Board of Studies Meeting

Department of Biotechnology

TERI School of Advanced Studies

Venue: Conference Hall / Online via Office Teams (Hybrid mode)

Date: 23rd June 2026

Time: 10:30 a.m. to 1:00 p.m.

Members

Prof. Ramakrishnan Sitaraman (HoD and Chair, BoS)

Prof. Shailendra Goel, Department of Botany, University of Delhi, New Delhi (External member)

Prof. Ashis K Nandi, Department of Life Sciences, Jawaharlal Nehru University, New Delhi (External member)

Prof. Anandita Singh

Prof. Shashi Bhushan Tripathi

Prof. Chaithanya Madhurantakam

Dr. Souren Paul

Ms. Jahnavi Varma, alumna, M.Sc. Biotechnology (2023-25, Reg. No. 2300182MSB)

Mr. Aniket Walia, doctoral student, Bioresources & Biotechnology (Reg. No. 1900506RSP)

Mr. Naman Dosi, second year student, M.Sc. Biotechnology (Reg. No. 2400135MSB)

Mr. Harsh Ghosalkar, first year student, M.Sc. Biotechnology (Reg. No. 2500323MSB)

Ms. Aanya Tyagi, first year student, FYUP/FYIPP Biotechnology (Reg. No. 2500039BSB)

Special invitees:

Prof. Rakesh Bhatnagar, Distinguished Professor, TERI SAS

Dr. Ankit Kumar, EYM Life Sciences

Dr. Priya Bhatnagar, EYM Life Sciences

1. Matters of information:

1. The Board of Studies approved the following resolution by circulation on March 25, 2026: 'The Board of Studies endorses the periodic inclusion of relevant national and international competitive examinations as eligibility criteria for undergraduate, post-graduate and doctoral programs offered by the Department of Biotechnology at the TERI School of Advanced Studies. The departmental faculty members may include examinations based on prevailing circumstances after reaching a consensus among themselves and after ensuring that all applicable UGC guidelines are adhered to. The Head of the Department shall provide a record of such actions as items for information to the Board of Studies.'

In accordance with the above resolution, the BoS is hereby informed that scores obtained in the IISER Admission Test (IAT) and the BITS Admission Test (BITSAT) will be accepted (with three-year validity) for admission to the FYUP & FYIPP Biotechnology programs, in addition to currently accepted test scores.

2. Approval of a 3-credit elective course titled "Artificial Intelligence and Machine learning for Biotechnology' for inclusion in the third and first semesters of the 2- and 1-year M.Sc. Biotechnology programs respectively.

Refer to Annexure 1. Course approved with modifications in title and contents.

3. Approval of courses for the third semester of the FYUP/FYIPP Biotechnology programs.

Refer to Annexure 2. All courses were approved with modifications to the title and/or contents of some courses.

4. Approval of upskilling courses for students availing the exit option after completion of the first and second year of the FYUP/FYIPP Biotechnology programs.

Upskilling course outlines are provided in Annexure 3.

NOTE: The semester fee paid at the beginning of each semester does not cover the cost of credits taught during the summer vacation. Therefore, all students opting for any upskilling courses during the summer vacation, whether as an open elective or for exit purposes, will be required to pay an extra fee as determined by TERI SAS from time to time.

All courses were approved.

5. Proposed ranking of national level test scores for FYUP & FYIPP Biotechnology programs.

The proposed ranking of recognized test scores for admission to the FYUP & FYIPP Biotechnology programs at TERI SAS is as follows (high to low rank) is as follows: NEET, CUET-UG, JEE mains, BITSAT, IAT.

The examination ranking presented above was approved, and the department was advised to detail the process of determining equivalence among rank holders in these competitive examinations.

6. Approval of all SWAYAM/NPTEL courses as open electives for all programs offered by the Department of Biotechnology.

The SWAYAM/NPTEL courses present learning opportunities across several subjects and topics that no single academic institution can realistically cover. Therefore, recognizing the importance of multi-disciplinary and lifelong learning, the Department of Biotechnology at TERI SAS wishes to henceforth recognize any SWAYAM/NPTEL courses completed by students at the undergraduate, postgraduate and doctoral levels as 'open electives.' The process for incorporation of corresponding grades in their official transcripts will be as follows:

1. The student should complete the written examination administered by the SWAYAM/NPTEL course coordinator and provide the administrative office with the final marks obtained, with original supporting documents (marksheet and certificate) for verification. (Sample marksheet provided in Annexure 4)
2. TERI SAS grades will be allocated as per the following absolute scale:

Marks obtained (%)	Letter grade
>90	A+
>80≤90	A
>70≤80	B+
>60≤70	B
>50≤60	C+
>45≤50	C
>40≤45	D
≤40	F

3. Once the marks are verified, the administrative office with add the awarded letter grade to a separate section of the transcript titled 'open electives.' Grades

obtained in such courses will not count towards the SGPA or CGPA. However, such grades will be deposited in the student's Academic Bank of Credits.

4. If SWAYAM/NPTEL do not indicate a fixed number of credits, the administrative office will allocate credits based on the number of lecture & tutorial hours taught and the rules specified by UGC (15 hrs of lecture/tutorial = 1 credit). If SWAYAM/NPTEL indicate a variable number of credits, the lowest number will be indicated in the transcript.

Important note: This arrangement will have no bearing on the incorporation of specific SWAYAM/NPTEL courses into the prescribed curriculum of various programs in accordance with the University Grants Commission (Credit Framework for Online Learning Courses through Study Webs of Active Learning for Young Aspiring Minds) Regulations, 2021. In such cases, the program coordinator will make the case for incorporation of the stated course(s) and provide complete operational details for completion of the evaluation components listed in the corresponding course outline(s).

Prof. Bhatnagar highlighted the mismatch between the TERI SAS grading system and the UGC-mandated letter grading system that could lead to much confusion. Accordingly, the adoption of the UGC mandated letter grading system will be presented as a university-wide agenda item in the forthcoming Academic Council meeting. If approved, it will be used to establish an absolute grading scale for SWAYAM / NPTEL courses as follows:

Marks obtained (%)	Letter grade
>90	O (Outstanding)
>80≤90	A+ (Excellent)
>70≤80	A (Very Good)
>60≤70	B+ (Good)
>50≤60	B (Above Average)
>45≤50	C (Average)
>40≤45	P (Pass)
≤40	F

7. Treatment of Systematic Reviews and Meta-Analysis conducted using internationally accepted guidelines (e.g., Cochrane Handbook for Systematic Reviews of Interventions, PRISMA guidelines) at par with conventional research articles for purposes of award of the doctoral degree.

Not approved.

8. Proposal to lower the minimum attendance requirement in theory courses offered by the Department of Biotechnology from 65% to 50%.

Students have requested this provision to facilitate their attendance in seminars/workshops/training programs/conferences. If this proposal is accepted, it will apply only to lecture-based courses hosted by the Department of Biotechnology. It will not be applicable to any laboratory-/project-/research-based courses hosted by the Department of Biotechnology.

Not approved. The department was advised to collectively decide on the attendance of conference/seminar/workshop/training program by students at other organizations on a case-by-case basis.

9. Any other matter.

There being no other matters for discussion, the meeting concluded at 1300 hrs.

.....The meeting ended at 1:00 PM .....

(Annexures in the following pages)

Prof. Ramakrishnan Sitaraman | Prof. Ashis Nandi | Prof Chaithanya Madhurantakam

Prof. Shailendra Goel | Prof. Anandita Singh | Dr. Souren Paul

Prof. Shashi Bhushan Tripathi | Mr. Aniket Walia | Mr. Naman Dosi

Mr. Harsh Ghosalkar | Ms. Aanya Tyagi | Ms. Jahnavi Varma

Annexure 1

<table>
<tr><td colspan="4">Course title: Artificial Intelligence and Machine Learning for Biotechnology</td></tr>
<tr><td>Course code: BBP XXX</td><td>No. of credits: 3</td><td>L-T-P: 28-17-0</td><td>Learning hours: 45</td></tr>
<tr><td colspan="4">Pre-requisite course code and title (if any): None</td></tr>
<tr><td colspan="4">Department: Department of Biotechnology</td></tr>
<tr><td colspan="2">Course coordinator:</td><td colspan="2">Course instructor:</td></tr>
<tr><td colspan="4">Contact details:</td></tr>
<tr><td colspan="2">Course type: DSE</td><td colspan="2">Course offered in: Semester 1/Semester 3 of 1-/2-year M.Sc. Biotechnology programs respectively.</td></tr>
<tr><td colspan="4">Course description:
This course introduces postgraduate biotechnology students to the principles, applications, and emerging frontiers of Artificial Intelligence (AI) and Machine Learning (ML) in life sciences. It provides a conceptual and application-oriented understanding of how AI technologies are transforming genomics, proteomics, drug discovery, precision medicine, and bioprocess engineering. The course covers foundational ML concepts such as supervised and unsupervised learning, model evaluation, and data workflows, followed by advanced applications including biomarker discovery, protein structure prediction, generative AI in drug design, and digital twins in biotechnology. Students will also explore AI-driven innovations in synthetic biology, medical imaging, and personalized healthcare.

Special emphasis is placed on explainable AI, ethical considerations, bias in healthcare algorithms, and regulatory challenges to ensure responsible application of AI in biomedical research. Through case studies and research paper discussions, students will develop the ability to critically analyze AI-based scientific literature and interpret model outputs in biological contexts. Designed for MSc-level learners without requiring extensive coding or advanced mathematics, this course prepares students for research careers, doctoral studies, and emerging AI-enabled roles in biotechnology and healthcare industries.</td></tr>
<tr><td colspan="4">Course objectives:

• To develop conceptual and analytical understanding of AI/ML in life sciences.
• To explore advanced and emerging AI applications in genomics, drug discovery, and bioprocessing.
• To critically evaluate AI-based research literature.
• To prepare students for research, PhD pathways, and AI-enabled biotech careers.</td></tr>
</table>

Course contents				
S. No.	Topic	L	T	P
Module 1	**Foundations of AI & Machine Learning in Life Sciences**	**6**	**2**	
1	**Introduction to AI** - Evolution of AI, AI vs ML vs Deep Learning, AI ecosystem in biotechnology	1		
2	**Machine Learning Basics** - Supervised and unsupervised learning. Classification & regression. Clustering. Dimensionality reduction	2		
3	**ML Workflow** - Data collection, Training vs testing data, Model building, Validation, Deployment	2	1	
4	**Model Evaluation Metrics** – Accuracy, Precision, Recall, F1 Score, ROC Curve, *Conceptual understanding only (no heavy mathematics).	1	1	
Module 2	**AI in Genomics, Proteomics & Biomedical Research**	**6**	**3**	
1	**AI in Genomics** - Gene expression data analysis, High-dimensional biological datasets, Biomarker identification, Disease subtype clustering, introductory multi-omics integration, single-cell RNA sequencing (scRNA-seq), and spatial transcriptomics (conceptual overview).	3	1	
2	**AI in Sequence Analysis & Structural Biology** - Pattern recognition in DNA sequences, Mutation impact prediction, AI-based protein structure prediction using AlphaFold	2	1	
3	**AI in Clinical & Precision Medicine** - Genotype–phenotype mapping, Risk prediction models, Stratified medicine, AI in electronic health records	1	1	
3	**AI in Drug Discovery & Bioprocessing**	**6**	**4**	
1	**AI in Drug Discovery** - Virtual screening, Target identification, Drug repurposing, AI-driven molecular modeling	1	2	
2	**Generative AI in Drug Design** - Concept of generative models, AI-designed molecules, generative AI in drug discovery, protein design, molecular optimization, biological foundation models and large language models (LLMs) in life sciences, and AI-assisted vaccine development.	2	1	
3	**Introduction to Digital Twins in Biotechnology** - Concept of digital twin, Difference between simulation & digital twin, Digital twin in: Fermentation monitoring, Bioprocess optimization, Virtual patient modeling, imaging and monitoring	2	1	

	environment, industrial biomanufacturing applications, Role in personalized medicine			
Module 4	**Frontier & Responsible AI in Biotechnology**	**7**	**3**	
1	**AI in Synthetic Biology** - Gene circuit prediction, CRISPR off-target prediction, Pathway optimization using AI	1	1	
2	**AI in Imaging & Diagnostics** - Neural networks, CNN for histopathology, AI in cancer detection, CT imaging workflows, digital pathology concepts, POCUS/ultrasound workflows, scan interpretation, triage support, and AI-assisted clinical decision systems.	2	1	
3	**Explainable AI (XAI)** - Importance in healthcare, Model interpretability, Bias detection	2	1	
4	**AI Ethics & Regulatory Landscape** - Data privacy in healthcare, Bias in biomedical AI, Regulatory challenges, Responsible AI principles	2		
Module 5	**Research Paper Analysis & Case Studies** - Critical reading of AI-biotech research articles, Identifying research gaps, Evaluating methodology, Understanding limitations, Student presentations	**3**	**5**	
	Total	**28**	**17**	**0**

