Biomedical Materials

Programme course

6 credits

Biomedicinska material

TFTB40

Valid from: 2017 Spring semester

Determined by
Board of Studies for Chemistry, Biology and Biotechnology

Date determined
2017-01-25

Main field of study
Engineering Biology

Course level
Second cycle

Advancement level
A1X

Course offered for
- Engineering Biology, M Sc in Engineering
- Biomedical Engineering, Master's programme

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Basic university level courses in chemistry, biology, physics, materials science and statistics.

Intended learning outcomes

This course will provide the basic knowledge of the various materials used in medicine including metals, ceramics, polymers, and composite materials used for the fabrication of medical devices and commonly used prostheses, as well as in the design and development of new materials for repair and replacement of failing or failed organs. The focus will be on polymeric biomaterials and their structure-property relationships. There will be discussions on the development of new materials that are targeted specifically to tissue engineering and regenerative medicine. The student should after this course be able to:< ul>

- Understand the basic structure and property relationships of metal, ceramic, polymeric, biopolymeric, and composite materials systems.
- Understand structure-property relationships of biological materials, including major tissues found in the body.
- Be familiar with characterization methods commonly used to analyze biomaterials.
- Name and describe a few specific materials in each of the main categories of materials used in medicine, such as metals, ceramics, polymers, degradable polymers, and biopolymers.
- Have an understanding of the requirements for materials used in several application areas in the body, such as soft tissue replacements, hard tissue replacements, blood contacting devices, as well as transplants and tissue engineered devices.
- Describe some advantages and disadvantages of different biomaterials as well as the main sterilization methods used in the medical device industry.
- Describe the main degradation mechanisms of materials in the body.
- Understand how to design biomaterials for certain applications as well as executing research experiments in a systematic approach (e.g. Multi-factorial design and statistical optimization) to develop new biomaterials.
- Have a general understanding of the commercialization process including how to get biomaterials to the Clinic including preclinical/clinical testing as well as principles of Good Manufacturing Practice (GMP).

Course content

The course covers the major classes of materials used in medicine, such as metals, ceramics, polymers, and composites. Structure, composition, mechanical properties, analytical methods, surface vs. bulk properties and degradation mechanisms of each material group will be reviewed with an emphasis placed on biopolymers and natural-based materials. Also covered are sterilization methods, and industry and regulatory standards required for implant materials and how to get biomaterials to patients. These aspects of biomaterials maybe further stressed in a site visit to a medical device manufacturer if feasible.

Teaching and working methods

The course is based on a combination of lectures, article review sessions, homework exercises, a potential site visit to a medical device company, and presentations of group tasks.
Article Seminars address current materials issues within the medical implant field. Each article is read, summarized and criticized during presentation/tutorial sessions. Emphasis is placed on the materials used, processing methods, characterization, and performance.

Examination

LAB2	Laboratory work	1.5 credits	U, 3, 4, 5
UPG2	Presentation, assignments	2 credits	U, 3, 4, 5
TEN2	Written examination	2.5 credits	U, 3, 4, 5

For the group tasks, each group of students will presents a particular application area of materials in medicine, biology or artificial tissues and organs. The application areas will be presented orally by the students during special sessions towards the middle/end of the course.
Grading is based on a final written examination, group work exercise (e.g. project report and presentation), laboratory reports, and quiz & homework. The final grade will be calculated as a weighted mean where the written examination, the group work project, the lab report, and quiz & homework gives 40%, 30%, 20%, and 10% of the final mark, respectively. Students need to get a passing mark (i.e. at least 3) in all the above to pass the course. Note that the quiz & homework is a part of the group work project (i.e. examination code UPG2). Hence, UPG2 has to total weight of 30%+10%=40%.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Material in Medicine (CDIO)

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Boman

Examiner

Mehrdad Rafat

Course website and other links

https://www.ifm.liu.se/edu/coursescms/TFTB40/index.xml

Education components

Preliminary scheduled hours: 50 h
Recommended self-study hours: 110 h

Course literature

Kopior på föreläsningsbilder, Laborationshandledningar samt BIOMATERIALS SCIENCE: AN INTRODUCTION TO MATERIALS IN MEDICINE by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, Hardcover: 864 pages Publisher: Academic Press; 2 edition (Jul 29 2004) ISBN-10: 01258246 PRINCIPLES OF TISSUE ENGINEERING Edited By Robert Lanza, Chief Scientific Officer, Advanced Cell Technology, MA, USA; Adjunct Professor, Institute of Regenerative Medicine, Wake Forest University School of Medicine, NC, USA Robert Lanza Advanced Cell Technology 381 Plantation Street Worcester, MA 01605, Robert Langer, Massachusetts Institute of Technology, Cambridge, U.S.A. Joseph Vacanti, Harvard Medical School and the Massachusetts General Hospital, Boston, U.S.A.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.