UNIVERSITY OF CHEMICAL TECHNOLOGY AND METALLURGY

PROGRAMME PROJECT

Subject:	BIOMATERIALS
Specialty:	MATERIALS SCIENCE AND ENGINEERING
Educational degree:	MASTER

Proposed by:

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SYLLABUS PROJECT

In BIOMATERIALS

Classes	**Semester**	**hours**	
		weekly	**all**
1. Lectures 2. Exercises	III III	**2** **1**	**20** **10**
3. Control	exam		

ANNOTATION

Biomaterials science and engineering is a highly interdisciplinary field intersecting medicine, biology, physics, chemistry, materials science, engineering and ethics.

This course tends to introduce students to Biomaterials, i.e. to materials (other than drugs) with different origins: synthetic, natural or modified natural, which are intended to interface with biological systems to evaluate, treat, augment or replace any tissue, organ or function of the body. The course includes briefly description of materials used for medical devices, implants, and coatings formations, their mechanical qualities, as well as biocompatibility and physiological reactions. Short description of the artificial organs, implants and other devices and tissues is also provided. The aim of the course is to draw the attention of the future specialist to advances in biomaterials that enable doctors and scientists to treat or replace diseased body parts with materials different from biological ones.

LECTION COURSE:

I. INTRODUCTION IN BIOMATERIALS: - 4 hours

1. Subject and history of the development of biomaterials.
2. Biocompatible materials - nontoxic and noncarcinogenic. Physiological response -blood coagulation, inflammation.
3. Fields of application of biomaterials: Tissue Engineering, Medical Devices, Drug Delivery, Biotechnology, Biomimetic and Natural Materials.
4. Mechanical properties of biomaterials: fracture, wear, corrosion, density, hardness, weakness, etc.
5. Materials selection: Metallic, Ceramic, Polymeric, Composites.

II. CERAMIC BIOMATERIALS /Bioinert and Bioactive Bioceramics/: - **2 hours**

6. Calcium Phosphate: Hydroxy apatite.
7. Alumina and Zirconia.
8. Silica based glasses -Bioactive Glasses and Machinable Glass-Ceramics.
9. Pyrolytic carbons.
10. Other bioceramics.

III. METALLIC BIOMATERIALS: - 2 hours

11. Metal allergy in patients.
12. Surgical stainless steel, tantalum, cobalt-, titanium-based alloys.
13. Gold-, platinum-, palladium- and other metals based alloys.

IV. POLYMERIC BIOMATERIALS: - 2 hours

14. Biodegradable polymers with adequate mechanical properties.
15. Natural polymers (fibrin, collagen, gelatin, hyaluronan).
16. Modified natural polysaccharides (cellulose, chitin, dextran) or modified proteins (fibrin, casein).
17. Synthetic polymers including polylactide (PLA), polyglycolide (PGA), poly(lactide-co-glycolide) (PLGA), etc.

V. COMPOSITES: - 1 hour

18. Combination of metallic alloys with other biomaterials.
19. Implants with improved mechanical and physical properties.

VI. COATINGS OF MEDICAL DEVICES AND IMPLANTS:/Surface chemistry/ **1 hour**

20. Surface composition and morphology
21. Surface tension and wettability.

VII. BIOMATERIALS AND TISSUE ENGINEERING: - 4 hours

22. **Hard tissues:**
    - Orthopaedics - joint replacements (hip, knee), bone cements, bone defect fillers, fracture fixation plates;
    - Dentistry - dental implants and sealants;
    - Tissue screws and tacks.
23. **Soft tissues:**
    - Skin - maxillofacial and plastic surgery;
    - Cardiovascular - blood vessel, heart valve, cardiac pacemaker;
    - Ophthalmologys - contact lenses, corneal implants and artificial corneas;
    - Artificial organs - kidney, heart;
    - Other soft tissues - artificial tendons and ligaments, sutures, tissue adhesives and sealants.

VIII. BLOOD SUBSTITUTES: - 1 hour

24. Biomimetic substitutes - Hemoglobin (Hb) based -chemically modified product **of** Hb.
25. Abiotic substitutes - Perfluorocarbon (PFC) based - synthetic chemicals **to deliver** oxygen to the tissues.

IX. BIOMATERIALS AND MEDICAL DEVICES: - 1 hour

27. Relationships between a material's structure, its properties, and the implementation of properties to achieve a desired functionality.

X. BIOMATERIALS AND DRUG DELIVERY: - 1 hour

28. Specific properties of various degradable systems to achieve optimal release kinetics of the drug or active agent.
29. Polymers and hydrogels in drug delivery process.

XI. NEW BIOMATERIALS - NEEDS AND PERSPECTIVES. - 1 hour

PRACTICAL EXERCISES

I. Testing for biocompatibility of two types materials: biocompatible and no biocompatible - 4 hours.

II. Moulding of a dental implant or element, e.g. by metal and photopolymer -4 hours.

III. Preparation of pH-dependant hydrogels - 1 hour

IV. Measurement of surface tension and wettability of coatings of some medical devices - 1 hour.