Evaluation criteria:

- Mid-semester exam: 30%
- End-semester exam: 40%
- Case study presentation: 30%

Learning outcomes:

Upon successful completion of this postgraduate course, students will be able to:

1. Describe the fundamental concepts of AI and ML as they apply to biotechnology research. (End-semester exam)

2. Evaluate how AI is utilized across various domains of biotechnology

3. Understand, interpret and critically evaluate the results generated by AI-based biological models (Mid-semester examination)

4. Analyze contemporary AI-driven research articles, identifying research gaps, and assessing

methodologies and limitations. (Case study presentation)

5. Understand the ethical, bias-related, and regulatory implications of deploying AI in healthcare and biomedical research. (End-semester exam)

Pedagogical Approach:

- Interactive lectures
- Biological analogies
- Case studies and examples from original research articles
- Short videos and animations

Skill Set:

This course equips undergraduate biotechnology students with interdisciplinary data literacy, analytical thinking, and ethical awareness, enhancing their employability in AI-enabled biotechnology, healthcare, and pharmaceutical sectors.

- Conceptual understanding of Artificial Intelligence and Machine Learning principles relevant to biotechnology
- Ability to interpret AI-based outputs in genomics, proteomics, diagnostics, and drug discovery
- Foundational data literacy for biological datasets, including sequence, expression, imaging, and clinical data
- Analytical and critical thinking skills through AI-based biological case studies
- Awareness of ethical, legal, and societal issues related to AI applications in life sciences
- Interdisciplinary communication skills bridging biology and data-driven technologies

Employability:

This course is designed to prepare students for various emerging roles in the AI-enabled biotech and healthcare sectors:

- **Academic Research:** Preparation for PhD pathways in Computational Biology and Bioinformatics research.
- **Industrial R&D:** Roles in AI-driven drug discovery laboratories and biotechnology startups.
- **Healthcare Analytics:** Positions in clinical data analytics and precision medicine projects.
- **Bioprocess Engineering:** Applying digital twin technology and AI for fermentation monitoring and bioprocess optimization.

Materials:

Suggested Readings

1. "AI in Biology: A Beginner's Guide" by K.N. Jha (2023)
2. "Deep Learning for the Life Sciences" by Bharath Ramsundar et al.
3. The AlphaFold Breakthrough: Jumper, J., et al. (2021). *"Highly accurate protein structure prediction with AlphaFold."* Nature. (Focus on the *Results* and *Biological Significance* sections).
4. AI in Diagnostics: Esteva, A., et al. (2017). *"Dermatologist-level classification of skin cancer with deep neural networks."* Nature.
5. Bera, K., et al. (2019). "Artificial intelligence in digital pathology — new tools for diagnosis and precision oncology." Nature Reviews Clinical Oncology.
6. Litjens, G., et al. (2017). "A survey on deep learning in medical image analysis." Medical Image Analysis.
7. Implementing generative artificial intelligence in precision oncology: safety, governance, and significance." Journal of Hematology & Oncology.
8. Academic journals and regulatory guidelines focusing on data privacy in healthcare, explainable AI, and bias in biomedical algorithms.
9. Online resources: Nature AI collections, NIH and EMBL-EBI AI resources, and other online academic content.

Industry case materials and technical resources

- NVIDIA Healthcare AI – AI infrastructure, medical imaging, and accelerated healthcare computing
- Isomorphic Labs – AI-driven drug discovery and protein structure research
- Tempus AI – Precision medicine and clinical AI applications
- Illumina – Genomics and sequencing analytics workflows
- GRAIL – Multi-cancer early detection and AI-enabled diagnostics
- Paige – AI-assisted digital pathology and cancer diagnostics
- PathAI – Digital pathology and AI-assisted pathology analysis
- Aidoc – AI-supported radiology workflows and clinical decision support
- Siemens Healthineers – AI-enabled medical imaging and healthcare workflow systems
- GE HealthCare – AI-assisted imaging and clinical workflow tools

Additional information (if any): This course has been jointly designed and developed by Dr. Ankit Kumar and Dr. Priya Bhatnagar (both of EYM Life Sciences) at the request of Dr. Ramakrishnan Sitaraman. Dr. Mahesh S. Dhar, Director, Haryaksh Scientific Pvt. Ltd. provided invaluable inputs that ensured alignment with current industry standards of student employability.

Student responsibilities:

- Class attendance.
- Active participation in case study discussions.
- Self-study of provided reading materials.
- Submission of case study presentation.

Course reviewers:

1. Dr. Pawan K Dhar, Executive Director, CVJ Centre for Synthetic Biology and Biomanufacturing, CUSAT Technology Business Incubator, 3rd Floor, CUSAT-Students Amenity Centre, Cochin University of Science and Technology, Kalamassery, Kochi 682 022 (Formerly Professor, School of Biotechnology, Jawaharlal Nehru University, New Delhi)

2. Dr. Anwar Alam, Associate Professor , Life Science, Sharda University, Plot no 32, 34, Knowledge Park III, Greater Noida, Uttar Pradesh 201310

3. Dr. Abhinav Kaushik, Research Scientist, Harvard T.H. Chan School of Public Health, Nadeau Lab: FXB, 1st Floor, 651 Huntington Ave., Boston, MA 02115, USA

4. Dr. Jatin Shrinet, Research Engineer, Institut Curie, 26 rue d'Ulm, 75248 Paris cedex 05, France.

Annexure 2

<table>
<tr><td colspan="4">Course title: Introduction to Machine learning for Biotechnology</td></tr>
<tr><td>Course code:
UBT XXX</td><td>No. of credits: 3</td><td>L-T-P:
34-11-0</td><td>Learning hours: 45</td></tr>
<tr><td colspan="4">Pre-requisite course code and title (if any):</td></tr>
<tr><td colspan="4">Department: Department of Biotechnology</td></tr>
<tr><td colspan="2">Course coordinator:</td><td colspan="2">Course instructor:</td></tr>
<tr><td colspan="4">Contact details:</td></tr>
<tr><td colspan="2">Course type: Minor (for those opting for a minor in Data Science)/DSE (for others)</td><td colspan="2">Course offered in: Semester 3 of FYUP/FYIPP Biotechnology</td></tr>
<tr><td colspan="4">Course description:
This course introduces undergraduate biotechnology students to the fundamental concepts and applications of Artificial Intelligence (AI) and Machine Learning (ML) in the life sciences. Designed for learners without a strong background in mathematics or programming, the course emphasizes conceptual understanding, biological relevance, and real-world applications rather than technical or computational details.
Students are introduced to the nature of biological data and the role of data-driven approaches in modern biotechnology. Core concepts of machine learning, including types of learning and commonly used models, are explained using intuitive examples from genomics, proteomics, transcriptomics, healthcare, and drug discovery. The course highlights how AI-based tools are transforming areas such as precision medicine, diagnostics, pharmaceutical research, and bioprocess optimization.
In addition to technical awareness, the course addresses ethical, legal, and societal issues associated with the use of AI in biotechnology, including data privacy, bias, and responsible decision-making. Through case studies and discussion-based learning, students develop analytical thinking, data literacy, and interdisciplinary communication skills.
Overall, the course prepares students for AI-enabled biotechnology environments and provides a strong foundation for employability in industry, healthcare, and research sectors, as well as for higher studies in bioinformatics and computational life sciences.</td></tr>
<tr><td colspan="4">Course objectives:
1. Introduce fundamental concepts of Artificial Intelligence (AI) and Machine Learning (ML) in the context of biotechnology.</td></tr>
</table>

2. Familiarize students with different types of biological data and their applications in AI-driven analysis.
3. Demonstrate real-world applications of AI in genomics, proteomics, diagnostics, drug discovery, and precision medicine.
4. Develop student's ability to interpret AI-generated results and analyze case studies from life sciences.
5. Instill awareness of ethical, legal, and societal considerations, while preparing students for AI-related career pathways in biotechnology.

Course contents

S. No.	Topic	L	T	P
Module 1	**Introduction to AI, ML, and Data in Biology**	**6**	**2**	
1	**What is Artificial Intelligence?** - Definition and evolution of AI, AI vs Human Intelligence, Narrow AI vs General AI, Examples of AI in daily life and biology.	2	1	
2	**What is Machine Learning?** - Definition of Machine Learning, Difference between AI, ML, and Deep Learning (conceptual only), Why ML is useful for biological problems.	2		
3	**Types of Data in Biotechnology** - DNA, RNA, protein sequences, Images (microscopy, radiology), Clinical and epidemiological data, Structured vs unstructured data, Introduction to big data in biology.	2	1	
Module 2	**Basics of Machine Learning**	**7**	**3**	
1	**Types of Machine Learning** - Supervised learning (with biological examples), Unsupervised learning, Semi-supervised learning, Reinforcement learning (conceptual overview)	2	1	
2	**Common ML Concepts (Intuitive)** - Features and labels (using biological analogies), Training and testing data, Model and prediction, Overfitting and underfitting (visual explanation).	2	1	
3	**Common ML Algorithms (Conceptual Understanding)** - Decision trees, k-Nearest Neighbors (k-NN), Naïve Bayes, Support Vector	3	1	

	Machines (idea only), Neural networks (biological inspiration)			
Module 3	**AI & ML in Genomics and Proteomics**	**6**	**3**	
1	**AI in Genomics** - Genome sequencing and data explosion, Gene prediction and annotation, Variant detection and disease association, AI in personalized genomics	2	1	
2	**AI in Transcriptomics** - Gene expression analysis, Clustering of gene expression data, AI in single-cell RNA sequencing (scRNA-seq) – dimensionality reduction (UMAP/t-SNE concepts), automated cell-type clustering, and importance of AI in handling high-dimensional biological data (conceptual overview).	2	1	
3	**AI in Proteomics** - Protein structure prediction, Protein–protein interaction prediction, Case study: AlphaFold (conceptual impact, not technical details).	2	1	
Module 4	**AI in Drug Discovery, Healthcare, and Diagnostics**	**6**	**3**	
1	**AI in Drug Discovery** - Traditional vs AI-driven drug discovery, Target identification, Virtual screening, Drug repurposing, Time and cost reduction using AI.	2	1	
2	**AI in Medical Diagnostics, imaging, and Bedside Decision Support** - Medical imaging (X-ray, MRI, CT scans), AI in cancer detection, Pathology image analysis.POCUS, workflow assistance, and image-based biomarker discovery (conceptual overview).	2	1	
3	**AI in Precision Medicine** - Personalized treatment strategies, AI-based clinical decision support systems, Case studies from oncology and rare diseases.	2	1	
Module 5	**5: AI in Biotechnology Industry, Ethics, and Future Trends**	**9**		
1	**AI in Biotech and Pharma Industry** - AI-driven bioprocess optimization, Fermentation monitoring,	3		

	Quality control and automation, Role of AI in vaccine development.			
2	**Ethical, Legal, and Social Issues** - Data privacy and security. Bias in AI models. Transparency and explainability. AI vs human decision-making in healthcare.	3		
3	**Future Trends and Careers** - Future of AI in biotechnology. Emerging fields like Digital biology and computational medicine. Introduction to digital health. wearable health data. and digital biomarkers (conceptual overview). Career paths for biotechnology students. Importance of interdisciplinary learning.	3		
	Total	**34**	**11**	**0**

Evaluation criteria:

Assignment: 40%

End-semester exam: 40%

Case study presentation: 20%

Learning outcomes:

Students will be able to:

1. Use AI and ML terminology correctly in biological and biomedical contexts. (End-semester exam)
2. Interpret AI-based outputs used in genomics, proteomics, and healthcare. (Assignment)
3. Analyze real-life case studies involving AI in biotechnology industries. (Case study presentation)
4. Demonstrate data literacy skills relevant to biological datasets. (Assignment)
5. Evaluate ethical, legal, and societal implications of AI applications (End-semester exam)
6. Identify career pathways and skill requirements at the AI–biotechnology interface. (End-semester exam)

Pedagogical Approach:

1. Interactive Conceptual Lectures: Use biological analogies to explain AI/ML concepts.
2. Case-Based Learning: Analyze real-world applications in genomics, proteomics, diagnostics, and drug discovery.
3. Visual & Multimedia Tools: Use animations, videos, and workflow diagrams to illustrate ML models and AI applications.
4. Guided Hands-On Demonstrations: GUI based ML exercises for model building, classification, and clustering.

