teri school of advanced studies

Minutes of Meeting
Department of Biotechnology
TERI School of Advanced Studies

Venue: Conference Hall, TERI SAS **Date:** 8 November 2024
Time: 11.30 a.m. – 3.30 p.m.

List of members who attended the meeting:

Prof. Ramakrishnan Sitaraman (Chairperson)
Prof. Shashi Bhushan Tripathi (Member, Implementation)
Dr. Souren Paul (Member, Implementation)
Dr. Chaithanya Madhurantakam (HoD & Member)
Prof. Anandita Singh (Member)
Prof. Ashish Nandi, School of Life Sciences, Jawaharlal Nehru University (External member)
Prof. Shailendra Goel, Department of Botany, Delhi University (External member)

1. All BoS members approved awarding a post-graduate diploma (PG Diploma) to students opting to exit the ongoing M.Sc. Biotechnology program after one year of study, subject to maintaining the minimum CGPA required to receive a degree (at least 4.00 out of 10.00). This provision will be effective immediately and applicable to the batch of M.Sc. Biotechnology students admitted during the Academic Year 2024-'25 .

2. All BoS members approved transitioning to a two-examination format – one mid-semester examination and one end-semester examination – in biotechnology/life sciences-related theory courses (a) currently offered by the Department of Biotechnology in the existing M.Sc. Biotechnology program and (b) to be offered in the proposed FYUP and FYIPP in Biotechnology (as detailed in item 3 below).

3. All BoS members provided in-principle approval for launching a Four-Year Undergraduate Program (FYUP) and a Five-Year Integrated Post-Graduate Program (FYIPP) in Biotechnology in the Academic Year 2025-'26 through the Department of Biotechnology, TERI SAS. Details are provided in Enclosure 1. All members agreed that the actual course titles, their positioning and credit distribution may be treated as tentative and subject to change based on expertise and facilities available.

4. All BoS members reviewed and approved the list of required investments from TERI SAS & TERI in terms of expertise, infrastructure, equipment, running costs, and

recruitment of regular faculty members for running the proposed FYUP and FYIPP. Full details are provided in Enclosure 2.

.....The meeting concluded at 3:30 PM .....

S. Ramakrishnan
Prof. Ramakrishnan Sitaraman
(Chairperson)

Prof. Shashi Bhushan Tripathi
(Member, Implementation)

Souren Paul
Dr. Souren Paul
(Member, Implementation)

Dr. Chaithanya Madhurantakam
(HoD & Member)
(Approved and in line with the minutes)

Prof. Anandita Singh
(Member)

Prof. Shailendra Goel
(External Member)

Prof. Ashish Nandi
(External Member)

Enclosure 1

Overview and outlines of the proposed Four-Year Undergraduate Program (FYUP) and the Five-Year Integrated Post-Graduate Program (FYIPP) in Biotechnology

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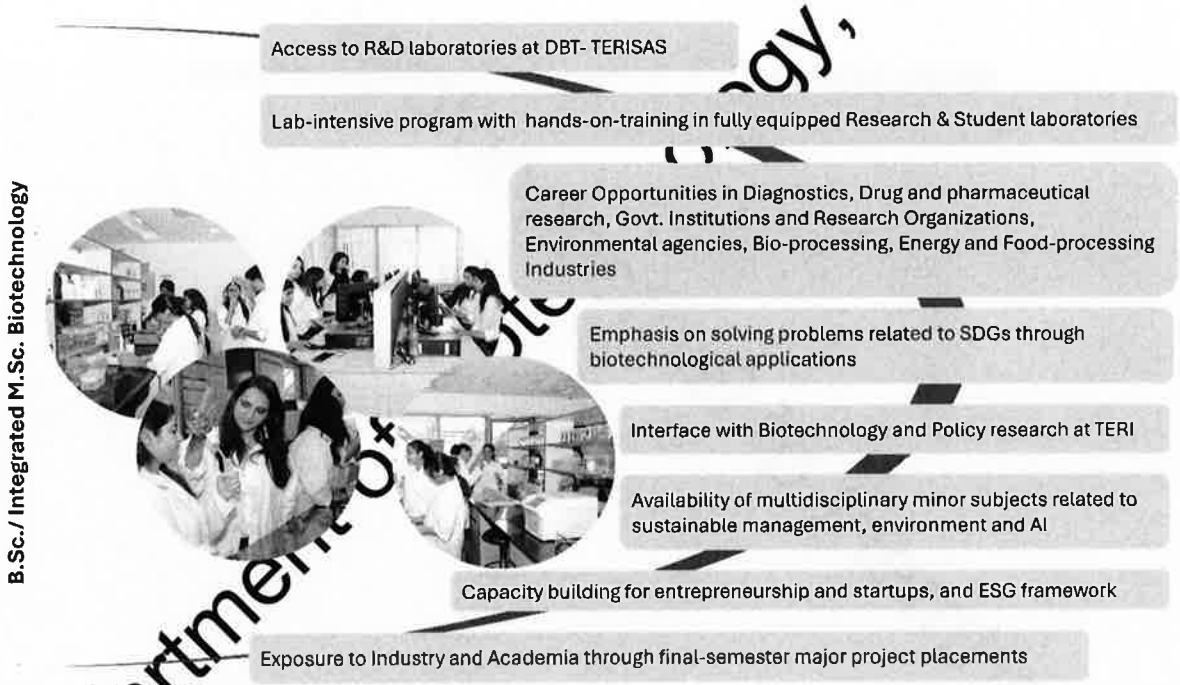

