NPTEL Syllabus Template

Course Title	• Polymeric Biomaterials: Structure, Properties, Function and Performance
Discipline	• Chemical Engineering • Biotechnology and Bioengineering • Materials Science
Duration of course **4/8/12 weeks (10/20/30 hours @2.5 hrs/week)**	• 12 weeks (30 hours)
Number of times you have taught this course totally and in the last 5 years (2-3 times is preferable, if not more)	• Once each in 2016, 2017, 2018, 2019: 2-credit course titled “Biomaterials Science and Engineering” • Once each in 2021, 2022, 2023: 1 credit of a 2-credit course titled “Polymeric Biomaterials: Science and Applications”
Is this course syllabus approved by AICTE or by Senate in your/any institute? If yes, please give the course name and institute under which this is approved.	• Yes, both approved by the Senate at IIT Hyderabad • CH6840: Biomaterials Science and Engineering • PB5090: Polymeric Biomaterials: Science and Applications
The time frame of when you would want to offer the course: (Jan 2024/July 2024)	• July 2024
Will it map to any course in the AICTE model curriculum? **LINK to AICTE Curriculum** **LINK 1** **LINK 2** **LINK 3** **LINK 4**	• Not applicable
Will it map onto any of the NPTEL domain? **LINK to Domain page:** **https://nptel.ac.in/noc/Domain/**	• Chemical Engineering • Biotechnology and Bioengineering

Name of the Instructor(s)	Satyavrata Samavedi
Department	Chemical Engineering
Institute	Indian Institute of Technology Hyderabad
Email ID	samavedi@che.iith.ac.in
Mobile Phone Number	+91-9444008633
Website of Instructor	samavedi.weebly.com

Intended audience	• Students in Chemical Engineering, Biomedical Engineering, Biotechnology and Materials Science • Researchers and industry personnel working with polymers for biomedical applications wishing to understand fundamental principles guiding the design of such materials
Is it a core/elective course?	• Elective
Is it a UG/PG/PhD level course?	• 4th year UG • PG • PhD
Is this course relevant for GATE exam preparation?	• Not applicable
Which degrees would it apply to? (BE/ME/MS/BSc/MSc/PhD etc)	• BE • MSc/MS/ME • PhD
What are the next set of courses that can be taken by students who complete this?	• Courses on specialized applications such as drug delivery and tissue engineering • Courses on advanced manufacture methods such as biofabrication and 3D bioprinting • Courses on characterization such as rheology for biomedical applications
Pre-requisites in terms of educational qualification of participants, or if any other courses should be done before this course can be taken	• Foundational courses in physics, chemistry and mathematics at the college level
Industry recognition of this course – List of companies/industry that will recognize/value this online course	• Pharmaceutical industries • Implant manufacturing companies • Medical device manufacturing companies • Biotechnology firms • MNCs with healthcare verticals
Will the final certification exam be– paper/pen type or computer based - both are proctored	• Online
Will the course require use of any software such as MATLAB or any programming language, etc. or any other tool? If yes, does it have a Linux based compiler available or if licensed, can we get the educational license for the same?	• Not applicable
Names of 2 reviewers for the course (can be from other institutes – will be used if we need any additional inputs on the course) – Name, Dept, email id, Institute	Name : Prof. Abhijit Deshpande Dept. : Chemical Engineering Institute : IIT Madras Email : abhijit@iitm.ac.in Name : Dr. Shamik Sen Dept. : Bioscience and Bioengineering Institute : IIT Bombay Email : shamiks@iitb.ac.in

List of reference materials/books	• Introduction to Physical Polymer Science, L.H. Sperling, 4th edition (2006), John Wiley and Sons • Biomaterials Science: An Introduction to Materials in Medicine, Edited by William R Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J Yaszemski, 4th edition (2020), Academic Press • Biomaterials: The Intersection of Biology and Materials Science, Johnna S. Temenoff and Antonios G. Mikos, International edition (2008), Pearson-Prentice Hall

