NJIT | DEPARTMENT OF BIOMEDICAL ENGINEERING

BME 422 – Biomaterials Characterization

3 Credits, 3 Contact hours Instructor: Michael Jaffe, Ph.D.

Textbook: Recommended " Biomaterials Science, An Introduction to Materials In Medicine", Buddy D. Buddy D. Ratner et al., Elsevier Science and Technology (2004) ISBN 0125824637

Prerequisites by topic:

MATH 112, PHYS 121, BME 304 and MTSE 301 all with a C or better

COURSE DESCRIPTION

The goal of BME 422 is to provide students with knowledge of the materials characterization techniques that are appropriate or unique to biomaterials, what these techniques measure and the underlying scientific principles on which they are based. The course provides BME students with tools to relate characterization methods back to the relevant science and forward to what technique is appropriate to the solution of a given problem. Students upon course completion are in a position to choose between techniques in the solution of a given problem and will be capable of discussing characterization issues with instrument experts and biomedical problem solvers. For example, the course will discuss the quantum mechanical origins of spectroscopy, the relationship of spectroscopic behavior to molecular characteristics of a material, and the differences in approach to the chemical and physical characterization of synthetic and biological polymers. It is not expected that the students will become expert in these techniques or the background science in detail, only that they have a strong underpinning for future problem solving.

Characterization of Materials: The ability to relate/choose characterization data relevant to the process-structure-property-performance behavior of a biomaterial. Specifically, an understanding of the importance of size scale, from the atomic to the macro, in the characterization of biomaterials, the ability to relate chemical, biological or morphological features to appropriate characterization methods and an understanding of the importance of test environment to the relevance of results to biological performance. The necessity of understanding technique precision and the need to establish the statistical relevance of data before drawing conclusions is emphasized.

Chemical Characterization: Knowledge of the various wet chemistry and spectroscopic techniques that are utilized to define the chemical composition of synthetic and biological biomaterials. Understanding of the classical and quantum mechanical principles from the techniques derive.

Scattering and Imaging Methods: Knowledge of the utility and limitations of modern imaging and scattering (diffraction) techniques appropriate to biomaterials. An understanding of the principles upon which these techniques are based

Mechanical, Thermomechanical and Thermal Analysis Techniques: Knowledge of the techniques most used to define the mechanical and thermal attributes of biomaterials. An understanding of the thermodynamic and kinetic principles upon which the techniques and subsequent data evaluation are based.

Surface Characterization: An understanding of the inherent differences between bulk and surface properties of biomaterials. Knowledge of the various techniques that are utilized in biorelevant surface characterization. .

Biological Testing: An overview of the techniques that are used to characterize the interactions of biomaterials with the biological environment, including proteins, nucleic aces and cells. Test requirements for FDA approval will be reviewed and related to the principles of materials characterization.

Course Learning Outcomes (CLO):

1. Students will understand the relationship between biomaterials characterization data and expected performance in a biological environment
2. Students will be familiar with the scientific origins, data generated and limitations of modern materials characterization techniques with emphasis on expected or observed biological performance
3. Students will understand the difference between surface and bulk materials characterization and the relevance of each to performance in a biological application/environment
4. Students will have knowledge of the interaction of biomaterials with cells and the molecules of the biological environment. Students will have knowledge of the rational and methods of FDA required testing for biomaterials approval.
5. Students will understand how biomaterials related biomedical problems may be solved by the application of appropriate materials characterization techniques

Student Outcomes:

Student outcome 1 Related CLO – 1, 2, 5

Student outcome 3 Related CLO – 5

Student outcome 5 Related CLO – 2, 4

Program Specific Criteria:

E - address problems associated with the interaction between living and non-living materials and systems

Related CLO – 1, 2, 3, 4, 5