Department of Biotechnology, TERI SAS

Submitted for consideration to the Board of Studies, Department of Biotechnology

6 November 2024

Prepared by

The DBT FYUP/FYIPP program formulation committee

Chair Person - Prof. Ramakrishnan Sitaraman

Implementation- Prof. Shashi Bhushan Tripathi, Dr. Souren Paul

Members- Prof. Anandita Singh, Dr. Chaithanya Madhurantakam

Senior Advisor- Prof. Suman K. Dhar, Vice-chancellor

Department of Biotechnology, TERI SAS

Requirement for an FYUP and FYIPP in biotechnology at TERI SAS

The National Biotechnology Development Strategy (2021-2025)[1] has emphasized that biotechnology will emerge as a key driver of a knowledge-based economy. According to the Indian Bioeconomy Report of 2024[2], India's bioeconomy was valued at USD 151 billion, while the cumulative total of start-ups reached 8,531. It is projected that the Indian bioeconomy will be worth USD 300 billion, reflecting a CAGR of 12.3%. The share of the bioeconomy in total GDP currently stands at 4.25% and is projected to be a key contributor to the economy. In addition to economic aspects biotechnology, through its contributions to the biomedical, pharmaceutical, agricultural and industrial sectors, has emerged as an indispensable and strategic enabler in the quest for national self-reliance (Atmanirbharta), environmental sustainability and the attainment of the sustainable development goals (SDGs) detailed by the United Nations[3]. This year (2024) the Department of Biotechnology, Government of India has recognized the potential of biomanufacturing for economic growth, employment generation and environmental protection in the national BioE3 policy[4]. One of the pillars of the BioE3 policy is 'nurturing a cohort of highly skilled workforce.'

The very first of the key strategies listed by the National Biotechnology Development Strategy (2021-2025) document for developing the bioeconomy is "building capacities – a skilled workforce and strengthened state-of-the-art infrastructure[5]." Given the collective expertise of both TERI SAS and TERI in biotechnology and sustainability studies, TERI SAS is uniquely poised to contribute to inter-disciplinary capacity building in both fields as well as to National Missions of critical sectoral and inter-sectoral importance such as:

1. POSHAN Abhiyan (Development of biofortified and protein rich wheat)[6]
2. National Action Plan on Anti-microbial Resistance[7]
3. IndCEPI (Coalition for Epidemic Preparedness Innovations – a mission to develop affordable vaccines against emerging infectious diseases)[8]
4. National Biopharma Mission[9]

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[1] *National Biotechnology Development Strategy (2021-2025): Knowledge- and Innovation-driven Bioeconomy.* Published by the Department of Biotechnology, Ministry Of Science And Technology, Government of India. URL: https://tinyurl.com/44dp93tz

[2] Suresh N, Chandan, S.R. & Krishnan G.S. *India BioEconomy Report 2024.* Published by the Association of Biotechnology Led Enterprises (ABLE) for the Make In India Facilitation Cell for Biotechnology of the Biotechnology Industry Research Assistance Council (BIRAC), Government of India. URL: https://tinyurl.com/bdznctc8

[3] URL: https://tinyurl.com/2s4cuzh4

[4] URL: https://tinyurl.com/yhz7vz42

[5] *Op. cit.* pp. 9-11.

[6] URL: https://tinyurl.com/en733wr4

[7] URL: https://tinyurl.com/8auesudr

[8] URL: https://tinyurl.com/3bem3z6c

5. Clean Energy Mission[10]
6. Swacch Bharat[11]
7. Svasth Bharat[12]
8. GARBH-Ini (A mission to promote maternal and child health, and develop prediction tools for pre-term birth)[13]
9. National program on nanoscience and technology (formerly Nano Mission)[14]
10. Atmanirbhar Bharat (National self-reliance)[15]

The specific reasons for TERI SAS initiating an integrated 5-year integrated Master's program in Biotechnology may be summarized as follows:

1. Development of skilled human resources in a field of economic and strategic importance nationally and global.
2. Leveraging existing capacities at TERI SAS and TERI to align with national policy decisions and national missions promoting biotechnology-related research and industries.
3. Organization-wide directive to adapt to the impending nation-wide re-structuring of tertiary educational programs that are anticipated to significantly reduce the student intake of standalone two-year Master's level programs.

TERI SAS aims to create a skilled cadre of biotechnology professionals, while maintaining quality parameters at par with current requirements in academia, industry and allied professions. The proposed program leading to an integrated Masters's degree aims to provide students with an understanding of advanced concepts and techniques in biotechnology, while promoting inter-disciplinary and holistic skill development and learning that contributes to the attainment of SDGs[16].

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[9] URL: https://tinyurl.com/358dzrsw
[10] URL: https://tinyurl.com/23mphs84
[11] URL: https://tinyurl.com/2exb2vh6
[12] URL: https://tinyurl.com/3utrdwrk
[13] URL: https://www.garbhinicohort.in/
[14] URL: https://tinyurl.com/8ys3n36z
[15] URL: https://manodarpan.education.gov.in/
[16] IMPORTANT NOTE:
-The success of the proposed integrated Master's program in biotechnology is critically dependent on its receiving the following types of support from TERI SAS authorities:
1. Timely recruitment of additional faculty members with diverse areas of expertise.
2. Expansion of physical laboratory infrastructure in the 2024-25 academic year.
3. Ensuring that the Ph.D. program in Bioresources and Biotechnology is strengthened, and doctoral students incentivized with paid teaching assistantships in accordance with the mandate of NEP 2020.
4. Allocation of monetary resources and assurance of timely procurement for laboratory-based courses and projects.

Overall guiding principles of the proposed integrated program based on NEP 2020[17]:

Removal of disciplinary barriers to entry, while maintaining the rigor of disciplinary requirements.

Provision of multidisciplinary and interdisciplinary learning opportunities for students by integrating minors in other fields of study available at TERI SAS.

Emphasis on inclusive, barrier-free entry options at all levels to provide credit- and/or degree-earning opportunities not only for regular students but also for members of the general public who aspire to be lifelong learners.

