MSE 204A
Introduction to Biomaterials

Credits: (06) 2-0-0

2017-18, Sem II

Lecture Hours: Tuesdays & Fridays: 12:00 – 12:50 pm
Venue: L-15

Dr. Kantesh Balani
Dept. of Materials Science and Engineering
Email: kbalani@iitk.ac.in
Ph: +91-512-259-6194

TAs: **Mr. Nitin Kumar Sharma** & **Mr. Kislay Kumar**

Office Hours: Mondays 12-1 pm; Wednesday 4-5 pm
Meeting Time: Pl schedule appointment in case you want to meet any other time

Course Objectives

- Learning concepts in defining a biomaterial from a material-engineer's perspective
- Classification of biomaterials based on the material-type, structural-application, and material-response.
- Engineering the Cell-Material Interaction
- Structure-Property correlation
- Immune-response and drug delivery
- Surface Engineering and Case-studies of biomaterials

TOPICS		# Lectures
1. Introduction to Biomaterials	Introduction to materials at the interface with biological sciences	2
	Social, Environmental & Ethical Issue	1
2. Classification of biomaterials	a) Response Based: Bioinert/ Bioactive/ Bioresorbable b) Material Based: Bioceramic/ Biopolymer/ Biometallic c) Application Based: ***Structural*** (Bone replacement materials, dental biomaterials, cardiovascular biomaterials, total hip and knee replacement), ***Non-structural*** (drug-delivery/ sensing/ surface modification)	3
	Concept of biocompatibility: - Definition, Immune response, Testing (*in vitro/ in vivo*)	3
3. Structure-Property correlation	- Biomimetics - Introduction to structure and properties of proteins, biological cells and tissues	2
	Biological phenomenon on material surfaces - Protein adsorption isotherms - Kinetics of cell-material interaction - Bacterial adhesion and kinetics of biofilm formation	4
	Principles of various surface Characterization techniques: Atomic force microscopy, fluorescence microscopy, tensiometer (contact angle measurement), quartz crystal microbalance	2
4. Processing and properties of biocompatible materials	- Quantification of structure-property correlation - Bioglass/ Glass-ceramics - Macroporous scaffolds - Biodegradable polymers - Biocomposites - Thin films and coatings	6
5.Surface engineering & case-studies	Surface Engineering - Micro-contact printing - Layer-by-layer assembly/ Functionalization Case Study - Self-assembly: Thermodynamics and kinetics aspects - Drug-delivery/ Bio-responsive surfaces - Articulating joints - Dental restorative applications - Cardiovascular patches/ heart valves	4
Total Lectures		*27*

- **Suggested text books:**
  - Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoen and Lemons, Second Edition: Elsevier Academic Press, 2004.
  - Biological Performance of Materials: Fundamentals of Biocompatibility, Jonathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
  - Biosurfaces: A Materials Science and Engineering Perspective, Ed: Kantesh Balani, Vivek Verma, Arvind Agarwal, Roger Narayan

- **Reference material:**
  - Essential Cell Biology – Alberts, Bray, Hopkins, Johnson, Lewis, Raff, Roberts, Walter (Garhard Science Publications)
  - Biomaterials: Principles and Applications Joon B. Park (Editor), Joseph D. Bronzino (Editor) CRC Press
  - Materials Characterization Techniques; Sam Zhang, Lin Li, Ashok Kumar; CRC press, (2008)
  - Advanced Biomaterials: Fundamentals, Processing and Applications; Ed. B. Basu, D. Katti and Ashok Kumar; John Wiley & Sons, Inc., USA (http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470193409.html)
  - Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
  - Advanced Structural Ceramics: B. Basu and K. Balani, John Wiley & Sons, Inc., USA, 2011.

Course Grading

- Quiz-I: (Feb. 03, 2018: Saturday, 12-1 pm): to be confirmed: **10%**
- Mid Sem 1 (Feb. 19-24, 2018): **25%**;
- Quiz-II: (Mar. 24, 2018, sat 12-1 pm): to be confirmed **10%**
- End Sem (Apr. 22- May 2, 2018): **35%;**
- Assignments: **20 %;**

- **Attendance 90% is required**, but not sufficient to clear the course.
- In-class interaction → Bonus marks!!

< 40% Fail

- Student with poor attendance will be deregistered by the instructor.
- No makeup examinations for mid semester examination

Mid Sem Grading

- Syllabus from what is taught till one class before the last class unless some portion was left unfinished.
  - One mark: True/False/ Fill in the blanks
  - Two Marks: reasoning
  - Three marks: Comparison, Conceptual
  - Five Marks: Descriptive

Assignments

- Problem solving, questions, background information, etc.
- Reading papers

Quizzes

- Two announced quizzes

Final Exam

All Inclusive

Requirements

Passing the Course:

1. Pass Marks 40%
2. Attendance > 90%
3. Any unethical behavior/ plagiarism will be dealt strictly and will lead to fail grade (F).

   - copying in mid-sem/ end sem → F grade + SSAC

   - copying in quiz/ assignment: zero in that quiz + further action may be taken

Conduct Rules:

- Copying/ Pasting from internet is NOT allowed
- Giving/ receiving help during exam/ quiz/ assignment is NOT allowed
- Maintain integrity, devotion, and sincerity towards your learning.
- Be courteous to your mentors and peers.
- ***Observe scheduled hours*** and be present at place of lecture on time.

Pointers

- Attend ALL classes
- Maintain a notebook and ‘take notes’ during the lecture.
- Do not hesitate to ask doubts if something is unclear.
- Do not come on the ‘last day’ to say that you had problems on certain topic.