Program Academic Information

Master of Technology

Bioengineering

2025-27

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Section 1: Program General Information

Program	**M.Tech Bioengineering** Specialization in I. Bioinformatics II. Biomaterials and Tissue Engineering
Level	**Postgraduate**
Course Duration	**2 years (4 Semester)**

Section 2: Program Educational Objectives (PEOs)

Broad goals that address institutional and program mission statements and are responsive to the expressed interests of various groups of program stakeholders.

PEO-1 :	Graduates will become innovators or entrepreneurs to be engaged in pharmaceuticals, life sciences, data analytics and biomedical industries.
PEO-2 :	Graduates will acquire in-depth knowledge and practical experience in bioinformatics, biomaterials, tissue engineering to handle specific challenges in the relevant fields.
PEO-3 :	Graduates with a strong foundation in bioengineering principles, will be able to gain employment in life science, pharmaceuticals and medical industries or interrelated professions.
PEO-4 :	Graduates will be able to exhibit leadership skills, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary activities.
PEO-5 :	Graduates will be successful in pursuing career opportunities in Research and Development.

Section 3: Program Outcomes

The program must then formulate a set of program outcomes (knowledge, skills, and attitudes the program graduates should have) that directly address the educational objectives and encompass certain specified outcomes.

1.	Ability to apply the knowledge of Life Science, Technology, and Engineering to address healthcare problems.
2.	Ability to identify and analyze healthcare related problems and formulate feasible technical solutions to improve health and health care.
3.	Ability to develop deep understanding of tissue engineering or bioinformatics techniques, enabling them to analyze complex biological data and contribute to the development of novel computational tools for various biological applications.
4.	Ability to apply computational tools and softwares for modeling biological systems, analyzing bio-molecular data, and simulating tissue growth, supporting the development of new biomedical technologies.
5.	Ability to integrate engineering principles with biological systems to solve complex problems in healthcare, developing innovative solutions for disease diagnosis, treatment, and prevention.
6.	Ability to think critically to inspire sustainable development.
7.	Ability to have a thorough understanding of professional and ethical responsibility.
8.	Ability to perform within a diversified multidisciplinary team and exhibit leadership.
9.	Ability to engage in independent and life-long learning.

Program Specific Outcomes : **By the end of the program, students should be able to develop the following specific skills and accomplishments**	
PSO-1	Graduates will be proficient in designing and implementing cutting-edge biomedical technologies. They will gain hands-on experience in the product development lifecycle, from conceptualization to commercialization, adhering to industry standards and regulatory requirements.
PSO-2	Graduates will have the ability to integrate biotechnological advancements, such as gene therapy, regenerative medicine, and bioinformatics, into clinical and industrial applications. This will be based on industry insights, ensuring they can contribute to solving pressing healthcare challenges while navigating the regulatory landscape and market demands of the bioengineering industry.

Section 4: Program Benchmarking

Details of the international standards / subject benchmark statements referred and web link for the same.

International standards / benchmarks statements referred	URL
University of Illinois	https://bioengineering.illinois.edu/academics/graduate/meng/curriculum/bioengineering
Indian Institute of Science and Technology (IISC Bangalore)	https://be.iisc.ac.in/m-tech-in-bioengineering/
Sree Chitra Thirunal Institute for Medical Sciences and Technology, Trivandrum	https://www.sctimst.ac.in/About%20SCTIMST/Organisation/BioMedical%20Technology%20Wing/Department%20of%20Medical%20Devices%20Engineering/
School of Medical science and Technology (SMST), IIT Kharagpur	http://www.smst.iitkgp.ac.in/Smst/curriculum
Indian institute of Information Technology (IIIT)-Allahabad	https://as.iiita.ac.in/wp-content/uploads/2023/11/M.Tech_.BI_NEP.pdf
Delhi Technological University (DTU)	https://www.dtu.ac.in/Web/Departments/BioTech/PEOs/MTechBIOINFOCO.pdf
Accreditation Board of Engineering & Technology (ABET)	http://www.abet.org/
CDIO™ Educational Framework	http://www.cdio.org/