Operational guidelines for implementation

The proposed program structures are based on the recommendations of the following UGC guidelines:

1. Curriculum and Credit Framework for Undergraduate Programs, 2022[18].
2. Curriculum and Credit Framework for Postgraduate Programs, 2024[19].

In the case of the proposed FYUP and FYIPP programs in biotechnology, the coverage of biotechnology/biology-related courses will be informed by the syllabus[20] prescribed by the Council of Scientific and Industrial Research, Human Resource Development Group (CSIR-HRDG) for the National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship.

Features common to the proposed FYUP & FYIPP programs

1. Open to all students who have passed class XII (or its equivalent abroad). No disciplinary barriers.

2. Multiple exit options with skill enhancement-based training as prescribed by UGC.

3. Multiple entry options provided as follows:

A. May enter in any semester, starting with semester 2, with no disciplinary barriers, after certification of eligibility by the Departmental Program Executive Committee.

B. Entry contingent on having completed one (or more, as applicable) entire semester(s) in a bachelor's degree program, provided the said program follows the UGC-prescribed structure and distribution of courses. (Incidentally, this facilitates re-entry for dropouts).

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5. Establishing MoUs with industry-focused finishing schools such as Biocon Academy.

[17] https://tinyurl.com/4knkadu6

[18] https://tinyurl.com/bdcpuzw3

[19] https://tinyurl.com/ypy7fd27

[20] https://tinyurl.com/yszpntj

C. Conferment of degree is contingent on completing the required credits in terms of Major, elective, and other types of courses as prescribed by the UGC. Therefore, students utilizing lateral entry will be given the opportunity to stay back and complete credit requirements for earning their degree/diploma/certificate by choosing appropriate courses, if required.

5. The structure and contents of the proposed FYUP will be aligned with the existing master's program such that semester 7 will be the same as semester 1 of the existing two-year Master's program in terms of Major biotechnology-specific courses.

6. The FYUP in Biotechnology program will award a B.Sc. (Hons.) with a major in Biotechnology (with 50% of total credits in the major subject) and a single minor (32 credits) in Environmental Studies/Business Administration/Data Science. Other minors will be added to as TERI SAS diversifies its FYUP offerings.

7. All the major courses offered in the FYUP in Biotechnology may be counted towards fulfilment of credit requirements for a minor subject in other FYUPs offered at TERI SAS based on their requirements.

8. Semester 8 involves both theory and minor project work. For this, it is strongly recommended that TERI SAS conclude an MoU with a finishing school (e.g. Biocon Academy) so that students can gain substantial industrial exposure as well as skills required by the market (see for example: BITS Biocon Certificate Program in Applied Industrial Microbiology[21]). Doing so would also serve to attract larger numbers of motivated students over time and build long-term links with industry. If this is done, semester 8 can be conducted in a modular form for students exiting after year 4 as well as for diploma-seeking students. The theory courses will be completed first before shifting to Biocon Academy for the rest of the semester so that the attendance requirements of the UGC are met.

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[21] URL: https://tinyurl.com/346dysyx

Eligibility and selection criteria (Entry options)

Program	Eligibility criteria	Selection criteria
Four-year Undergraduate Program (FYUP) in biotechnology	Senior Secondary School (10 + 2) Certificate in science or equivalent, from a recognized Board of Education with at least 50% marks in aggregate (best of 3 subjects + English).	Aggregate marks obtained in the qualifying Senior School Certificate Examination, followed by interaction/counselling or CUET-UG sMajor in specific subjects or the general test (see appendix 1).
Five-year Integrated PG Program (FYIPP) in biotechnology with specialization in plant/microbial biotechnology	Senior Secondary School (10 + 2) Certificate in science or equivalent, from a recognized Board of Education with at least 50% marks in aggregate (best of 3 subjects + English).	Aggregate marks obtained in the qualifying Senior School Certificate Examination, followed by interaction/counselling or CUET-UG sMajor in specific subjects or the general test (see appendix 1).
Two-year PG Program with specialization in plant/microbial biotechnology	Three-year B.Sc. Degree in Science / Technology or equivalent from a recognised University	Aggregate marks /CGPA of qualifying B.Sc. Degree, followed by interaction/counselling or CUET-PG sMajor in specific subjects or the general test (see appendix 1).
One-year PG Program in biotechnology	Four-year B.Sc. (Honours/Honours with research) Degree or equivalent from a recognized University	Aggregate marks /CGPA of qualifying B.Sc. Degree, followed by interaction/counselling or CUET-PG sMajor in specific subjects or the general test (see appendix 1).

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Exit options

Program	Year1	Year2	Year3	Year4	Year5
Four-year Undergraduate Program	UG Certificate	UG Diploma	B.Sc. Degree	B.Sc. (Honours/Honours with research)	NA
Five-year Integrated PG Program	UG Certificate	UG Diploma	B.Sc. Degree	B.Sc. (Honours/Honours with research)	PG Degree
Two-year PG Program	PG Diploma	PG Degree	NA	NA	NA
One-year PG Program	PG Degree	NA	NA	NA	NA

NOTE: Students can re-enter within three years to complete the degree program. The total duration for completing the programme shall not exceed 7 years.

Detailed semester-wise list of major and minor courses of study

NOTES:

1. All students entering the FYUP/FYIPP will be required to opt for a minor subject from one of three choices at the time of registration in the first semester: Environmental Studies, Data Science and Business Administration. Based on their choice of minor, courses in the selected minor will be allotted to them as listed to fulfil credit requirements as specified by prevailing regulations.

