

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Hyderabad Campus
SECOND SEMESTER
2023-2024

Course Handout (Part II)

09/01/2024

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : BITS F418
Course Title : Introduction to Biomedical Engineering
Instructor-in-Charge: KAVI DEVRAJ

1. Course Description:

Introduction; Engineering principles applied for physiological phenomena; Bio-implant materials: Metallics, Ceramics; Polymeric materials for Bio-applications; Protein-biomaterials, Surface Interactions and modification of surface of the biomaterials; Tissue engineering; Drug delivery systems: principles, and applications; Biomedical sensors; Modeling and simulation.

2. Scope and Objective of the course: Biomedical Engineering is a relatively new branch of engineering that involves the use of cutting-edge technologies to help improve human healthcare. Biomedical engineers are involved in the design and creation of medical devices, implants such as stents, instruments and materials for clinical use.

3. Text Book (T):

T1: Introduction to Biomedical Engineering, Third Edition, JD. Enderle, JD Bronzino, Academic Press Series Editor, Trinity College—Hartford, Connecticut: Put as Text book. Year 2011.

T2: Principles of Biomedical Engineering Second Edition Sundararajan V. Madihall, © 2020 Artech House 685 Canton Street Norwood, MA 02062

T3: Biomedical Instrumentation and Measurements; 2nd Ed., 2007, Cromwell.L, Weibell, F.J, Pfeiffer, E.A: Pearson Education.

4. Reference Books (R):.

R1: Bronzino Biomedical Engineering Handbook, CRC and IEEE Press, Boca Raton, FL, 2000

R2: Moore J.E. and Zouridakis G. Editors-in-Chief Biomedical Technology and Devices Handbook CRC Press, 2003. 2. J. D

R3: Drug Delivery Systems Edited by Kewal K. Jain, MD Jain PharmaBiotech, Basel, Switzerland, Humana Press

R4: Encyclopedia of Biomedical Engineering (vol. 1-3): Min Wang, Xiaojun Yu, Cato Laurencin, Roger Narayan; 2018; Elsevier

R5: John G. Webster, Medical Instrumentation: Application and Design, John Wiley & Sons, 3rd Edition, 2004.

R6: W. Mark Saltzman, Biomedical Engineering, Cambridge University Press, 2009.

5. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference Chap./Sec (Book)
1-3	Introduction	Overview, role, history of biomedical engineering, moral and ethical issue	T2 Ch 1, T1 Ch 1
4-5	Physiological Modeling	Hemodynamic Modeling, Neural Control of Saccadic Eye Movements, Cochlear Mechanics, Pulmonary compliance, Homeostasis and feedback paths in physiological systems, Renal Blood Flow Dynamics	T1, R6, Ch 13 Lecture notes
6-9	Biomaterials	Bio-implant materials: Metallics, Ceramics; Polymeric and protein-based materials for Bio-application, Surface Interactions, and modification of surface of the biomaterials	T1 Ch, Lecture notes, Research reviews
10-11	Biomechanics	Introduction, Basic Mechanics, Mechanics of Materials, Viscoelastic Properties. Biomechanics of Neurovasculature, Cartilage, Ligament, Tendon, and Muscle	T1 Ch 4, Lecture Notes, Research reviews
12-15	Tissue Engineering and cellular engineering	Materials Used in Tissue Regeneration, Scaffold Formation Techniques, Cell Culture Microenvironment, Characterization and Utilization of Products, Cellular Processes, Storage of Cells and Tissues	T1 Ch 6, T2 Ch 6.5 & Ch 7
16-18	Neuroengineering / Introduction to Bioelectricity (5)	Bioelectric potentials, Biopotential Electrodes, Different potentials and their propagation, Electrodes, signals and artifacts, Optogenetics, Calcium Imaging, Electrical Stimulation of CNS, Comparing electrodes, Epileptic seizures, and Neuromodulation	T2 Ch 3 Lecture notes
19-26	Transport dynamics across biological membranes	Characteristics of peripheral, CNS membranes (epithelial, endothelial) and associated transport mechanisms, kinetics. Blood-Brain Barrier (BBB) and its role in CNS homeostasis	Lecture notes, Research reviews
27-31	Drug delivery systems: principles, and applications	Overview of various drug delivery systems, and strategies for CNS drug delivery, impact of CNS barriers. Therapeutic antibodies	R3 Ch 1, Lecture notes
32-34	Biosensors and Biomedical Signal Processing	Optical Sensors, Chemical Biosensors Transducers, Sensors and Electrodes in Medical Instrumentation, Biosensors Design and application, neuroimaging tools, EEG and its application, Artificial Intelligence in signal processing	Ch6 (R2), T1 Ch 11 Lecture notes

35-38	Design of Medical Devices and Diagnostic Instrumentation (3)	Medical Product Design, Cardiovascular Devices, Design and Product Development, Six Sigma and its Applications	T1 Ch 5
39-40	Rehabilitation Engineering (2)	Technology and Disability, applied universal Design, Home Modification Design, and automation	Lecture notes and Research reviews

6. Evaluation Scheme:

Component	Duration	Weightage (%)	Date	Remarks
Mid-Sem Exam	90 min	30	11/03 - 4.00 - 5.30PM	CB
Project/ Assignments	–	30	–	OB
Comprehensive Exam	180 min	40	07/05 AN	CB/OB

7. Chamber Consultation Hour: Tentatively every Friday, 5 PM (On call at **9319851158**)

8. Notices: Notices concerning the course will be communicated through email or CMS.

9. Make-up policy: As per the clause 4.07 in the Academic regulations booklet. Only hospitalized cases will be considered for makeup.

10. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-Charge
BITS F418