5. Collaborative Learning: Group discussions and presentations to develop interdisciplinary thinking and communication skills.

6. Reflective Practice: Maintain learning journals for data interpretation, case analyses, and model evaluation.

7. Ethics & Societal Awareness: Integrate discussions on bias, privacy, transparency, and responsible AI in biotechnology.

8. Future-Oriented Exposure: Introduce frontier applications like multi-omics integration, precision medicine, and computational biology.

Skill Set:

This course equips undergraduate biotechnology students with interdisciplinary data literacy, analytical thinking, and ethical awareness, enhancing their employability in AI-enabled biotechnology, healthcare, and pharmaceutical sectors.

1. Conceptual understanding of Artificial Intelligence and Machine Learning principles relevant to biotechnology

2. Ability to interpret AI-based outputs in genomics, proteomics, diagnostics, and drug discovery

3. Foundational data literacy for biological datasets, including sequence, expression, imaging, and clinical data

4. Analytical and critical thinking skills through AI-based biological case studies

5. Awareness of ethical, legal, and societal issues related to AI applications in life sciences

6. Interdisciplinary communication skills bridging biology and data-driven technologies

Employability:

1. Entry-level technical/support roles in academia and industry requiring AI/ML.

2. Assistant teacher in middle schools.

3. Junior researcher in industry & academia.

4. Entry-level data scientist.

Materials:

Suggested Readings

1. AI in Biology: A Beginner's Guide by K.N. Jha (2023).
2. Deep Learning for the Life Sciences by Bharath Ramsundar et al.
3. The AlphaFold Breakthrough: Jumper, J., et al. (2021). "Highly accurate protein structure prediction with AlphaFold." Nature. (Focus on the Results and Biological Significance sections).
4. AI in Diagnostics: Esteva, A., et al. (2017). "Dermatologist-level classification of skin cancer with deep neural networks." Nature.
5. Esteva, A., et al. "A guide to deep learning in healthcare." Nature Medicine (2019).
6. Litjens, G., et al. "A Survey on Deep Learning in Medical Image Analysis." Medical Image Analysis (2017).
7. Online resources:
    - Nature AI collections
    - NIH and EMBL-EBI AI resources
8. Industry case materials and technical resources
    - GRAIL – Multi-cancer early detection and AI-enabled diagnostics
    - GE HealthCare – AI-assisted imaging and clinical workflow tools
    - Butterfly Network – Portable ultrasound and AI-supported imaging
    - Illumina – Genomics and sequencing analytics workflows
    - Tempus AI – Precision medicine and clinical AI applications
    - PathAI – Digital pathology and AI-assisted pathology analysis

Additional information (if any): This course was jointly designed by Dr Ankit Kumar and Dr Priya Bhatnagar (both from EYM Life Sciences) at the request of Dr. Ramakrishnan Sitaraman. Dr. Mahesh S. Dhar (Director, Haryaksh Scientific Pvt. Ltd.) provided inputs to effectively align the course with industry standards and student employability.

Knowledge of basic biology and statistics at high-school level recommended. *No prior programming experience required.*

Mapping table: Illustrative AI Applications in Biotechnology and Healthcare

Application Area	Data Type	Example Use Case	Reference Organization
Genomics	DNA sequencing data	Variant analysis	Illumina
Transcriptomics	scRNA-seq data	Cell-type clustering	Tempus
Diagnostics Imaging	CT/MRI/Pathology	Cancer detection	GE HealthCare /

	images		PathAI
Portable Diagnostics	Ultrasound imaging	Bedside imaging support	Butterfly Network
Precision Medicine	Clinical + molecular data	Treatment recommendation	GRAIL
Digital Health	Wearable sensor data	Digital biomarkers	Apple Health
Assistive Healthcare Technologies	Audio and wearable sensor data	AI-assisted hearing enhancement and adaptive sound processing	Phonak

Student responsibilities:
Class attendance.
Active participation in case study discussions.
Self-study of provided reading materials.
Submission of assignment/case study presentation.

Course reviewers:

1. Dr. Pawan K Dhar, Executive Director, CVJ Centre for Synthetic Biology and Biomanufacturing, CUSAT Technology Business Incubator, 3rd Floor, CUSAT-Students Amenity Centre, Cochin University of Science and Technology, Kalamassery, Kochi 682 022 (Formerly Professor, School of Biotechnology, Jawaharlal Nehru University, New Delhi).

2. Dr. Anwar Alam, Associate Professor , Life Science, Sharda University, Plot no 32, 34, Knowledge Park III, Greater Noida, Uttar Pradesh 201310.

3. Dr. Abhinav Kaushik, Research Scientist, Harvard T.H. Chan School of Public Health, Nadeau Lab; FXB, 1st Floor, 651 Huntington Ave., Boston, MA 02115, USA.

4. Dr. Jatin Shrinet, Research Engineer, Institut Curie, 26 rue d'Ulm, 75248 Paris cedex 05, France.

Course title: Evolutionary biology			
Course code: UBT XXX	**No. of credits:** 2	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): None			
Department: Biotechnology			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Core	**Course offered in:** Semester 3		

Course description:

This course is meant to provide undergraduates with an overview of evolutionary phenomena and theory in biology. The first module is devoted to an account of the history of ideas in the field. It also provides an overview of the current views on the evolution of complexity and dependencies, concluding with different views of evolution, co-evolution and the long-term survival of species over time. The second module provides a description of molecular processes driving evolution and their implications for evolution by natural selection. The final module provides an overview of some basic and applied science contexts using evolutionary biology is the overarching framework. It concludes with a description of findings from long-term evolution experiments and recent trends in evolutionary biology.

Course objectives:

1. To present a summary of the historical development of ideas on evolutionary biology.
2. To provide insights into the mechanisms of evolution by natural selection.
3. To emphasize the importance of evolution and natural selection by means of examples from science, technology and medicine.

Course contents

S.No	Topic	L	T	P
Module 1	**Theoretical Development**	**12**	0	0
1	History of life on earth, the fossil record and mass extinctions Accounting for biodiversity – pre-Darwinian views.	3	0	0
2	Malthus and differential reproductive fitness, development of Darwin's ideas and those of his predecessors & contemporaries. Geological theory and its impact on the study of biogeography. Mechanistic problems with Darwin's theory, Mendel's experiments and the modern synthesis. Overview of the species concept. Evidence for evolution.	3	0	0
3	Individual versus group and kin selection. Evolution of dependencies and cooperation – the Black Queen hypothesis. Extinction events and their role in shaping biodiversity; Adaptive radiation and convergent evolution. Coevolution	6		

	and evolutionary arms races – the Red Queen hypothesis,			
Module 2	**Mechanisms of evolution**	**10**	0	0
1	Sources of variation - genes and mutations, Hardy-Weinberg law and genetic drift, gene flow and mechanisms of speciation. Phylogenetic analysis as a window into evolutionary processes and patterns. Horizontal and vertical gene transfer, the role of ecology in evolution. Neutral theory, evolution of complexity.	7	0	0
2	Evolution of cellular structures, functions, and multicellularity. Mutations and mechanisms of molecular evolution.	3	0	0
Module 3	**Understanding and utilizing evolutionary processes**	**8**		
1	Leveraging evolution and natural/artificial selection. SELEX, phage display, the adaptive immune system, bioprospecting – phages, antibiotics and bioremediation, disease control – AIDS, antimicrobial resistance and cancer.	5	0	0
2	Experimental study of evolution and future developments.	3	0	0
	Total	**30**	0	0

Evaluation criteria:
Test 1 – 40% weightage – mid-semester
Test 2 – 60% weightage – final

Learning outcomes:
1. Knowledge of the history of evolutionary ideas (Test 1).
2. Understanding of the modern synthesis of evolutionary theory (Test 1).
3. Gaining an appreciation of recent developments in evolutionary theory. (Tests 1 & 2).
4. Appreciating the importance of evolutionary processes in diverse contexts (Tests 1 & 2).

Pedagogical Approach:
A combination of online/offline lectures/self-study/group study for various topics.

Skill Set:
1. Hypothesis formulation and testing in evolutionary biology.
2. Ability to analyze cases in biology and medicine within an evolutionary framework.
3. Critically evaluating the applicability of various evolutionary models to biological contexts.

Employability:
1. Life science tutoring at the middle-school level.
2. School assistant teacher.
3. Laboratory assistant.
4. Junior researcher.

5. Environmental monitoring.

Study Materials:

Textbooks

1. Futuyma, D. J. & Kirkpatrick, M. Evolution. (Oxford University Press, New York, NY, 2023)
2. Herron, J. C. & Freeman, S. Evolutionary Analysis. (Pearson, Boston, 2014).
3. Lomolino, M. V., Riddle, B. R. & Whittaker, R. J. Biogeography: Biological Diversity across Space and Time. (Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, U.S.A, 2018).
4. Young, D. The Discovery of Evolution. (Natural History Museum, London, 2007)

Case studies

1. Lenski, R. E. Experimental evolution and the dynamics of adaptation and genome evolution in microbial populations. *The ISME Journal* **11**, 2181–2194 (2017).

Suggested readings

1. Darwin, C. & Mayr, E. On the Origin of Species. (Harvard Univ. Press, Cambridge, Mass., 2003).
2. Bulmer, M. The theory of natural selection of Alfred Russel Wallace FRS. *Notes Rec R Soc Lond* **59**, 125–136 (2005).
3. Pievani, T. Individuals and groups in evolution: Darwinian pluralism and the multilevel selection debate. *J Biosci* **39**, 319–325 (2014).
4. Pigliucci, M. & Finkelman, L. The Extended (Evolutionary) Synthesis Debate: Where Science Meets Philosophy. *BioScience* **64**, 511–516 (2014).
5. Okasha, S. Why Won't the Group Selection Controversy Go Away? *The British Journal for the Philosophy of Science* **52**, 25–50 (2001).
6. Shanker, K., Vijayakumar, S. P. & Ganeshaiah, K. N. Unpacking the species conundrum: philosophy, practice and a way forward. J Genet 96, 413–430 (2017).

Journals – None

Other readings

1. Dawkins, R. The Selfish Gene. (Oxford University Press, Oxford, United Kingdom, 2016).
2. Gould, S. J. Ever since Darwin: Reflections in Natural History. (Norton, New York London, 2007)
3. Ridley, M. The Red Queen: Sex and the Evolution of Human Nature. (Harper Perennial, New York, NY, 2003).