2. Course titles are tentative and subject to change.

3. Courses without complete codes are yet to be formulated and/or approved.

4. Key terms:

Major – course required for degree/diploma in biotechnology

Minor – course required for minor in selected subject

MDC – multi-disciplinary course

AEC – ability enhancement course

SEC – skill enhancement course

VAC – value-added course

5. Color codes for minor subjects: Blue – Data Science; Yellow – Business Administration; Green – Environmental Studies

6. Credit requirement for major subject in FYUP – 80.

7. Credit requirement for minor subject in FYUP – 32. The credit requirement for the minor subject is assigned in accordance with UGC guidelines[22] that mandate providing sufficient credits to students to support their applications doctoral programs in the minor subject as well.

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[22] https://tinyurl.com/bdcpuzw3

Semester-wise list of courses

Semester	Course No.	Course Title	Type	Number of Credits
Sem 1	New	Origin and diversity of Life	Major	2
Sem 1	New	Biological chemistry	Major	4
Sem 1	New	Cell and molecular biology	Major	2
Sem 1	New	Biotechnology laboratory 1	Practical	2
Sem 1	AEC 101	Communications skills and technical writing	AEC	2
Sem 1	SEC 101	Fundamentals of Computers and Programming	MDC	2
Sem 1	BBP XXX	Ethics and Values in Life Sciences	Elective	2
Sem 1	VAC 102	Ancient Indian Sustainable Practices	VAC	2
Sem 1	MDC 103	Data Science Fundamentals	Minor/Data Science	2
Sem 1	UDS 101	Statistics for Data Science	Minor/Data Science	4
Sem 1	UDS 103	Mathematics for Data Science	Minor/Data Science	4
Sem 1	UES 102	Introduction to Environmental Physics	Minor/ES	3
Sem 1	UES 106	Introduction to Environmental Chemistry	Minor/ES	3
Sem 1	UBA 101	Financial Accounting	Minor/BBA	4
Sem 1	UBA 103	Principles of Management	Minor/BBA	4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 2	New	Essentials of Bioinformatics	Major	2
Sem 2	New	Molecular and cellular physiology	Major	4
Sem 2	New	Gene expression and regulation	Major	2
Sem 2	New	Biotechnology laboratory 2	Practical	2

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Sem 2	BBP XXX/ NRE 113	Introductory Mathematics/ Applied Mathematics	MDC	3
Sem 2	UDS 102	Problem-Solving and Python Programming	SEC	3
Sem 2	BPB 120	Constitutional Values and Fundamental Duties	VAC	2
Sem 2	UDS 102	Problem-Solving and Python Programming	Minor/Data Science	3
Sem 2	UDS 104	Fundamentals of Information Technology	Minor/Data Science	3
Sem 2	UDS 106	Database Management System	Minor/Data Science	3
Sem 2	UES 101	Ecology and Ecosystems	Minor/ES	4
Sem 2	UES 103	Earth and Earth Surface Processes	Minor/ES	4
Sem 2	UBA 102	Marketing management I	Minor/BBA	4
Sem 2	UBA 104	Organisational Behaviour	Minor/BBA	4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 3	New	Evolutionary Biology	Major	2
Sem 3	New	Structural biology, informatics and A	Major	4
Sem 3	New	Statistics for The Life Sciences-I	Major	2
Sem 3	New	Biotechnology laboratory 3	Practical	3
Sem 3	MDC 101	Environment and Society	MDC	2
Sem 3	BPB 213	Data analysis and spreadsheet modelling	SEC	3
Sem 3	VAC 101	Basic concepts of sustainable development	VAC	2
Sem 3	UDS 201	Data Wrangling and Visualization	Minor/Data Science	3
Sem 3	UDS 203	Cybersecurity for Data Science	Minor/Data Science	3
Sem 3	UDS 205	Data Mining and Data Analysis	Minor/Data Science	3

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Sem 3	UES 201	Sustainable Built Environment	Minor/ES	3
Sem 3	UES 203	Biodiversity Conservation	Minor/ES	3
Sem 3	UES 205	Soil Conservation and Management	Minor/ES	3
Sem 3	UBA201	Marketing management II	Minor/BBA	4
Sem 3	UBA203	Operations Management	Minor/BBA	4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 4	New	Genetic engineering and recombinant DNA technology - Part 1	Major	2
Sem 4	New	Microbiology and infectious diseases	Major	4
Sem 4	New	Mammalian cell culture and Animal Biotechnology	Major	2
Sem 4	New	Biotechnology laboratory 4	Practical	3
Sem 4	New	Sustainable agriculture: Biofertilizers and biopesticides	DSE	2
Sem 4	New	Presentation and public speaking	AEC	3
Sem 4	UDS 106	Database Management System	SEC	3
Sem 4	UDS XXX	Network Science	Minor/Data Science	4
Sem 4	UDS XXX	Time Series Analysis	Minor/Data Science	4
Sem 4	UDS XXX	Open Source Programming	Minor/Data Science	4
Sem 4	UES XXX	Natural Resource Management and Sustainability	Minor/ES	4
Sem 4	UES XXX	Environmental Policy, Law and Governance	Minor/ES	4
Sem 4	UES XXX	Water and Soil Pollution	Minor/ES	4
Sem 4	BPB202	Human Resource Management	Minor/BBA	4
Sem 4	BPB204	Management Accounting	Minor/BBA	4

