

MS 7022 Biomedical Polymers

(39 hours lectures)

This advanced subject in polymer engineering is intended to provide students with fundamentals of polymer use in biomedical applications, as well as of the relevant advanced polymer characterisation techniques including the in-vitro and in-vivo testing methods. The subject discusses both synthetic and natural polymers. The emphasis is on the relationship of structure to function in a biological setting.

Assessment:

- Report & Review : 40%
- Quiz: 60%
- No final exam.

Pre-requisites: MS2010 (Polymers & Composites) or equivalent; MS4001 (Biomaterials) or equivalent

Course Details:

Introduction & Biocompatibility 6 hours

Overview of polymer use in the human body; General concepts of biocompatibility; FDA regulations: tissue toxicity, immune system stimulation, inflammation, cell proliferation; in vitro and in vivo tests; sequence of events after implant insertion; healing processes and biocompatibility. Biocompatibility of degradable polymers and elastomers

Hydrogels and Crosslinked Polymers 6 hours

Introduction to gels; Flory-Rehner theory; swelling phenomena; diffusion through swollen systems. Hydrogels. Contact lenses. Glucose-sensitive hydrogels. Other applications.

Natural Polymers 6 hours

Collagen: structure and properties. Elastin. Cellulose and derivatives. Chitosan. Alginates. Selected applications.

Biodegradable Polymers 3 hours

Hydrolytic scission. Enzymatic hydrolysis. Classes of Biodegradable Polymers. Mechanisms.

Stimuli-Responsive Polymers 3 hours

pH and temperature-sensitive polymers; applications.

Drug Delivery 3 hours

Drug delivery principles: design criteria for controlled release, permeation and diffusion, measurement of diffusion in polymers, concepts of rate control/device control, oral tablets for controlled release, transdermal systems, designs and polymers

Tissue Engineering 3 hours

Tissue engineering: concepts of scaffolds for organ growth, polymer requirements, processing.

Case studies and Tutorials 3 hours

Varies with each offering..

Blood-compatible Polymers 3 hours

Blood-contacting polymers; anti-thrombotic strategies; hemocompatibilization.

References:

1. Polymeric Biomaterials, 2nd Edition, edited by S.Dimitriu, Marcel Dekker: **ISBN 0-8247-0569-6 (2002)**
2. Biomaterials Science: An Introduction to Materials in Medicine/ B.D.Ratner, A.S.Hoffman, F.J.Schoen and J.E.Lemons, Eds., Academic Press, 1996. ISBN 0-12-582460-2
3. Controlled Release of Biologically Active Agents by R.W.Baker, John Wiley & Sons, New York (1987). Treatise on Controlled Drug Delivery by A.Kydonieus, Marcel Dekker, 1992.
4. Biomaterials Science and Engineering, by J.B.Park, Plenum press, 1984.
5. Tissue-Biomaterial Interactions, Dee, Puleo and Bizios, Wiley-Liss, 2002.