Additional information (if any): Course designed by Dr. Ramakrishnan Sitaraman

Student responsibilities:

1. Class attendance (online/offline).
2. Study/self-study of course materials as specified by the instructor.

Course reviewers:

1. Dr. Kartik Shanker, Professor & Chairperson, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012.

2. Dr. Richa Priyadarshini, Associate Professor, Department of Life Sciences, School of Natural Sciences, Shiv Nadar University, Gautam Buddha Nagar, U.P 201314.

3. Dr. Krushnamegh Kunte, Associate Professor and Principal Investigator, Biodiversity Lab, National Centre for Biological Sciences (NCBS), Tata Institute of Fundamental Research (TIFR), GKVK Campus, Bellary Road, Bengaluru 560065.

Course title: Structural Biology, Informatics and AI			
Course code: XXXX	**No. of credits: 4**	**L-T-P: 60**-0-0	**Learning hours: 60**
Pre-requisite course code and title (if any): None			
Department: Department of Biotechnology			
Course coordinator:		**Course instructor**	
Contact details:			
Course type: Core		**Course offered in:** Semester 3	

Course description:

This course aims to provide students with concepts that will introduce them to the interface of structural biology, macromolecular informatics, and artificial intelligence. Knowledge of structural architecture and associated computational tools is a necessity for students to understand, predict, and engineer the complex molecular functions of living systems. This course will provide detailed information on the spatial and chemical nature of biological macromolecules, the biophysical pipelines used to resolve them, and the physics-based simulations of their dynamics (wherever applicable). Further, this course will provide a conceptual understanding of the deep learning architectures and generative AI models driving the revolution in de novo protein design and structure-based drug discovery.

Course objectives:

1.To familiarize students with macromolecular architecture, structural databases, and advanced 3D visualization platforms.
2.To acquaint students with the physical principles and computational reconstruction pipelines of X-ray crystallography, NMR, and Cryo-EM.
3.To introduce students to physics-based modeling, empirical force fields, and molecular dynamics trajectory informatics.
4.To provide students with the fundamentals of geometric deep learning, evolutionary coupling, and generative AI models used for structural prediction and protein engineering.

Course contents

Module	Topic	L	T	P
Module 1: Macromolecular Architecture & Structural Informatics				
	1.1. Biophysical Foundations of Macromolecules Protein Structural Hierarchy, Intrinsically Disordered Proteins & Structural Flexibility, Structure-function relationships in biology, and an overview of structural biology techniques. **Protein Folding Thermodynamics:** Anfinsen's dogma, Levinthal's	7	0	0

paradox, and the energy landscape theory ("folding funnels"). **Forces Driving Stability:** Hydrophobic collapse, hydrogen-bonding networks, van der Waals forces, and electrostatic interactions. **Nucleic Acid Architectures:** Polymorphism in DNA, non-canonical structures (G-quadruplexes, Holliday junctions), and complex RNA tertiary folds.			
1.2. Data Curation and Structural Databases **The Protein Data Bank (PDB):** Evolution from the legacy .pdb format to the macromolecular Crystallographic Information File (.mmCIF) format; data dictionaries and validation reports. **Specialized Databases:** Nucleic Acid Database (NDB), Electron Microscopy Data Bank (EMDB), and AlphaFold Protein Structure Database. **Data Mining & Uniformity:** Programmatic access to structural data using APIs (Biopython, RCSB Search API) and data cleaning for machine learning pipelines.	4	0	0
1.3. 3D Data Visualization and Structural Mechanics **Molecular Graphics Platforms:** Advanced rendering, surface electrostatics, and density map visualization using PyMOL. **Structural Mechanics:** Coordinate transformations, translation/rotation matrices, and calculating Root-Mean-Square Deviation (RMSD). **Local Geometry & Structural Validation Metrics:** Ramachandran plots, torsion angles (phi, psi, omega, chi), and sidechain rotamer libraries.	4	0	0
Module 2: Experimental Foundations of Macromolecular Structures			
2.1. X-ray Crystallography **Physical Principles:** Crystal lattices, Bragg's Law, and X-ray diffraction in reciprocal space; **The Phase Problem:** Solving phases via Molecular Replacement (MR) and anomalous dispersion (SAD/MAD); automated model building, and structural refinement algorithms. **Structure quality indicators** (resolution, B-factors, R-work/R-free, clash scores)	6	0	0
2.2. Nuclear Magnetic Resonance (NMR) Spectroscopy **Physical Principles:** Nuclear spin, chemical shifts, and the Zeeman effect; Multidimensional heteronuclear NMR and the Nuclear Overhauser Effect (NOE) for distance constraints; chemical shifts, structural flexibility, comparison between NMR, Cryo-EM, and crystallography.	5	0	0
2.3. Cryo-Electron Microscopy (cryo-EM) **Physical Principles:** Sample vitrification, transmission electron microscopy, and direct electron detectors; Cryo-EM image processing workflows—movie frame alignment, 3D initial model generation, and high-resolution map refinement.	4	0	0

Module 3: Computational Modeling & Molecular Dynamics			
3.1. Molecular Dynamics (MD) Simulations Conceptual interpretation of bonded and non-bonded interactions, biological significance of simulations. Basics of Trajectories and Conformational changes. **Empirical Force Fields:** Mathematical formulation of potential energy functions (e.g., AMBER, CHARMM) governing bonded (bond, angle, dihedral) and non-bonded (electrostatic, van der Waals) terms. **MD Workflow:** structure preparation, solvation, energy minimization, equilibration, production run, trajectory analysis.	**8**	0	0
3.2. Core Template-Based Modeling **Homology Modeling & Threading:** Sequence alignment, loop modeling, side-chain placement, and profile-based fold recognition.	**4**	0	0
Module 4: AI-Driven Macromolecular Design			
4.1. Predictive AI in Structural Biology **Evolutionary Coupling:** Multiple Sequence Alignments (MSAs) and co-evolutionary signals used to infer spatial contacts; Conceptual role of MSAs, Confidence metrics such as pLDDT and PAE, **AlphaFold Architecture** (Introduction to AlphaFold2 and Evoformer modules), **Alternative Architectures:** Single-sequence structural predictions using protein language models (e.g., ESMFold)	**8**	0	0
4.2. Generative AI and De Novo Protein Design **Structure-to-Sequence Models:** Deep learning sequence generation via inverse folding models for designing sequences that adopt targeted backbones.	**6**	0	0
4.3. AI for Drug Discovery: Structure-based virtual screening, machine learning scoring functions, and AI-driven protein-ligand docking tools operating over non-Euclidean manifolds (e.g., DiffDock). Docking limitations, **Case Studies:** Antiviral/cancer drug discovery,	**4**		
Total	**60**	**0**	**0**

Evaluation criteria:

1. Test 1: Mid-semester (40%)
2. Test 2: End-Semester (60%)

Learning outcomes:

1. Grasp of the structural properties, local geometries, and stabilizing forces of all biological macromolecules, alongside proficiency in structural databases and 3D visualization platforms (Test 1).
2. Knowledge of the physical principles, data acquisition workflows, and computational reconstruction pipelines for X-ray crystallography, NMR, and Cryo-EM (Test 1 & 2).
3. Understanding of empirical force fields, simulation physics, and trajectory informatics used to evaluate

the time-dependent thermodynamic behavior of macromolecular ensembles (Test 2).
4. A grasp of deep learning architectures, generative AI models, and geometric frameworks used for high-accuracy structure prediction, de novo protein engineering, and drug design (Test 2).

Pedagogical Approach: Classroom teaching and provision of case study (as per requirement)
Skill Set: Knowledge of structural biology, informatics, and AI principles and concepts, and to apply these principles in further studies.

Employability:
The course will provide skill sets and knowledge that may be crucial to being employed in Universities, R & D industry, medical centres/Colleges, Research Institutes and Diagnostic centres apart from specialized units like pharma, breweries, dairy and agri- sectors at an entry (junior) level after graduation.

Materials:

Text Books

1.Brändén C, Tooze J. Introduction to Protein Structure. 2nd ed. Garland Science; 1999.2.
2.Liljas A, Liljas L, Piskur J, Lindblom G, Nissen P, Kjeldgaard M. Textbook of Structural Biology. 2nd ed. World Scientific Publishing; 2016. (Liljas, 2016)
3. Schlick T. Molecular Modeling and Simulation: An Interdisciplinary Guide. 2nd ed. Springer; 2010.
4. Chor, B., & Rubinstein, A. (2022). Computational Thinking for Life Scientists. Cambridge University Press.

Suggested Readings:

1.Abramson J, Adler J, Dunger J, et al. Accurate structure prediction of biomolecular interactions with AlphaFold 3. Nature. 2024;630(8016):493-500. doi:10.1038/s41586-024-07487-w
2.Adams PD, Afonine PV, Bunkóczi G, et al. PHENIX: a comprehensive Python-based system for macromolecular structure solution. Acta Crystallogr Sect D Biol Crystallogr. 2010;66(2):213-221. doi:10.1107/s0907444909052925
3.Agarwal V, McShan AC. The power and pitfalls of AlphaFold2 for structure prediction beyond rigid globular proteins. Nat Chem Biol. 2024;20(8):950-959. doi:10.1038/s41586-021-03819-2
4.Agirre J, Atanasova M, Bagdonas H, et al. The CCP4 suite: integrative software for macromolecular crystallography. Acta Crystallogr Sect D Struct Biol. 2023;79(6):444-461. doi:10.1107/s2059798323003595
5.Baek M, DiMaio F, Anishchenko I, et al. Accurate prediction of protein structures and interactions using a three-track neural network. Science. 2021;373(6557):871-876. doi:10.1126/science.abj8754
6.Borkakoti N, Thornton JM. AlphaFold2 protein structure prediction: Implications for drug discovery. Curr Opin Struct Biol. 2023;78:102526. doi:10.1016/j.sbi.2022.102526
7.Corso G, Stärk H, Jing B, Barzilay R, Jaakkola T. DiffDock: Diffusion Steps, Twists, and Turns for Molecular Docking. arXiv. Preprint submitted October 17, 2022. doi:10.48550/arxiv.2210.01776
8.Dauparas J, Anishchenko I, Bennett N, et al. Robust deep learning–based protein sequence design using ProteinMPNN. Science. 2022;378(6615):49-56. doi:10.1126/science.add2187
9.DeLano WL. The PyMOL Molecular Graphics System. DeLano Scientific; 2002. http://www.pymol.org/pymol
10.Edich M, Briggs DC, Kippes O, Gao Y, Thorn A. The impact of AlphaFold2 on experimental structure solution. Faraday Discuss. 2022;240:184-195. doi:10.1039/d2fd00072e
11.Friesner RA, Banks JL, Murphy RB, et al. Glide: a new approach for rapid, accurate docking and scoring. 1. Method and assessment of docking accuracy. J Med Chem. 2004;47(7):1739-1749.

doi:10.1021/jm0306430
12.Halgren TA, Murphy RB, Friesner RA, et al. Glide: a new approach for rapid, accurate docking and scoring. 2. Enrichment factors in database screening. J Med Chem. 2004;47(7):1750-1759. doi:10.1021/jm030644s
13.Jones G, Willett P, Glen RC, Leach AR, Taylor R. Development and validation of a genetic algorithm for flexible docking. J Mol Biol. 1997;267(3):727-748. doi:10.1006/jmbi.1996.0897
14.Jumper J, Evans R, Pritzel A, et al. Highly accurate protein structure prediction with AlphaFold. Nature. 2021;596(7873):583-589. doi:10.1038/s41586-021-03819-2
15.Liebschner D, Afonine PV, Baker ML, et al. Macromolecular structure determination using X-rays, neutrons and electrons: recent developments in Phenix. Acta Crystallogr Sect D Struct Biol. 2019;75(10):861-877. doi:10.1107/s2059798319011471
16.Trott O, Olson AJ. AutoDock Vina: improving the speed and accuracy of docking with a new scoring function, efficient optimization, and multithreading. J Comput Chem. 2010;31(2):455-461. doi:10.1002/jcc.21334
17.Watson JL, Juergens D, Bennett NR, et al. De novo design of protein structure and function with RFdiffusion. Nature. 2023;620(7976):1089-1100. doi:10.1038/s41586-023-06415-8
18.Winn MD, Ballard CC, Cowtan KD, et al. Overview of the CCP4 suite and current developments. Acta Crystallogr Sect D Biol Crystallogr. 2011;67(4):235-242. doi:10.1107/s0907444910045749

Additional information (if any): Course designed by **Dr. Rinki Sisodia** and **Prof. Chaithanya Madhurantakam**. Initial review by Dr. Pooja Anjali Mazumdar (Independent Researcher) subsequently followed by reviews from Prof. Rajakumara E (IIT, Hyd) and Prof. S. Hazra (IIT, Roorkee).