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Sem 4	BPB204	Economic, environment and Business implication	Minor/BBA	4
Sem 4	BPB206	Business law	Minor/BBA	4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 5	New	Introduction to Nanobiotechnology	Major	2
Sem 5	New	Plant tissue culture, transformation and genome editing	Major	3
Sem 5	New	Immunology and Cancer Biology	Major	3
Sem 5	New	Biotechnology laboratory 5	Practical	6
Sem 5	New	Research methods in cell and molecular biology	DSE	2
Sem 5	New	Scientific writing	AEC	3
Sem 5	MDC 103	Fundamentals of Data Science	MDC	2
Sem 5	UDS XXX	Predictive Modelling and Analytics	Minor/Data Science	4
Sem 5	UDS XXX	Cloud Computing and Big Data	Minor/Data Science	4
Sem 5	UDS XXX	Blockchain Security	Minor/Data Science	4
Sem 5	UES XXX	Solid and Hazardous Waste Management	Minor/ES	4
Sem 5	UES XXX	Contemporary Environmental Issues	Minor/ES	4
Sem 5	UES XXX	Environmental Economics	Minor/ES	4
Sem 5	BPB301	Entrepreneurship and startup ecosystems in India	Minor/BBA	4
Sem 5	BPB303	Design thinking and critical analysis	Minor/BBA	4
Sem 5	BPB305	Operations Research	Minor/BBA	4

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Semester	Course No.	Course Title	Type	Number of Credits
Sem 6	New	Stem cells, regenerative and molecular medicine	Major	3
Sem 6	New	Molecular genetics and epigenetics	Major	3
Sem 6	New	Systems Biology and Omics	Major	3
Sem 6	New	Biotechnology laboratory 6	Practical	6
Sem 6	New	Non-coding RNAs -biology and applications	DSE	2
Sem 6	New	Artificial intelligence in sustainable agriculture	DSE	2
Sem 6	New	Enzyme technology	DSE	2
Sem 6	UDS XXX	Machine Learning & NLP	Minor/Data Science	4
Sem 6	UDS XXX	Digital Marketing Analytics	Minor/Data Science	4
Sem 6	UDS XXX	Performance Evaluation of Computing Systems	Minor/Data Science	4
Sem 6	UES XXX	Air and Noise Pollution	Minor/ES	3
Sem 6	UES XXX	Environmental Convention and Treaties	Minor/ES	3
Sem 6	UES XXX	Natural Hazards and Disaster Risk Reduction	Minor/ES	4
Sem 6	BPB302	Financial Management	Minor/BBA	4
Sem 6	BPB304	Business Research Methods	Minor/BBA	4
Sem 6	BPB306	Supply Chain Management	Minor/BBA	4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 7	BBP 111	Advanced bioanalytical techniques	Major	3
Sem 7	BBP 158	Conceptual foundations of molecular biology	Major	2
Sem 7	BBP 161	Advanced Biochemistry and Biophysics	Major	2
Sem 7	New	RNA biology: Concepts, methods and applications	Major	2

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Sem 7	BBP 105	Biotechnology laboratory 7	Practical	7
Sem 7	New	Algal biotechnology	DSE	2
Sem 7	New	Bioremediation and pollution control	DSE	2
Sem 7	New	Biofuels for sustainability	DSE	2
Sem 7	BPB 301	Entrepreneurship and startup ecosystems in India	Elective	
Sem 7	BPB 403	Entrepreneurship development and SME	Elective	3
Sem 7		Sustainability reporting	Elective	2
Sem 7	BPB 403	Entrepreneurship development and SME	Elective	4
Sem 7	NRE 123	Biodiversity Assessment and Conservation	Elective	3
Sem 7	NRE 168	Food Security and Agriculture	Elective	3
Sem 7	UDS XXX	Spatial Data Modelling	Minor/Data Science	4
Sem 7	UDS XXX	Software Engineering and Project Management	Minor/Data Science	4
Sem 7	UDS XXX	Soft - Computing	Minor/Data Science	4
Sem 7	UES XXX	Climate Science and Policy	Minor/ES	4
Sem 7	UES XXX	Integrated Watershed Management	Minor/ES	4
Sem 7	UES XXX	Environmental Health and Risk Assessment	Minor/ES	4
Sem 7	BPB 401	Strategic management	Minor/BBA	4
Sem 7	BPB 403	Entrepreneurship development and SME	Minor/BBA	4
Sem 7	BPE 403	Research methodology		4

Semester	Course No.	Course Title	Type	Number of Credits
Sem 8	BBP 144	Conservation Genetics and Genomics	Major	2
Sem 8	BBP 146	Genome Structure and Diversity: Concepts and Methodologies	Major	3
Sem 8	BBP 114	Molecular Cell Biology - From Genes to Communities	Major	2
Sem 8	BBP 131	Molecular Microbiology and Immunology	Major	2

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Sem 8	New	Recent advances in biotechnology (Seminar and term paper)	Major	2
Sem 8	BBP 106	Biotechnology Laboratory 8	Practical	7
Sem 8	BBP 115	Applied Nanobiotechnology	DSE	2
Sem 8	BBP 145	Microbial Pathogenesis	DSE	2
Sem 8	BBP 116	Molecular Plant Physiology and Metabolism	DSE	2
Sem 8		Fundamentals of Environmental, Social, and Governance (ESG) Principles	Elective	
Sem 8	New	Research Project	Research Project	12

Semester	Course No.	Course Title	Type	Number of Credits
Sem 9	BBP 174	Advanced Bioinformatics and computational biology	Major	2
Sem 9	BBP 155	Genetic engineering and recombinant DNA technology- Part 2	Major	3
Sem 9	BBP 162	Statistics for The Life Sciences-2	Major	3
Sem 9	BBP 163	Gene Expression Analysis and Transcriptomics	Major	2
Sem 9	NRE 165	Proteomics and Protein Engineering	Major	3
Sem 9	BBP 147	Biotechnology Laboratory 9	Practical	7
Sem 9	BBP 112	Bioprocess Engineering and Environmental Biotechnology	DSE	3
Sem 9	BBP 141	Molecular Genetics for Plant Functional Genomics: Principles and Practice	DSE	3
Sem 9	BBP XXX	Biotechnology for Sustainable Agriculture	DSE	2
Sem 9	BBP 103	Bioethics, IPR and Regulations in Biotechnology	DSE	3

Semester	Course No.	Course Title	Type	Number of Credits
Sem 10	BBP 108	Major Project	Major Project	20

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Appendix 1 – Qualifying CUET-UG Examination List

NTA code	Subject
302	Agriculture
304	Biology/Biological Studies/Biotechnology/Biochemistry
306	Chemistry
307	Environmental Studies
308	Computer Science/Informatics Practices
315	Home Science
319	Mathematics / Applied Mathematics
322	Physics
327	Teaching Aptitude
501	General Test

Note: One or more subjects may be chosen from the above. The highest percentage score among the chosen subjects will be considered for admission purposes.