FOR GETTING THE INTRODUCTORY COURSE PAGE READY – TO OPEN FOR ENROLLMENTS

1. Introduce the course in about 4-5 lines

Polymeric biomaterials find extensive use in clinical implants and in research domains such as drug delivery and tissue engineering. Despite their use in diverse areas, a common structure-property-function framework guides their design and performance across applications. This course will provide a fundamental understanding of this framework to enable the effective design of polymeric biomaterials for biomedical applications. Real-world examples of clinically relevant synthetic/natural polymers and biomedical hydrogels will be discussed to highlight hierarchical organization and multi-scale functionality. Important structural, thermodynamic, mechanical and surface properties of polymeric biomaterials will be correlated with function and performance. Principles that govern their processing and physico-chemical/biological modification strategies will be elucidated. Key biological responses (e.g., protein adsorption, inflammation, adverse reactions) and clinical performance will also be discussed.

2. Photograph of instructor(s)

3. About the instructor(s)

Dr. Satyavrata Samavedi is currently an associate professor in the Department of Chemical Engineering at IIT Hyderabad. He obtained his B.Tech. in Chemical Engineering from NIT Tiruchirappalli, and his Ph.D. also in Chemical Engineering from Virginia Tech, USA. Subsequently, he worked as a postdoctoral researcher in Biomedical Engineering at Rensselaer Polytechnic Institute, USA before joining IIT Hyderabad in late 2015. His research centers around unraveling structure-property-processing relationships in polymeric biomaterials with the goal of designing functionalized soft materials for biomedical applications. His research lab at IIT Hyderabad studies the process of polymer electrospinning and employs the insights gained from such investigations to design electrospun meshes for controlled drug release, combination therapeutic delivery and immunomodulation.

4. An introductory video about the course (2-5 minutes' duration)

As intimated to us by the CCE office at IIT Hyderabad, this video will be provided at a later stage.

Weekly Course Plan			
Weeks		**Lecture Names**	**Assignments**
Week 1		**Introductory concepts** • Motivation and background • Historical perspective • Clinical relevance of biomaterials • Biomaterials and biocompatibility	Online
Week 2		**Structural properties of polymeric biomaterials** • Macromolecular arrangement • Polymerization • Molecular weight distribution • Conformation and configuration	Online
Week 3		**Thermodynamic properties of polymeric biomaterials** • Crystallinity models • Glass transition and melting • Structure-property correlations • Solvent interactions/effects	Online
Week 4		**Bulk properties of polymeric biomaterials** • Degradation mechanisms • Mechanical deformation • Viscoelastic behavior	Online
Week 5		**Polymers in the clinic: Part 1** • Overview of synthetic polymers • Non-degradable synthetic polymers • Degradable synthetic polymers	Online
Week 6		**Polymers in the clinic: Part 2** • Overview of natural polymers • Proteins: conformation-property relations • Polysaccharides: property-function relations	Online
Week 7		**Biomedical hydrogels** • Cross-linking behavior • Swelling dynamics • Flory-Rehner theory • Polyelectrolyte-based hydrogels	Online
Week 8		**Bulk processing** • Polymeric scaffolds • Porosity and mechanical stability • Important processing techniques	Online
Week 9		**Surface properties & functional modification** • The material-body interface • Topography, hydrophobicity and charge • Physico-chemical modification strategies	Online
Week 10		**Protein adsorption** • Factors affecting adsorption • Adsorption kinetics and irreversibility • Conformational stability of proteins • Competitive adsorption and Vroman effect	Online

Week 11		**Implantation & performance** • Inflammation and healing • Immune response: material perspectives • Infection, biofilms and calcification	Online
Week 12		**Clinical translation** • Regulatory aspects for medical devices • Implant and device failure • Case studies	Online

TA Details				
	:	**Teaching Assistant 1**	**Teaching Assistant 2**	**Teaching Assistant 3**
Name	:	Lalitha Sri Ramakrishnan	Swasthika Arunachalam	I have listed two TAs on a tentative basis. I request assistance from NPTEL with the allocation of one or two additional TAs as per the actual need.
Department	:	Interdisciplinary program	Chemical Engineering	
Email ID	:	id22resch11007@iith.ac.in	ch21resch11007@iith.ac.in	
Mobile Number	:	+91-9940676521	+91-9486926002	
Currently pursuing degree	:	PhD	PhD	