Student responsibilities:

1. Study of course material as specified by the instructor.
2. Proactive involvement in studying and analysing the accessible scientific literature in online/offline modes.

Course reviewers:

1. Prof. Rajakumara E

Room: BT-213, Biotechnology and Biomedical Engineering Building
Indian Institute of Technology Hyderabad
Kandi-502284, Sangareddy, Telangana, India

2. Prof. Saugata Hazra

Department of Biosciences and Bioengineering

IIT Roorkee, Roorkee - Haridwar Highway, Roorkee, Uttarakhand 247667

3. Dr. Pooja Anjali Mazumdar (IIT Kgp),

Independent Researcher, Vasant Kunj, New Delhi 110070

Course title: Statistics for Life Science-1

Course code: BBP ---	**No. of credits: 2**	**L-T-P:** 30-0-00	**Learning hours:** 30

Pre-requisite course code and title (if any): None

Department: Department of Biotechnology

Course coordinator:	**Course instructor:**
Contact details:	
Course type: Major	**Course offered in:** Semester 3

Course description: This course introduces fundamental concepts of biostatistics, including descriptive statistics, probability distributions, random variables, and mathematical expectation. It covers statistical methods such as correlation, regression analysis, and hypothesis testing using the t-test, chi-square test, and F-test. Students will also gain practical exposure to modern statistical software, such as MS Excel and SPSS, for data analysis and biostatistical applications.

Course objectives:

To train students in using computational and mathematical tools to solve biological problems. After completing this course, students will be able to understand descriptive and inferential statistical tests for interpreting experimental data.

Course contents

Module	Topic	L	T	P
1	Descriptive Statistics & Probability: Measures of central tendency and dispersion, Axiomatic concepts of probability; Introduction to Binomial, Poisson, and Normal distribution.	6	2	0
2	Random variables and expectation: Random variable and distribution function. Mathematical expectation. Statistical parameters. Chebyshev's inequality.	4	3	0
3	Correlation, and regression: Correlation - types and methods of correlation, Regression- simple regression equation, Method of least squares and curve fitting, similarities and dissimilarities of correlation and regression. (Illustrated with appropriate case studies).	4	3	0
4	Statistical inference and hypothesis testing. Selection of appropriate probability distribution for different contexts. Student's t-test - chi-square test, F-test. Uses of advanced software:- MS Excel and SPSS, in modern biostatistics. (Illustrated with appropriate case studies).	5	3	0
	Total	19	11	0

Evaluation criteria:

Minor exam: 30%
Major exam:50%
PPT/Assigenment:20%

Learning outcomes:

1. Describe the fundamental concepts of Biostatistics as they apply to biotechnology research
2. Capacity to compare and evaluate various approaches in solving a given experimental problem.

Pedagogical Approach:

1. Interactive lectures
2. Biological analogies
3. Case studies and examples from research articles

Skill Set:

1. Hypothesis formulation and testing in Biostatistics.
2. Ability to analyze primary and secondary experimental data.

Employability:

1. School assistant teacher
2. Laboratory assistant
3. Junior researcher
4. Statistician in the private and government sectors

Suggested Readings

1. Principles of Biostatistics by Pagano, M. and Gaureau, K. 7th ed., Publisher: Thomson Learning, (2007).
2. Statistical Method for Engineering and Sciences by Taneja, H.C. Publisher: IK International, (2009).
3. Introduction to Biostatistics, L Forthofer (1995), Academic Press, New York.
4. Probability and Statistics for Engineers and Scientists by Ross, S.M. 3rd ed. Publisher: Academic Press, (2005).
5. Experimental Design & Data Analysis for Biologists. PQ Gerry & JK Michael (2002), Cambridge University Press.

Additional information (if any): This course was designed by Dr. Yogendra Kumar Gautam

Student responsibilities:

1. Class attendance.
2. Study/self-study of course materials as specified by the instructor.

Course reviewers:

1. Dr. Jai Gopal Sharma, Professor, Department of Biotechnology, Delhi Technical University, New Delhi
2. Dr. Gaurav Kumar, Associate Professor, Delhi University, New Delhi

Course title: Biotechnology Laboratory 3

Course code: UBT ---	**No. of credits:** 3	**L-T-P:** 0-0-90	**Learning hours:** 90

Pre-requisite course code and title (if any): None

Department: Department of Biotechnology

Course coordinator:	**Course instructor:**

Contact details:

Course type: Major	**Course offered in:** Semester 3

Course description: The objective of this UG level laboratory course is to introduce students to basic experiments related to biochemistry and bioinformatics. This is a basic level laboratory course which intends to introduce the students to basic laboratory activities required for biotechnology research. The experiments will be related to the theory courses which have already been taught during the first two semesters. The list of experiments is representative and not exhaustive.

Course objectives:

1. To provide a basic level training of analytical biochemistry used in biotechnology research
2. Basic understanding of bioinformatics tools

Course contents

Module	Topic	L	T	P
1	**Essential biochemical methods** • Familiarisation with lab equipment such as thermal cycler, spectrophotometer and ELISA plate reader • Preparation of simple and complex solutions (Molar, % w/v and % v/v) • Protein isolation and estimation from bacterial cells • Estimation of titratable acidity in fruit juice • Estimation and characterisation of ascorbic acid in fruit juice	**0**	**0**	**45**
2	**Genptypic and phenotypic marker analysis** • Pollen viability assay with acetocarmine • PCR screening of male fertile plants using Rf marker	**0**	**0**	**15**
3	**Computational Tools in Biology** • Familiarisation of PDB database and visualisation • Introduction to PyMol • Introduction to BLAST for nucleotide and protein sequences	**0**	**0**	**30**
	Total	**0**	**0**	**90**

Evaluation criteria:

1. Attendance: 5%

2. Preparation of lab record(s) throughout the semester: 25%
3. End semester evaluation: 70% (Following components would be included)
    1. Spotting: 15 %
    2. Viva-voce: 15 %
    3. Experiment(s) assigned on the day of the exam: 40%

Learning outcomes:

1. Ability to conduct experiments with adequate safety precautions.
2. Capacity to compare and evaluate various approaches in solving a given experimental problem.

Pedagogical Approach:

1. Laboratory experiments, demonstration, writing and experiments result analysis.
2. Visit to laboratories and research institutions

Skill Set:

1. Able to work in biotechnology lab and perform experiments
2. Able to analyses experimental data and critical thinking.

Employability:

1. Academic and industrial research
2. Industries based on biotechnology, pharmacy, and agriculture

Materials:

Suggested Readings

1. Campbell Biology: Australian and New Zealand edition, Reece J.B. and others, Pearson 12th ed. 2021
2. National Academy of Sciences. 1999. Science and Creationism: A View from the National Academy of Sciences, Second Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/6024.

Additional information (if any):

Student responsibilities:

1. Class attendance.
2. Conducting experiments as instructed during the class
3. Self-study

Reviewers

1. Prof. Bijoy Neog, Department of Life Sciences, Dibrugarh University, Dibrugarh, Assam
2. Dr. Santan Barthwal, Scientist-G & Head, Genetics & Tree Improvement Division, Forest Research Institute, Dehradun

Annexure 3

<table>
<tr><td colspan="5">Course title: TERI SAS-DIVACC Upskilling Course in Biotechnology – I</td></tr>
<tr><td colspan="2">Course code:XXX</td><td>No. of credits: 4</td><td>L-T-P: (0-0-120)</td><td>Learning hours: 120</td></tr>
<tr><td colspan="5">Pre-requisites:
For those registered in FYUP/FYIPP Biotechnology programs who opt to exit after Year 1: Successful completion of all first-year courses, with a CGPA of 4 or higher.
For those registered in other programs OR those in the FYUP/FYIPP Biotechnology programs not opting for an exit: None, provided this course is opted for under the category of 'open elective'.</td></tr>
<tr><td colspan="5">Department: Department of Biotechnology</td></tr>
<tr><td colspan="2">Course coordinator:</td><td colspan="3">Course instructor:</td></tr>
<tr><td colspan="5">Contact details:</td></tr>
<tr><td colspan="3">Course type: Vocational course</td><td colspan="2">Course offered in: Summer term</td></tr>
<tr><td colspan="5">Course description:
The objective of this laboratory course is to systematically enhance the laboratory skills of students of the FYUP and FYIPP programs in Biotechnology who opt for the exit option by earning a certificate at the end of Year 1. The course is designed to impart competency in PCR-based cloning, enzyme-linked immunosorbent assays (ELISA) and preparation of scientific reports within an industry setting i.e., DIVACC Research Laboratories Pvt Ltd. Students who opt for an exit after Year 1 should receive a grade of B ('good') or better to receive a certificate in biotechnology.</td></tr>
<tr><td colspan="5">Course objectives:
1. To impart hands-on skills in PCR cloning and ELISA.
2. To provide training in technical report writing, data analysis, and interpretation.</td></tr>
<tr><td colspan="5">Course contents</td></tr>
<tr><td>Module</td><td colspan="2">Topic</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="6">Training modules</td></tr>
<tr><td>1</td><td colspan="2">Gene Amplification and Recombinant Cloning via PCR
1. Amplification of specific gene(s) of interest by the polymerase chain reaction (PCR) and optimization for yield.
2. Purification of PCR amplicons followed by their cloning in specified vectors.
3. PCR-based screening of colonies for the presence of desired insert.
4. Establishment of stock cultures of host bacteria harbouring the insert followed by verification of the presence of insert by restriction digestion.
5. Sanger sequencing to verify the sequence of insert.</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>2</td><td colspan="2">Diagnostic method – Enzyme-linked</td><td>0</td><td>0</td><td>60</td></tr>
</table>

	immunosorbent assay (ELISA)* 1. Understanding the operation of the ELISA plate reader. 2. Preparation of samples for ELISA with appropriate controls. 3. Analysis of test/unknown samples using ELISA. 4. Measurement of the sensitivity and specificity of ELISA for a given analyte. * A suitable diagnostic kit in clinical use will be used for this module e.g. the Hepatitis B antigen detection kit.			

Evaluation criteria:

1. Attendance and punctuality – 10%
2. Regularity in data presentation at lab meetings – 20%
3. Final technical report of experiments and outcomes – 30%
4. Viva-voce – 40 %

As this is an upskilling course for individual students who opt to exit with a certificate after year 1 of the FYUP/FYIPP Biotechnology program, letter grades will be awarded on an absolute scale as follows:

Total marks out of 100%	**Letter grades**
≥ 90	A+
≥ 80 & < 90	A
≥ 70 & < 80	B+
≥ 60 & < 70	B

Students receiving a grade below B ('good') will not be eligible for the certificate. Such students will have to repeat the course until they obtain a 'B' grade if they wish to receive a certificate.

Learning outcomes:

1. Ability to independently perform PCR cloning and ELISA.
2. Ability to conduct experiments with adequate safety precautions.
3. Writing scientific reports.

Pedagogical Approach: Performance of specified laboratory experiments by the students under supervision.