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Enclosure 2

Required investments from TERI SAS & TERI for the proposed FYUP & FYIPP

Contents

-Laboratory space and Infrastructure

- Non-recurring costs
  - Equipment
- Recurring costs
  - Consumables
  - Manpower (core faculty members & lab support personnel)
  - Guest Faculty

- Budgetary allocations projected for Four Year UG Program (2025-2028)

- Nature of participation required from TERI adjunct faculty members

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A. Laboratory Space and Infrastructure

- The batch strength is 25 per admission cycle. The laboratory space requirement is for **50 additional students** via the FYIPP (keeping in perspective the add-on strength coming in for 2-year time duration + concurrently running M.Sc. program until at least 2027).
- Requirement of work benches catering to 25 students at one time.
- Two rooms (C-001 & Seminar Hall) for establishing teaching + research laboratories.
- Utilization @ five full days per work week + additional usage as per experimental requirements (both teaching and research)

I- Non-recurring costs- Purchase of basic laboratory equipment[1]:

S. No.	Laboratory Equipment [2](only a representative model and manufacturer detail provided)	Cost in INR (projected as on 28-10-2024/ 1 number of unit)	Requirement for the batch of 2025-2026	Cost in INR for the batch of 2025-2026	Requirement by 2027-2028	Total Number of Units	Total cost[3] projected for the number of units considered till 2028	Justification/ Remarks[4]
1	Ohaus® pH Meter pH meters-Model ST2100-F, AC/DC input 120 V, US 3-pin plug	45,300.00	1	45,300.00	1	2	90,600.00	-To prepare buffer solutions
2	Microwave- Haier 19 L Inverter Technology, Light Weight, Defrost, 5 Power Levels Solo Microwave Oven (HIL1901MBPB, Black)	8,500.00	1	8,500.00	0	1	8,500.00	-To prepare laboratory reagents
3	Accuris™ Precision Balance, Mettler-Weighing balance (digital)	1,12,132.00	1	1,12,132.00	1	2	2,24,264.00	- To weight laboratory chemicals and preparation of buffers
4	Magnetic Stirrer with Hot	4,250.00	1	4,250.00	1	2	8,500.00	-Preparation of buffers

[1] The costs projected are as per information on the manufacturer's web page.
[2] The webpages: https://www.sigmaaldrich.com/IN/en/product/ ; https://www.medikabazaar.com/products/ and https://www.moglix.com/ are used to provide information on majority of products indicated above.
[3] **GST** and **currency conversion** rates **are not provided.** Further, add on charges like service costs, AMCs any associated transport costs are also not indicated in the table.
[4] Existing laboratory infrastructure optimally caters to Masters's program in Biotechnology with a running strength of ~80 students per year.

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	Plate- Lab Solution India Ishmayra							and analytical reagent solutions
5	Incubator Shaker							
	a. Digital Bacteriological Incubator -336 L capacity, 10-110 deg C, Lab Solution India Ishmayra	42,600.00	1	42,600.00	0	1	42,600.00	-experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial as well as Eukaryotic cells.
	b. Digital Bacteriological Incubator -224 L capacity, 10-110 deg C, Lab Solution India Ishmayra	27,600.00	0	0	1	1	27,600.00	-lesser capacity with same applications in experiments related to microbiology
6	Microscopes					4		
	a. Labcare 100-265VAC Microscope with LED Light & Lab Binocular Head, LB-98BL	16,800.00	2	33,600.00		2	33,600.00	-General Microbiology experiments
	b. Stereo microscope ST-30C-2LOO binocular tubus, wide field oculares WF10X/20mm, objective changer type C: 2X, 4X- Bishops Scientific Pvt Ltd	37,000.00			1	1	37,000.00	-For microbiology, cell biology and plant physiology experiments
7	Pipettes (set of 2 µl, 10 µl, 20 µl, 100 µl and 1000 µl)							-To prepare reagents, to perform experiments that require microscopic view and use of micropipettes for rDNA

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								technology, protein biology, micropropagation in plants, and cell biology
	a. Tarsons Accupipette Variable Volume Pipette Micropipette - 2-20ul Pack of 1 Piece (Model No-T20)	5,750.00	2	11,500.00	2	4	23,000.00	
	b. Thermo Scientific FinnPipette F3 Pipette - 1-10ul Universal Pack of 1 Piece (4640010)	9,206.00	2	18,500.00	2	4	37,000.00	
	c. Tarsons Accupipette Variable Volume Pipette Micropipette - 10-100ul Pack of 1 Piece (Model No-T100)	5,854.00	2	11,708.00	2	4	23,416.00	
	d. Tarsons Accupipette Variable Volume Pipette Micropipette - 200-1000ul Pack of 1 Piece (Model No-T1000)	5,610.00	2	11,220.00	2	4	22,440.00	
	e. Tarsons Accupipette Variable Volume Pipette Micropipette - 20-200ul Pack of 1 Piece (Model No-T200)	5,711.00	2	11,422.00	2	4	22,844.00	
8	Centrifuges							
	a. Z763101-Prism™	46,775.00	1	46,775.0	0	1	46,775.00	