Section 5: Program Structure

CL	Classroom Interaction	**TU**	Tutorials	**PR**	Practical
CC	Core Course	**FE**	Free Elective	**DE**	Specialization Sequence with Directed Electives
I	Specialization in Bioinformatics			**II**	Specialization in Biomaterials and Tissue Engineering

Semester - 01 **Total Credits: 24**

S. No	Course Code	Course Title	Course Type	Credits	Weekly Contact Hours			
					CL	TU	PR	Total
1.		Mathematical Methods for Bioengineers	CC	4	3	1	0	4
2.		Human Physiology	CC	4	3	1	0	4
3.		Design Thinking for Medical Innovation	DE	3	3	1	0	4
4.		Computational Biology and Biostatistics	CC	4	2	1	2	5
5.		Introduction to R Programming [I]	DE	4	3	1	0	4
		Biomaterials and Artificial Organs[II]			3	1	0	4
6.		Seminar and Technical Writing - I	CC	0	0	0	2	2
7.		Research Methodology and Medical Ethics	CC	2	1	1	0	2

*Bridge course in Biology (credit -0) can be offered for students having non-relevant backgrounds.

Semester - 02								Total Credits: 24
S. No	**Course Code**	**Course Title**	**Course Type**	**Credits**	**Weekly Contact Hours**			
					CL	**TU**	**PR**	**Total**
1		Bio analytical Techniques	CC	4	2	1	2	5
2		Entrepreneurship and IPR	DE	2				
3		OMICS [I]	CC	4	3	1	0	4
		Principles of Tissue Engineering [II]			3	1	0	4
		Drug Delivery: Principles and applications [II]			3	1	0	4
4		Molecular structure prediction and Visualization [I]	DE	4	2	1	2	5
		Microfluidics [II]			3	1	0	4
5		Biomedical Device Quality and Regulatory Standards	FE	4				
6		Python and bio-python[I]	CC	4				
7		Data mining in Bioinformatics			2	1	2	5
		Devices and Diagnostics			2	1	2	5
8		Seminar and Technical Writing - II	CC	0	0	0	2	2
9		Industrial Internship / Certification	CC	2	0	0	0	0

Semester - 03									Total Credits: 21
S. No	Course Code	Course Title	Course Type	Credits	Weekly Contact Hours			
					CL	TU	PR	Total
1.		Next Generation Sequencing [I]	DE	4	2	1	2	5
		Stem Cell Technology [II]			2	1	2	5
2.		Advanced Genetic Engineering [I]	DE	4	3	1	0	4
		Synthetic Biology and Genetic Engineering [II]			3	1	0	4
3.		Research Project-I	CC	5	0	0	0	0
4.		Advanced Proteomics	FE	4	2	1	2	5
		Molecular Imaging			2	1	2	5
		Material Characterization and Techniques			2	1	2	5
5.		Machine learning for biological system[I]	DE	4				
6.		Cell Mechanics[II]	DE	4				
7.		Fundementals of Perl and BioPerl	FE	4				

Semester - 04								Total Credits: 18
S. No	Course Code	Course Title	Course Type	Credits	Weekly Contact Hours			
					CL	TU	PR	Total
1		Research Project-II	CC	15	0	0	0	0
2		Industrial Internship/Certification	CC	3	0	0	0	0

Total Program Course Distribution		
Course Category	**Credits**	**Courses**
CC: Core Courses	47	12
DE: Specialization Sequence with Directed Electives	28	07
FE: Free Electives	08	02

Total Program Credit Distribution			
SN	**Year**	**Semester**	**Credits Assigned**
1	First	I	24
2		II	24
3	Second	III	19
4		IV	18
	Total Semester	**4**	**85**

Section 6: Course Sequence

Sequence of courses attaining a particular curriculum outcome or a sequence of courses attaining a particular specialization. Courses sequences could be more than 3 also. Courses to be mentioned in a sequential manner.