Skill Set:

1. PCR cloning.
2. ELISA assays.

Employability:

1. Technician in academic and industrial labs.
2. Demonstrator in academic labs.
3. Assistant teacher in schools.

Materials-

1. Green, M.R. and Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor Laboratory Press.

2. Ausubel, F. M. (2003). Current Protocols in Molecular Biology Core. John Wiley & Sons Canada, Limited.

Websites

None

Journals

None

Advanced Reading Material

None.

Additional information (if any)

1. This course was jointly designed by Dr. Ramakrishnan Sitaraman and Prof. Rakesh Bhatnagar, Distinguished Professor, TERI SAS.
2. A bench fee to cover laboratory expenses is applicable and will be periodically determined by TERI SAS and DIVACC.
3. DIVACC Research Laboratories Pvt Ltd. reserves the right to determine the number of students who can be trained based on available facilities and supervisory effort required.

Student responsibilities

1. Attendance and punctuality.
2. Study of technical background materials as specified by the instructor.
3. Performance of prescribed experiments.
4. Regular documentation of results.
5. Fulfilment of evaluation criteria.

Course reviewers:

1. Dr. Nidhi Adlakha, Associate Professor, Regional Centre for Biotechnology, NCR-Biotech Cluster, Faridabad, Haryana - 121001
2. Prof. Veena Pande, Department of Biotechnology, Kumaun University, Sir J.C. Bose Technical Campus, Bhimtal, Nainital (Uttarakhand) - 263136

Course title: TERI SAS-DIVACC Upskilling Course in Biotechnology – II			
Course code:XXX	**No. of credits:** 4	**L-T-P:** (0-0-120)	**Learning hours:** 120

Pre-requisites:
For those registered in FYUP/FYIPP Biotechnology programs who opt to exit after Year 2: Successful completion of all second-year courses, with a CGPA of 4 or higher.
For those registered in other programs OR those in the FYUP/FYIPP Biotechnology programs not opting for an exit: None, provided this course is opted for under the category of 'open elective'.

Department: Department of Biotechnology

Course coordinator:	**Course instructor:**

Contact details:

Course type: Vocational course	**Course offered in:** Summer term

Course description:
The objective of this laboratory course is to systematically enhance the laboratory skills of students of the FYUP and FYIPP programs in Biotechnology who opt for the exit option by earning a diploma at the end of Year 2. The course is designed impart competency in protein expression and purification, real-time PCR (RT-PCR) and preparation of scientific reports within an industry setting i.e., DIVACC Research Laboratories Pvt Ltd. Students who opt for an exit after Year 2 should receive a grade of B ('good') or better to receive a diploma in biotechnology.

Course objectives:
1. To impart hands-on skills in protein expression, purification and diagnostic real-time PCR.
2. To provide training in technical report writing, data analysis and interpretation.

Course contents

Module	Topic	L	T	P
Training modules				
1	**Protein expression and purification** 1. Expression of protein in bacterial expression systems. 2. Affinity purification of the protein(s) of interest. 3. Protein purification to homogeneity from complex mixtures by serial fractionation/chromatography. 4. Evaluation and Graphical Representation of Product Purity	0	0	60
2	**Diagnostic method – RT-PCR** 1. Understanding the operation of a real-time PCR cycler. 2. Preparation of sample and isolation of nucleic acids. 3. Evaluation of template quality using appropriate controls.	0	0	60

	4. Analysis of test/unknown samples using RT-PCR 5. Measurement of the sensitivity and specificity of real-time RT-PCR for a given target sequence.			

Evaluation criteria:

1. Attendance and punctuality – 10%
2. Regularity in data presentation at lab meetings – 20%
3. Final technical report of experiments and outcomes – 30%
4. Viva-voce – 40 %

As this is an upskilling course for individual students who opt to exit with a certificate after year 1 of the FYUP/FYIPP Biotechnology program, letter grades will be awarded on an absolute scale as follows:

Total marks out of 100%	Letter grades
≥ 90	A+
≥ 80 & < 90	A
≥ 70 & < 80	B+
≥ 60 & < 70	B

Students receiving a grade below B ('good') will not be eligible for the certificate. Such students will have to repeat the course until they obtain a 'B' grade if they wish to receive a certificate.

Learning outcomes:

1. Ability to independently perform protein expression, purification and real-time diagnostic RT-PCR.
2. Ability to conduct experiments with adequate safety precautions.
3. Writing scientific reports.

Pedagogical Approach: Performance of specified laboratory experiments by the students under supervision.

Skill Set:

1. Protein expression and purification.
2. Diagnostic RT-PCR testing.

Employability:

1. Technician in academic and industrial labs.
2. Demonstrator in academic labs.
3. Teaching assistant in schools.
4. Junior researcher.

Materials-

1. Green, M.R. and Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor Laboratory Press.
2. Ausubel, F. M. (2003). Current Protocols in Molecular Biology Core. John Wiley &

Sons Canada, Limited

Websites

None

Journals

None

Advanced Reading Material

None.

Additional information (if any)

1. This course was jointly designed by Dr. Ramakrishnan Sitaraman and Prof. Rakesh Bhatnagar, Distinguished Professor, TERI SAS.
2. A bench fee to cover laboratory expenses is applicable and will be periodically determined by TERI SAS and DIVACC.
3. DIVACC Research Laboratories Pvt Ltd. reserves the right to determine the number of students who can be trained based on available facilities and supervisory effort required.

Student responsibilities

1. Attendance and punctuality.
2. Study of technical background materials as specified by the instructor.
3. Performance of prescribed experiments.
4. Regular documentation of results.
5. Fulfilment of evaluation criteria.

Course reviewers:

1. Dr. Nidhi Adlakha, Associate Professor, Regional Centre for Biotechnology, NCR-Biotech Cluster, Faridabad, Haryana - 121001
2. Prof. Veena Pande, Department of Biotechnology, Kumaun University, Sir J.C. Bose Technical Campus, Bhimtal, Nainital (Uttarakhand) - 263136

Course title: TERI SAS-EYM Life Sciences Upskilling Course in Biotechnology – Applied Artificial Intelligence and Machine Learning in Biotechnology			
Course code:XXX	**No. of credits:** 4	**L-T-P:** (0-0-120)	**Learning hours:** 120
Pre-requisites: **For those registered in FYUP/FYIPP Biotechnology programs who opt to exit after Year 1:** Successful completion of all first-year courses, with a CGPA of 4 or higher. **For those registered in other programs OR those in the FYUP/FYIPP Biotechnology programs not opting for an exit**: None, provided this course is opted for under the category of 'open elective'.			
Department: Department of Biotechnology			
Course coordinator:	**Course instructor:**		
Contact details:			
Course type: Vocational course		**Course offered in:** Summer term	

Course description:

This course introduces Artificial Intelligence (AI) and Machine Learning (ML) applications in biotechnology, integrating theoretical understanding with hands-on exercises. Students explore AI/ML fundamentals, including supervised and unsupervised learning, classification, regression, clustering, and workflow evaluation.

Module 1 introduces AI applications in biotechnology, including disease prediction, drug discovery, diagnostics, genomics, and protein structure prediction. It also emphasizes biological data literacy, covering dataset structure, variable types, data cleaning, normalization, outlier detection, and basic statistical analysis. Students gain hands-on experience using Excel, GUI-based ML tools such as Orange and WEKA, and guided Python notebooks to apply these concepts to real datasets, bridging theory with practical skills.

Module applies ML to genomic and microbiome datasets, including NGS data preprocessing, variant classification, gene expression modeling, and microbiome diversity analysis. Frontier topics like multi-omics integration and introductory deep learning are included conceptually. Students complete mini-projects and a capstone project, gaining portfolio-ready skills for bioinformatics, research internships, and industry roles in genomics, diagnostics, and biotechnology analytics.

Course objectives:

1. Understand AI & ML principles and workflows in biotechnology.
2. Apply ML techniques for disease prediction, drug discovery, and diagnostics.
3. Develop biological data literacy, including cleaning, normalization, and statistical analysis.
4. Build, evaluate, and interpret ML models using GUI and Python tools.
5. Analyze genomic and microbiome datasets using ML workflows.
6. Explore frontier applications such as multi-omics integration and deep learning.
7. Complete mini-projects and capstone projects with professional reporting.
8. Apply ethical reasoning in AI and biotechnology applications.

Course contents

Module	**Topic**	**L**	**T**	**P**
Training modules				

1	**MODULE 1: Foundations of AI & Biological Data Analytics** **Unit 1: Basics of AI & ML** • Introduction to Artificial Intelligence • AI vs Automation • Machine Learning concepts • Features, labels, training/testing • Supervised & Unsupervised learning • Classification, Regression, Clustering **Unit 2: AI Applications in Biotechnology** • Disease prediction • Drug discovery • AI in diagnostics, imaging, and healthcare interfaces (CT scan, digital pathology, POCUS) • Genomics & biomarker discovery • Protein structure prediction (AlphaFold – concept) • Ethics & limitations in healthcare AI • Illustrative industry examples and platforms **Unit 3: Biological Data Literacy** • Dataset structure • Variables & data types • Missing data handling • Outlier detection • Normalization • Basic statistics **Unit 4: ML Tools** • Orange/WEKA interface • Workflow creation • Classification model building • Confusion matrix & accuracy • Decision trees & clustering	0	0	60 12 14 14 20
2	**MODULE 2: Applied AI in Genomics & Microbiome** **Unit 5: NGS & Genomic Data** • Overview of WGS, RNA-Seq, 16S • FASTQ & VCF • Quality control concepts • Feature extraction **Unit 6: ML in Genomic Analysis** • Variant classification	0	0	60 14 14

	• Gene expression modeling • Biomarker prediction • Model evaluation **Unit 7: Microbiome Data Analysis** • 16S sequencing • Abundance tables • Alpha & beta diversity • Microbiome-health association **Unit 8: Frontier Applications** • Microbiome classification • Multi-omics integration (concept) • Introduction to deep learning • Project & presentation			14 18

Evaluation criteria:

Lab Exercises (4 x 10 marks each) - 40 %
Mini-Projects (2 x 15 marks each) - 30 %
Capstone Project - 20 %
Presentation - 10 %

As this is an upskilling course for individual students who opt to exit with a certificate after year 1 of the FYUP/FYIPP Biotechnology program, letter grades will be awarded on an absolute scale as follows:

Total marks out of 100%	**Letter grades**
≥ 90	A+
≥ 80 & < 90	A
> 70 & < 80	B+
≥ 60 & < 70	B

Students receiving a grade below B ('good') will not be eligible for the certificate. Such students will have to repeat the course until they obtain a 'B' grade if they wish to receive a certificate.

Learning outcomes:

- Understand and explain AI and ML concepts in biotechnology. (Lab Exercises / Assignments)
- Distinguish between supervised and unsupervised learning approaches. (Lab Exercises / Assignments)
- Preprocess and clean biological datasets effectively. (Lab Exercises / Assignments)
- Apply basic statistics for data analysis and interpretation. (Lab Exercises / Assignments)
- Develop and evaluate ML models using GUI-based tools. (Mini-Projects)
- Perform data analysis, visualization, and ML tasks using Python. (Mini-Projects)

- Analyze genomic datasets for variant classification and gene expression modeling. (Mini-Projects)
- Conduct microbiome data analysis, including diversity metrics and clustering. (Mini-Projects)
- Explore frontier applications, including multi-omics integration and introductory deep learning. (Capstone Project and presentation)
- Execute mini-projects and capstone projects with professional reporting and ethical considerations. (Capstone Project and Presentation)

Pedagogical Approach:

- Interactive lectures with real-life case discussions
- Hands-on labs using Orange, WEKA, Galaxy, QIIME2, Excel, and guided Python notebooks
- Mini-projects and capstone project for practical application
- Group discussions and data interpretation exercises

Skill Set:

- Build and evaluate ML models for biological data
- Preprocess genomic and microbiome datasets
- Apply Python and Excel for data analysis and visualization
- Interpret ML results and communicate findings effectively

Employability:

Bioinformatics Analyst

- Data Analyst – Life Sciences
- Computational Biologist (entry-level)
- Diagnostics and Healthcare Analytics (entry-level)
- Research Assistant
- Biotechnology and Biopharmaceutical Companies
- Genomics and Molecular Diagnostics Labs
- Microbiome and Metagenomics Research Labs
- Healthcare Analytics and AI-assisted Diagnostics
- Bioinformatics and Life Sciences Startups
- Research Institutes and Academic Labs
- Contract Research Organizations (CROs)
- Multi-omics and Data Analytics Platforms

Materials-

- "AI in Biology: A Beginner's Guide" by K.N. Jha (2023) - Specifically tailored for life scientists to understand AI logic.- Jha, K.N. (2023). AI in Biology: A Beginner's Guide for Life Scientists.
- Géron, A. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow,

2nd Edition. O'Reilly, 2019.

