Overall for Block M3
- ….**employ** a continuum version of the constitutive law of elasticity
- ….**explain** the factors that contribute to material properties in terms of behavior that can and cannot be controlled
- ….**discuss** the limits of the model of linear elasticity for materials
- ….**summarize** the key components to solve problems of elasticity

Unit M3.1
- ….**explain** what a material property is and represents
- ….**cite** various material properties and types thereof
- ….**indicate** how material properties are used in material selection for structural applications and **employ** such

Unit M3.2
- ….**explain** the meaning of the elasticity and compliance tensors and **analyze** their mathematical details
- ….**describe** the behavior of a material in terms of constitutive response
- ….**discuss** engineering/elastic constants, their measurement, and their relationship to tensors
- ….**employ** a continuum version of the constitutive law of elasticity

Unit M3.3
- ….**identify** the various types of atomic bonds and the factors involved in such
- ….**describe** the atomic/molecular structure of materials and the effects on basic material behavior
- ….**employ** an atomic model to estimate the elastic modulus of materials
- ….**explain** the make-up of a composite and the contributors to its elastic response

Unit M3.4
- ….**explain** three basic phenomena associated with stress-strain behavior (basic response, classes of behavior, nonlinear response) in terms of atomic factors
- ….**describe** the role of scale in elastic response and the concept of "effective moduli"