Sequence I	**Sequence II**	**Sequence III**	**Sequence V**
Bioinformatics	**Biomaterials and Tissue Engineering**	**Bioengineering Fundamentals**	**Research**
OMICS	Principles of Tissue Engineering	Mathematical Methods for Bio engineers	Research Methodology and IPR
Biological information system& Management	Drug Delivery: Principles and applications	Bio Techniques	Research project -I
Molecular structure	Microfluidics	Human Physiology	Research project -II

prediction and Visualization			
Machine learning for biological system	Cell Mechanics	Essential Biophysics	Internship
Python and bio-python	Devices and Diagnostics	Computational Biology & Biostatistics	
Data mining in bioinformatics	Biomechanics	Research Methodology and IPR	
Next generation Sequencing	Synthetic Biology and Genetic Engineering		
Advanced Genetic Engineering	Stem cell Technology		
Advanced proteomics	Material characterization and Techniques		
Cognitive Modelling			
Molecular Imaging			

Specialization Sequence	
I.	Bioinformatics
II.	Biomaterials and Tissue Engineering
III.	Bioengineering Fundamentals
IV.	Research

Curriculum Implementation through C-D-I-O Initiative

The CDIO™ INITIATIVE is an innovative educational framework for producing the next generation of engineers. The framework provides students with an education stressing engineering fundamentals set in the context of Conceiving — Designing — Implementing — Operating (CDIO) real-world systems and products. Throughout the world, CDIO Initiative collaborators have adopted CDIO as the framework of their curricular planning and outcome-based assessment [1].

[1] http://www.cdio.org

In this curriculum, the topics in each course have been classified under one or more of C-D-I-O to provide an understanding to the students and faculties about the scope of learning. The CDIO approach addresses the needs of students, faculty and industry by collecting and formalizing the knowledge, skills and attributes that student's desire and that industry leaders expect graduating engineers to have.

List of Textbooks and Reference Books

- Molecular Biology of the Gene by James D. Watson, Tania A. Baker, StephenP. Bell, Alexander Gann, Michael Levine, and Richard Losick.
- Biochemistry by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer.
- Kuby Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby.
- Lehninger Principles of Biochemistry by Albert L. Lehninger, David L. NelsonandMichael M. Cox
- Biological Databases by Attwood.
- Programming the Perl DBI by O'Reilly
- Essential of MATLAB for Scientist and Engineer by Hahn Brian D
- Beginning PHP and MySQL 5: from novice to professional by W.Jason Gilmore
- Analytical Techniques In DNA Sequencing by Veena Kumari ii. DNA Sequencing From Experimental Methods To Bioinformatics by Alphey, Luke Next-Generation Sequencing Data Analysis
- Introduction to Protein Structure: Carl Branden, John Tooze (Garland)

- Proteins: Structures and Molecular Properties: Thomas E. Creighton (Freeman)
- Pattern recognition and image analysis by Earl Gose.
- Pattern Classification by Duda, Richard and David Stork
- Machine Learning by Mitchell and Tom
- Chemoinformatics, Concepts, Methods & Tools for Drug Discovery; Ed. Jurgen Bajorath(Humana Press)
- Chemoinformatics Ed by Johann Gasteigen, Thomas Engel, Wiley-VCH
- Molecular Modeling, Principles & Applications, Andrew R. Leach
- Bioinformatics from Genomes to Drugs ; Vol I & 2
- An Introduction to Chemoinformatics, Andrew R. Leach, Valerie J. Gillet. REisbergandR. Resnick.
- The Art of Concurrency by Clay Breshears, O Reilly 91
- Introduction to Parallel Computing (2 Ed) by Ananth Grama, Anshul Gupta, GeorgeKarypis, Vipin Kumar, Addison Wesley
- Professional C++ by M Gregoire, NA Solter, SJ Kleper (2Ed)