- Brownlee, J. Machine Learning Mastery with Python, 2020
- Orange Data Mining Documentation
- Galaxy Platform Tutorials
- QIIME2 Documentation
- NCBI Genomic Resources
- Relevant research articles and reviews.
- Case studies.

Industry case materials and technical resources

- GRAIL – Multi-cancer early detection and AI-enabled diagnostics
- GE HealthCare – AI-assisted imaging and clinical workflow tools
- Butterfly Network – Portable ultrasound and AI-supported imaging
- Illumina – Genomics and sequencing analytics workflows
- Tempus AI – Precision medicine and clinical AI applications
- PathAI – Digital pathology and AI-assisted pathology analysis

Advanced Reading Material

- Jumper, J., et al. "Highly accurate protein structure prediction with AlphaFold." Nature, 2021.
- Min, S., Lee, B., & Yoon, S. "Deep learning in bioinformatics." Briefings in Bioinformatics, 2017.
- Knight, R., et al. "Best practices for analyzing microbiomes." Nature Reviews Microbiology, 2018.
- Libbrecht, M., & Noble, W. "Machine learning applications in genetics and genomics." Nature Reviews Genetics, 2015.
- Litjens, G., et al. "A Survey on Deep Learning in Medical Image Analysis." Medical Image Analysis, 2017.
- Bera, K., et al. "Artificial Intelligence in Digital Pathology — New Tools for Diagnosis and Precision Oncology." Nature Reviews Clinical Oncology, 2019.
- Coravos, A., et al. "Digital Medicine: A Primer on Measurement." npj Digital Medicine, 2019.

Additional information (if any)

This course was jointly designed by Dr Ankit Kumar (EYM Life Sciences) and Dr Priya Bhatnagar (EYM Life Sciences) at the request of Dr. Ramakrishnan Sitaraman. Dr. Mahesh S. Dhar (Director, Haryaksh Scientific Pvt. Ltd.) provided invaluable inputs that ensured the program's alignment with industry standards of student employability.

Student responsibilities

- Attend lectures and labs regularly
- Complete weekly exercises, mini-projects, and reports
- Maintain lab notebooks and submit assignments on time
- Participate in capstone project and presentation
- Follow guidelines for ethical AI/ML usage.

Course reviewers:

1. Dr. Pawan K Dhar, Executive Director, CVJ Centre for Synthetic Biology and Biomanufacturing, CUSAT Technology Business Incubator, 3rd Floor, CUSAT-Students Amenity Centre, Cochin University of Science and Technology, Kalamassery, Kochi 682 022 (Formerly Professor, School of Biotechnology, Jawaharlal Nehru University, New Delhi)

2. Dr. Anwar Alam, Associate Professor , Life Science, Sharda University, Plot no 32, 34, Knowledge Park III, Greater Noida, Uttar Pradesh 201310

3. Dr. Abhinav Kaushik, Research Scientist, Harvard T.H. Chan School of Public Health, Nadeau Lab; FXB, 1st Floor, 651 Huntington Ave., Boston, MA 02115, USA

4. Dr. Jatin Shrinet, Research Engineer, Institut Curie, 26 rue d'Ulm, 75248 Paris cedex 05, France.

Course title: TERI SAS - EYM Life Sciences Upskilling Course in Biotechnology – Industrial Biotechnology Quality Systems, Biosafety and Regulatory Compliance			
Course code:XXX	**No. of credits:** 4	**L-T-P:** (0-0-120)	**Learning hours:** 120
Pre-requisites: **For those registered in FYUP/FYIPP Biotechnology programs who opt to exit after Year 1:** Successful completion of all first-year courses, with a CGPA of 4 or higher.			

For those registered in other programs OR those in the FYUP/FYIPP Biotechnology programs not opting for an exit: None, provided this course is opted for under the category of 'open elective'.	
Department: Department of Biotechnology	
Course coordinator:	**Course instructor:**
Contact details:	
Course type: Vocational course	**Course offered in:** Summer term

Course description:

This laboratory-focused course is designed to upskill Year 1 Biotechnology students who opt for an exit certificate under the FYUP/FYIPP programs. It provides hands-on training in Quality Assurance (QA), Quality Control (QC), and regulatory compliance aligned with pharmaceutical and biotech industry standards. Students gain practical experience in SOP preparation, deviation reporting, CAPA documentation, risk assessment, internal audits, and QC testing of raw materials, in-process, and finished products. Emphasis is also placed on regulatory guidelines (WHO-GMP, FDA, CDSCO) and professional documentation and reporting practices. The course culminates in a capstone project simulating a complete QA/QC workflow for a mock production batch, equipping students with industry-ready competencies and employable skills in biotechnology, diagnostics, and pharmaceutical settings.

Course objectives:

1. Develop practical skills in Quality Assurance (QA), Quality Control (QC), and regulatory compliance for biotechnology research and industry.
2. Enable students to prepare, maintain, and audit SOPs, batch records, and regulatory documentation according to GMP and GLP standards.
3. Train students in hands-on QC testing, risk assessment, and biosafety practices for raw materials, in-process, and finished products.
4. Equip students with industry-ready competencies for entry-level roles in QA/QC, regulatory affairs, and production compliance.

Course contents

Module	Topic	L	T	P
1.	**Quality Systems, GLP and Laboratory Compliance** **Concepts** • Introduction to Quality Management Systems (QMS) • Difference between Quality Assurance (QA) and Quality Control (QC) • Principles of Good Laboratory Practices (GLP), Good Documentation Practices (GDP), Good Clinical Practices (GCP) and Good Manufacturing Practices (GMP). • Laboratory record keeping and data integrity (ALCOA+ , 21 CFR Part 11) • Documentation hierarchy in pharmaceutical industries **Exercises** • Laboratory documentation exercises • Preparation of standard laboratory records • GLP compliance checklist preparation • Laboratory inspection simulation • Case studies on laboratory errors and compliance failures	0	0	24 10 14
2.	**Biosafety, Bioethics and Laboratory Risk**	0	0	20

	Management **Concepts** • Principles of biosafety in biotechnology laboratories • Biosafety levels (BSL-1 to BSL-4) • Biological hazard identification • Waste management and decontamination • Ethical principles in biotechnology research • Bioethics and responsible scientific conduct • Regulatory guidelines for biological research **Exercises** • Biosafety risk assessment exercises • Preparation of laboratory safety SOPs • Personal protective equipment (PPE) demonstration • Biohazard labeling and waste segregation • Industrial case studies			8 12
3.	**Pharmaceutical QA Systems and Regulatory Compliance** **Concepts**	0	0	26 10

	• Overview of pharmaceutical Quality Assurance systems • Guidelines by DBT and ICMR • FDA regulatory framework • CDSCO and Schedule M regulations in India • WHO-GMP guidelines • Role of QA in manufacturing and documentation control • Quality by Design • Regulatory inspections and compliance requirements **Exercises** • SOP preparation workshop • Deviation reporting exercises • CAPA documentation training • Risk assessment tools (Fishbone diagram, 5-Why analysis) • Internal audit checklist preparation • Mock regulatory inspection simulation			
4.	**Industrial Quality Control and Analytical Practices** **Concepts** • Structure and functions of Quality Control laboratories • Raw material quality testing • In-process quality checks	0	0	30 12

	• Finished product quality evaluation • Microbiological quality control concepts and basics of analytical techniques. • Instrument calibration and validation • Stability study principles **Exercises** • Raw material inspection exercises • In-process QC simulations • Basic microbiological testing (plating and colony counting) • Instrument calibration documentation exercises • QC data recording and interpretation • Stability study planning and data analysis			18
5.	**Regulatory Documentation, Internal Audit and Capstone Project** **Concepts** • Regulatory dossier overview • Common Technical Document (CTD) structure • Regulatory submission basics • Internal audit procedures • Quality reporting systems • Application procedures for regulatory	0	0	20 6

	compliance certifications • Industry Case studies **Exercises** • Mock regulatory dossier preparation • Batch Manufacturing Record (BMR) review • Documentation compliance exercise • Internal audit role-play simulation **Capstone Project** Students simulate quality review of a mock pharmaceutical production batch, including: • Batch record review • QC result interpretation • Deviation documentation • CAPA preparation • Final QA/QC report Students present their Quality Evaluation Report.			14

Evaluation criteria:

- Attendance : 10%
- Practical Exercises : 25%
- Documentation & SOP Writing : 20%
- Biosafety & Compliance Assignment : 10%
- Capstone QA/QC Project : 25%
- Viva Voce : 10%

As this is an upskilling course for individual students who opt to exit with a certificate after year 1 of the FYUP/FYIPP Biotechnology program, letter grades will be awarded on an absolute scale as follows:

Total marks out of 100%	Letter grades
≥ 90	A+
≥ 80 & < 90	A
≥ 70 & < 80	B+
≥ 60 & < 70	B

Students receiving a grade below B ('good') will not be eligible for the certificate. Such students will have to repeat the course until they obtain a 'B' grade if they wish to receive a certificate.

Learning outcomes:

- Skill-based, hands-on learning with real industry simulations. (Practical Exercises, Biosafety & Compliance Assignment)
- Immediate employability in QA/QC roles. (Capstone QA/QC Project)
- Integration of regulatory knowledge with laboratory practice. (Practical Exercises, Biosafety & Compliance Assignment)
- Professional report and documentation skills. (Documentation & SOP Writing :)

Pedagogical Approach:

- Experiential Learning: Students perform all QA/QC tasks through guided laboratory simulations.
- Simulation-Based Training: Internal audit, deviation reporting, and batch record exercises replicate real industry scenarios.
- Project-Based Learning: Capstone project integrates all QA/QC modules into a comprehensive mock production workflow.
- Collaborative Learning: Students work in teams to foster communication and teamwork.
- Reflective Practice: Students maintain lab notebooks, document observations, and

review performance with instructors.

Skill Set:

- Foundational Skills: QA/QC principles, regulatory standards
- Practical Skills: SOP drafting, QC testing, audit simulation
- Analytical Skills: Risk assessment, deviation analysis
- Communication Skills: Documentation, reporting, presentation

Employability:

Target Roles:

- QA Executive / Trainee
- QC Analyst / Trainee
- Documentation Officer
- Regulatory Affairs Assistant
- Production Compliance Officer
- Clinical Research Compliance Assistant

Industries:

- Pharma manufacturing companies
- Biologics & vaccine companies
- CROs and Clinical Research Organizations
- Nutraceutical / Food biotech companies
- Research & diagnostic labs

Materials-

- WHO, Good Manufacturing Practices for Pharmaceutical Products, 2020 Edition
- Good Laboratory Practices: QA/QC Manual, CRC Press
- ICH Guidelines: Q7 (GMP for APIs), Q9 (Quality Risk Management), Q10 (Pharmaceutical Quality System)
- FDA Guidelines for Biotechnology and Pharmaceutical Industries
- CDSCO Guidelines for Biotech and Pharma Products
- Organisation for Economic Co-operation and Development – OECD Principles of

Good Laboratory Practice • Sample SOPs, batch manufacturing records, and regulatory templates (provided in lab)
Advanced Reading Material • Quality Management in the Pharmaceutical Industry, by Graham Bunn • Case Studies and other regulatory guidelines.
Additional information (if any) This course was jointly developed by Dr. Ankit Kumar and Dr. Priya Bhatnagar (both of EYM Life Sciences) at the request of Dr. Ramakrishnan Sitaraman. Dr. Mahesh S. Dhar (Director, Haryaksh Scientific Pvt. Ltd.) provided invaluable inputs that greatly strengthened the program's alignment with industry standards and student employability.
Student responsibilities • Attend all laboratory sessions punctually and actively participate. • Prepare for each session by reviewing technical background materials. • Perform prescribed experiments and exercises accurately. • Maintain detailed documentation of experiments, observations, and results. • Complete assignments, mini-projects, and capstone project according to evaluation criteria. • Demonstrate professional communication in lab reports and presentations. • Follow safety, biosafety, and ethical guidelines in all laboratory activities.