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	Mini Centrifuge			0				
	b. Hettich® ROTOFIX 32A centrifuge	2,62,625.00	0	0	1	1	2,62,625.00	
9	Laminar flow hood							
	a. Laminar Air Flow Cabinet (Vertical) - Lab Solution India Ishmayra	49,500.00	1	49,500.00	0	1	49,500.00	
	b. Laminar Flow Hood- Krishna Scientific Suppliers	96,000.00	0	0	1	1	96,000.00	
10	Refrigerator							
	a. Celfrost Double Door Upright Showcase Cooler FKG 600 ltr	1,06,000.00	1	1,06,000.00	0	1	1,06,000.00	- To store lab samples, reagents, columns, matrices and analytical kits
	b. Whirlpool 235 L 3 Star Convertible Frost-Free Double Door Refrigerator (IF INV 278 RADIANT STEEL(3S) CONV-TL, 2024 Model)	35,000.00	1	35,000.00	0	1	35,000.00	-To store lab samples, reagents
11	Water bath shaker- Remi Water Bath Shaker with Tray RSB-12	59,000.00	0	0	0	1	59,000.00	-To use in experiments related toshaking and mixing of samples, while concurrently maintaining a constant temperature
12	UV/Vis Spectrophotometer							
	a. Laboratory Digital Spectrophotometer – Labline products (325-1000 nm)	30,000.00	1	30,000.00	0	1	30,000.00	-To perform protein and DNA quantitation experiments, enzyme kinetics

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	a. Z742712-Accuris™ SmartReader™ 96 microplate - absorbancy reader	6,28,000.00	0	0	1	1	6,28,000.00	To perform protein and DNA quantitation experiments, enzyme kinetics
13	Rotary Vortex mixer- Lab Vortex Mixer for Microbiology Laboratory Smart Mix-V	12,000.00	1	12,000.00	0	1	12,000.00	-suitable for shaking and mixing various reagents, solutions, chemical and other samples especially suitable for samples from small vessels up to 50ml centrifugal tubes
14	Electrophoresis Units							
	a. Z742286- myGel™ Mini Electrophoresis System	64,350.00	1	64,350.00	1	2	1,28,700.00	-DNA electrophoresis experiments, molecular biology
	b. Benchmark myGel InstaView Complete Electrophoresis System with Blue LED Illuminator	1,06,600.00	1	1,06,600.00	0	1	1,06,600.00	-protein separation, gel imaging, gel casting, transillumination
	c. Sigma-Aldrich-Z741768- Sigma-Aldrich® Dual Run and Blot System	89,480.00	1	89,480.00	0	1	89,480.00	-SDS-PAGE equipment, electrophoresis and blotting equipment
	d. Millipore- MA700-mA700 Essential Power Supply	60,890.00	0	0	0	1	60,890.00	- power supply
	Total Cost (in INR)			**8,50,437.00**			**23,11,934.00**	

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II- **Recurring costs**

A. Consumables (4 year program)

S. No.	Type of Consumable	Semester 1	Semester 2	Total cost for 2025-2026	Semesters 1 & 3	Semesters 2& 4	Total cost for 2026-2027	Semesters 1,3 & 5	Semesters 2,4 & 6	Total cost for 2027-2028	Semesters 1,3, 5 & 7	Semesters 2,4 ,6 & 8*[5]	Total cost for 2028-2029
1	Analytical reagents	75,000.00	75,000.00	1,50,000.00	1,00,000.00	1,00,000.00	2,00,000.00	1,25,000.00	1,25,000.00	2,50,000.00	1,50,000.00	1,25,000.00	2,75,000.00
2	Plastic labware	50,000.00	50,000.00	1,00,000.00	75,000.00	75,000.00	1,50,000.00	1,00,000.00	1,00,000.00	2,00,000.00	1,25,000.00	1,00,000.00	2,25,000.00
3	Laboratory kits	75,000.00	75,000.00	1,50,000.00	1,00,000.00	1,00,000.00	2,00,000.00	1,25,000.00	1,25,000.00	2,50,000.00	1,50,000.00	1,25,000.00	2,75,000.00
4	Regular chemical	75,000.00	75,000.00	1,50,000.00	1,00,000.00	1,00,000.00	2,00,000.00	1,25,000.00	1,25,000.00	2,50,000.00	1,50,000.00	1,25,000.00	2,75,000.00
	Total cost (INR)			**5,50,000.00**			**7,50,000.00**			**9,50,000.00**			**10,50,000.00**

B. Manpower[6]

S. No.	Manpower designation	Year 1	Year 2	Year 3	Year 4
1	Laboratory Technician @ 30,000.00 per month	3,60,000.00	3,60,000.00	3,60,000.00	3,60,000.00
2	Teaching Assistantship/honorarium as applicable	1,00,000.00	1,50,000.00	2,00,000.00	2,00,000.00
	Total	**4,60,000.00**	**5,10,000.00**	**5,60,000.00**	**5,60,000.00**

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[5] Semester 8 allocated for major project

[6] The teaching assistantship and/or honorarium for PhD scholars registered with DBT has been provisioned as per TERI SAS stipulations.

C. Core Faculty Members

S. No.	Specialization	Compensation	BoS Approval
1	Bioinformatics and computational biology[7]	As per prevailing norms	Yes
2	Systems & Synthetic Biology[8]	As per prevailing norms	Yes
3	Virology[9]	As per prevailing norms	Yes
4	Additional faculty members at Assistant Professor rank, specializations not determined yet, primarily for FYUP & FYIPP.	As per prevailing norms	Requested

D. Guest Faculty Members[10]

S. No.	Faculty requirements	Year 1	Year 2	Year 3	Year 4
1	Guest faculty 1 @75,000 for 2 credits course of 30 hrs Teaching load	75,000.00	75,000.00	75,000.00	75,000.00
2	Guest faculty 2 @75,000 for 2 credits course of 30 hrs Teaching load	75,000.00	75,000.00	75,000.00	75,000.00
3	Guest faculty 3 @1,12,500 for 3 credits course of 45 hrs Teaching load	1,12,500.00	1,12,500.00	1,12,500.00	1,12,500.00
	Total	**2,62,500.00**	**2,62,500.00**	**2,62,500.00**	**2,62,500.00**

[7] The request for regular faculty in Bioinformatics has been approved by the Academic Council. The process of recruitment is in the pipeline and this specialization is not considered for Guest faculty requests.
[8] Recruitment process not initiated yet.
[9] Recruitment process not initiated yet.
[10] The number of guest faculty would vary depending on the actual requirements of the developed course, non-availability of expert teachers at the Institute. Accordingly, the costs may vary between 1,50,000.00 to 4,00,000.00 per year.

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E. TERI SAS support required for the doctoral program in Bioresources & Biotechnology

Strengthening the Ph.D. program with incentives for Ph.D. students in the form of competitive teaching assistantships as outlined in NEP 2020.

Responsive administrative support.

Dean (Research & Partnerships) to establish linkages with industry to establish modular training programs, internship opportunities and research collaboration.

F. Expertise and support required from adjunct faculty members at TERI[11]

Teaching existing courses or modules thereof.
Involvement of TERI labs on a regular basis in delivering lab courses, hosting lab visits
Student research projects
Formulation of new specializations and advanced courses in – e.g. Nanobiotechnology, Environmental Biotechnology, Industrial Biotechnology & Biorefineries, Sustainable Agriculture (Biofertilizers & Biopesticides), Bioenergy, Biomaterials and Bioprospecting.
Designing and delivering Ph.D. courses in TERI researchers' areas of expertise
Facilitating industrial linkages and training opportunities

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[11] As per framework outlined in the 42 Board of Management (now Executive Council) meeting

Budgetary requirements projected for FYUP (2025-2028)[12]

S. No.	Type of budgetary allocation	Year 1	Year 2	Year 3	Year 4	Total
I	Non-recurring					
	A. Equipment	8,50,437.00	0	14,61,497.00	0	23,11,934.00
II	Recurring					
	B. Consumables	5,50,000.00	7,50,000.00	9,50,000.00	10,50,000.00	33,00,000.00
	C. Manpower	4,60,000.00	5,10,000.00	5,60,000.00	5,60,000.00	20,90,000.00
	D. Guest Faculty	2,62,500.00	2,62,500.00	2,62,500.00	2,62,500.00	10,50,000.00
	Total cost (in INR)	**21,22,937.00**	**15,22,500.00**	**32,33,997.00**	**15,22,500.00**	**87,51,934.00**
						~90 Lakh INR[13]

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[12] Does not include the CTC of core faculty member recruitments.
[13] The costs may escalate by another 10 Lakh INR depending on requirement of any other critical equipment to a total of 100 Lakh INR

Outlook

Re: Fw: Minutes of the BoS meeting, November 8, 2024

From Ashis Nandi <aknandijnu@gmail.com>
Date Tue 11/19/2024 4:02 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>
Cc Ramakrishnan Sitaraman <rkraman@terisas.ac.in>

I approve the minutes. Please ensure that courses are as per the requirement of the credit hours and distribution.
Regards
Ashis

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

On Tue, Nov 19, 2024 at 10:38 AM Vidhya Sharma <vidhya.sharma@terisas.ac.in> wrote:

> Dear Sir,
>
> As discussed, for your information.
>
> Thanks and Regards
> Vidhya Sharma

From: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Sent: Wednesday, November 13, 2024 2:00 PM
To: TERI SAS-Biotechnology <dbt@terisas.ac.in>; ashis_nandi <ashis_nandi@yahoo.com>; shailendragoel <shailendragoel@gmail.com>
Cc: Vidhya Sharma <vidhya.sharma@terisas.ac.in>
Subject: Minutes of the BoS meeting, November 8, 2024

Dear members of the Board of Studies,

Attached herewith are the minutes of the meeting held on November 8, 2024.

Please provide your approval and/or suggestions by or before November 15, 2024.

Ms. @Vidhya Sharma may obtain signatures on paper once all members approve.

Sincerely,
Dr. Ramakrishnan Sitaraman
Department of Biotechnology
TERI School of Advanced Studies

10 Institutional Area, Vasant Kunj
New Delhi - 110070, India
Ph: 011-71800222 ext. 4766; 9971005164

Outlook

Dr. Shailendra Goel : Minutes of the BoS meeting, November 8, 2024

From Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Date Wed 11/20/2024 12:01 PM
To Vidhya Sharma <vidhya.sharma@terisas.ac.in>

From: Shailendra Goel <shailendragoel@gmail.com>
Sent: Tuesday, November 19, 2024 11:44 AM
To: Ramakrishnan Sitaraman <rkraman@terisas.ac.in>
Subject: Re: Minutes of the BoS meeting, November 8, 2024

Dear Colleagues

I have no questions. The minutes are approved.

Regards
Shailendra

On Wed, Nov 13, 2024 at 2:00 PM Ramakrishnan Sitaraman <rkraman@terisas.ac.in> wrote:

> Dear members of the Board of Studies,
>
> Attached herewith are the minutes of the meeting held on November 8, 2024.
>
> Please provide your approval and/or suggestions by or before November 15, 2024.
>
> Ms. @Vidhya Sharma may obtain signatures on paper once all members approve.
>
> Sincerely,
> Dr. Ramakrishnan Sitaraman
> Department of Biotechnology
> TERI School of Advanced Studies
> 10 Institutional Area, Vasant Kunj
> New Delhi - 110070, India
> Ph: 011-71800222 ext. 4766; 9971005164

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Shailendra Goel
Professor
Department of Botany
University of Delhi
Delhi 110007