Course Reviewers:

1. Dr Pawan K Dhar, Executive Director, CVJ Centre for Synthetic Biology and Biomanufacturing, CUSAT Technology Business Incubator, 3rd Floor, CUSAT-Students Amenity Centre, Cochin University of Science and Technology, Kalamassery, Kochi 682 022. (Former Professor, School of Biotechnology, JNU, Delhi).

2. Dr Nitin Yadav, Associate Professor, Department of Pharmaceutics, GITAM School of Pharmacy, Gandhi Nagar, Rushikonda, Visakhapatnam – 530045

3. Dr Sunil K Dubey, **Associate Research Scientist**, Center for Infection and Immunity, Columbia University, Mailman School of Public Health, 722 West 168th Street, New York, NY 10032, USA.

4. Dr Sutapa Sarkar, **Senior Clinical Research Scientist**, Abbott Rapid Diagnostics, San Francisco Bay Area, California, USA

Annexure 4

Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) July 2024 Semester
Score Card

Roll Number:	DL01000R27	Application No.	2415130015776	
Candidate's Name:	[redacted]	Date of Birth:	[redacted]	
Mother's Name:	[redacted]	Father's Name:	[redacted]	
Gender:	[redacted]	Nationality:	INDIAN	
Person With Disability (PwD):	NO	Category:	GENERAL	

SCORE DETAILS

Course Code	nou24_ig64			
Course Name	BSKLA 131 Sanskrit Bhashaa Aur Sahitya			
Date of Exam	14.12.2024			
Shift of Exam	03:00 P.M. - 06:00 P.M.			
Maximum Marks	100			
Marks obtained	064			
Marks Obtained in words	Sixty Four Only			

Date of Declaration of Result (CBT COURSES): 17-01-2025

Sd/-
Senior Director (NTA)

Note:

1. Candidate particulars have been indicated as mentioned by her/him in the online application form, which is subject to verification by the admitting authorities.
2. Candidate, if found submitting incorrect information or tampering with the Score Card, will be considered as using unfair means and their candidature will be cancelled.
3. Candidates must preserve the Score Card for future use.
4. Final scores & certificates will be given by respective National Coordinators.

Elite

NPTEL ONLINE CERTIFICATION

(Funded by the MoE, Govt. of India)

Skill India
कौशल भारत-कुशल भारत

This certificate is awarded to

[redacted]

for successfully completing the course

Basics of language Science

with a consolidated score of **77** %

Online Assignments	23.13/25	Proctored Exam	54/75

Total number of candidates certified in this course: **152**

Prof. Andrew Thangaraj
Chair
Centre for Outreach and Digital Education, IITM

Jan-Apr 2025
(12 week course)

Prof. Vignesh Muthuvijayan
NPTEL Coordinator
IIT Madras

Indian Institute of Technology Madras

swayam

Roll No: NPTEL25HS04S1053901466 To verify the certificate No. of credits recommended: 3 or 4

Outlook

Agenda_PhD related matters_Department meeting_DoPMS_July 31

From Shantanu De Roy <hod.dpms@terisas.ac.in>
Date Tue 6/30/2026 11:16 PM
To Raj <raj@terisas.ac.in>; Mayank Mohanty <mayank.mohanty@terisas.ac.in>; Yogender Kumar <yogender.kumar@terisas.ac.in>

Dear All,

I am requesting you to identify the possible agenda points for discussions for the upcoming Department meeting that is scheduled on **July 31, 2026.**

You may use the agenda points of the past DRCs as a reference.

There are certain points that are immediately coming to my mind. These are the following:

(a) Special cases, if any
(b) Matters pertaining to extensions, if any.
(c) Thesis submitted and oral defence held.
(d) Issues pertaining to Department changes, if any
(e) Approvals related changes in the composition of the SRC [previous email communications

Please add the aforementioned agenda points that can be taken up for discussions.

The relevant period is the current semester [January 19-July 10, 2026].

It will be extremely useful if the relevant agenda points pertaining to the Doctoral Programme are shared by End of Day, July 2, 2026 [Thursday].

Regards,
Shantanu

Outlook

Approval, Dr. Ashis Nandi: Draft minutes of the BoS meeting held on June 23, 2026

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Tue 6/30/2026 6:57 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Ashis Nandi <aknandijnu@gmail.com>
Sent: 24 June 2026 11:06
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

I approve the minutes.
Regards
Ashis

Ashis Kumar Nandi, Ph.D.
Professor
415, School of Life Sciences
Jawaharlal Nehru University
New Delhi 110067, India
Website: https://sites.google.com/view/plant-immunity-lab/home
E-mail: aknandijnu@gmail.com; ashis_nandi@mail.jnu.ac.in
Phone: +91-11-2670-4152 (office)

On Tue, Jun 23, 2026 at 7:14 PM Ramakrishnan Sitaraman <rkraman@terisas.ac.in> wrote:

Dear all,

Given below is the link to the draft minutes of the BoS meeting held on June 23, 2026.

DBT BoS draft minutes 23-06-26

The suggested revisions have been incorporated as required and highlighted for clarity.

Please provide your approval/comments/suggestions at your earliest convenience.

Thank you.

Sincerely,
Dr. Ramakrishnan Sitaraman
Head, Department of Biotechnology
TERI School of Advanced Studies
10 Institutional Area, Vasant Kunj
New Delhi - 110070, India
Ph: 011-71800222 ext. 4766; 9971005164

Outlook

Approval, Dr. Shailendra Goel: Draft minutes of the BoS meeting held on June 23, 2026

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Tue 6/30/2026 6:57 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Shailendra Goel <shailendragoel@gmail.com>
Sent: 23 June 2026 20:52
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: aknandijnu <aknandijnu@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

I approve

Shailendra Goel
Professor
Department of Botany
University of Delhi
Delhi 110007

On Tue, 23 Jun 2026 at 7:14 PM, Ramakrishnan Sitaraman <rkraman@terisas.ac.in> wrote:

> Dear all,
>
> Given below is the link to the draft minutes of the BoS meeting held on June 23, 2026.
>
> DBT BoS draft minutes 23-06-26
>
> The suggested revisions have been incorporated as required and highlighted for clarity.
>
> Please provide your approval/comments/suggestions at your earliest convenience.
>
> Thank you.
>
> Sincerely,
> Dr. Ramakrishnan Sitaraman
> Head, Department of Biotechnology
> TERI School of Advanced Studies
> 10 Institutional Area, Vasant Kunj
> New Delhi - 110070, India
> Ph: 011-71800222 ext. 4766; 9971005164

Outlook

Approval, Jahnavi Varma: Draft minutes of the BoS meeting held on June 23, 2026

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Tue 6/30/2026 6:58 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Jahnavi Varma <jahnavivarma0109@gmail.com>
Sent: 24 June 2026 14:52
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: aknandijnu <aknandijnu@gmail.com>; shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

Dear Dr. Ramakrishnan,

The minutes of the meeting have been read and are approved.

Sincerely,
Jahnavi Varma
2300182MSB
M. Sc. Biotechnology 2023 -2025

On Tue, 23 Jun 2026, 7:14 pm Ramakrishnan Sitaraman, <rkraman@terisas.ac.in> wrote:

> Dear all,
>
> Given below is the link to the draft minutes of the BoS meeting held on June 23, 2026.
>
> DBT BoS draft minutes 23-06-26
>
> The suggested revisions have been incorporated as required and highlighted for clarity.
>
> Please provide your approval/comments/suggestions at your earliest convenience.
>
> Thank you.
>
> Sincerely,
> Dr. Ramakrishnan Sitaraman
> Head, Department of Biotechnology
> TERI School of Advanced Studies
> 10 Institutional Area, Vasant Kunj
> New Delhi - 110070, India
> Ph: 011-71800222 ext. 4766; 9971005164

Outlook

Approval, Harsh Ghosalkar: Draft minutes of the BoS meeting held on June 23, 2026

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Tue 6/30/2026 6:55 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>
Sent: 24 June 2026 14:54
To: Naman Dosi <naman.dosi@terisas.ac.in>; aknandijnu <aknandijnu@gmail.com>; Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

I have read the changes and I approve
the decisions made.

Thanks and regards
Harsh Ghosalkar
2500323MSB
M.sc Biotechnology 2026

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From: Naman Dosi <naman.dosi@terisas.ac.in>
Sent: Wednesday, 24 June 2026 14:37:51
To: aknandijnu <aknandijnu@gmail.com>; Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

I have read the changes and i approve.

Thanks and Regards
Naman Dosi
2400135MSB

Sent from Outlook for Android

From: Ashis Nandi <aknandijnu@gmail.com>
Sent: Wednesday, 24 June 2026 11:06:38
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Cc: shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

I approve the minutes.
Regards
Ashis

Ashis Kumar Nandi, Ph.D.
Professor
415, School of Life Sciences
Jawaharlal Nehru University
New Delhi 110067, India
Website: https://sites.google.com/view/plant-immunity-lab/home

Outlook

Approval, Aanya Tyagi: Draft minutes of the BoS meeting held on June 23, 2026

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Tue 6/30/2026 6:54 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Aanya Tyagi <aanya.tyagi@terisas.ac.in>
Sent: 24 June 2026 16:28
To: Shashi Bhushan Tripathi <shashi.tripathi@terisas.ac.in>; Aniket Walia <aniket.walia2@terisas.ac.in>; Ramakrishnan Sitaraman <rkraman@terisas.ac.in>; aknandijnu <aknandijnu@gmail.com>; shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

Good evening sir,
I have read the minutes and it's fine by me.

Regards
Aanya Tyagi
2500039BSB

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From: Shashi Bhushan Tripathi <shashi.tripathi@terisas.ac.in>
Sent: Wednesday, 24 June 2026 16:19:58
To: Aniket Walia <aniket.walia2@terisas.ac.in>; Ramakrishnan Sitaraman <rkraman@terisas.ac.in>; aknandijnu <aknandijnu@gmail.com>; shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>
Subject: RE: Draft minutes of the BoS meeting held on June 23, 2026

The minutes are fine from my side.

Sincerely,
Shashi Bhushan Tripathi

****

From: Aniket Walia <aniket.walia2@terisas.ac.in>
Sent: 24 June 2026 15:03
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>; aknandijnu <aknandijnu@gmail.com>; shailendragoel <shailendragoel@gmail.com>; CoreFacultyDBT <CoreFacultyDBT@terisas.ac.in>; Jahnavi Varma <jahnavivarma0109@gmail.com>; Harsh Ghosalkar <harsh.ghosalkar@terisas.ac.in>; Naman Dosi <naman.dosi@terisas.ac.in>; Aanya Tyagi <aanya.tyagi@terisas.ac.in>
Subject: Re: Draft minutes of the BoS meeting held on June 23, 2026

Respected Ramakrishnan Sir,

I have read the suggestions and approved the minutes.

Yours Sincerely
Aniket Walia