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Post-Graduate Programme

Curriculum and Syllabus for

M.Sc. Biotechnology

(With effect from the Academic Year 2023-24)

JUNE 2023

Note: The Board of Studies in Biotechnology (PG) designed the syllabus as per Common Model Syllabus provided by TANSCHE based on Learning Outcome based Curriculum Framework (LOCF) as prescribed by the UGC.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc. BIO-TECHNOLOGY**
Programme Code	
Duration	**PG – 2 YEARS**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning**

	Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Template for P.G Programme

Semester–I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
Core-I	4	3	. Core-IV	4	3	Core-VII	4	3	Core-XI	4	4
Core-II	4	3	Core-V	4	3	Core-VIII	4	3	Project with viva voce	14	22
Core – III	4	3	Core – VI	4	3	Core – IX	4	3	Elective - VII	2	2
Elective -I Discipline Centric	2	3	Elective – III Discipline Centric	2	2	Elective-V	2	2	Skill Enhancement course / Professional Competency Skill-III	2	2
Elective-II Generic:	2	3	Elective -IV Generic:	2	2	Elective - VI Discipline Centric	2	2	Extension Activity	1	
			Skill Enhancement course-I	2	2	Skill Enhancement Course-II	2	2	Practical-III Practical – III (A) Bioinformatics (B) Immunology (C) BioprocessTechnology	4	-
Practical-1 Practical – I (A) Biochemistry (B) Molecular Genetics (C) Molecular Cell biology	-	15	Practical-1 Practical – I (A) Biochemistry (B) Molecular Genetics (C) Molecular Cell biology	4	-	Practical-III Practical – III (A) Bioinformatics (B) Immunology (C) BioprocessTechnology	-	15			
			Practical-II Practical – II (A) Microbiology (B) Plant and Animal Biotechnology (C) GeneticEngineering	4	15	Internship/ Industrial Activity	4	-			
	16	**30**		**26**	**30**		**22**	**30**		**27**	**30**
Total Credit Points -91											

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Post – Graduate Courses including Lab Hours

First Year – Semester – I

Part	List of Courses	Credits	No. of Hours
	Core – I	4	3
	Core – II	4	3
	Core – III	4	3
	Core –IV (Practical-1)	-	15
	Elective – I	2	3
	Elective – II	2	3
		16	**30**

Semester-II

Part	List of Courses	Credits	No. of Hours
	Core – V	4	3
	Core – VI	4	3
	Core – VII	4	3
	Core Practical -IV(Practical-I)	4	
	Core VIII (Practical-II)	4	15
	Elective – III	2	2
	Elective – IV	2	2
	Skill Enhancement Course - I	2	2
		26	**30**

Second Year – Semester – III

Part	List of Courses	Credits	No. of Hours
	Core – IX	4	3
	Core – X	4	3
	Core – XI	4	3
	Core-XII (Practical-III)	-	15
	Elective-V	2	2
	Elective – VI	2	2
	Skill Enhancement Course - II	2	2
	Internship / Industrial Activity	4	-
		22	**30**

Semester-IV

Part	List of Courses	Credits	No. of Hours
	Core – XIII	4	4
	Project with VIVA VOCE	14	22
	Core-XII (Practical-III)	4	-
	Elective – VII	2	2
	Skill Enhancement Course – III / Professional Competency Skill	2	2
	Extension Activity	1	-
		27	**30**

Total 91 Credits for PG Courses

Learning Outcomes based approach to Curriculum Planning:

The Learning Outcomes based approach to Curriculum planning aims to factor in on the aptitude, interests and strengths of the students during their progress through the coursework and at the same time focus on overall student attainment. The main objective of the learning outcomes based framework is to better equip the students in their pursuit of knowledge, with the required employability skills, innovation in research and entrepreneurship skills. The course is so designed with practical work that will help students to apply their theoretical knowledge in experimenting and exploring. The curriculum envisions that the student, once graduates as specialists in a discipline, have an important role to play in the newer developments and innovations in the future in the subject for the advancement of the discipline.

Graduate Attributes in Biotechnology:

Graduate attributes are the high-level qualities, skills and understandings that a student should gain as a result of the learning and experiences. They equip students and graduates for lifelong personal development, learning and to be successful in society. Students will be equipped to be active citizens both nationally and globally. The students graduating in biotechnology should also develop excellent communication skills both in the written as well as spoken language which are a must for them to pursue higher studies from some of the best and internationally acclaimed universities and research institutions spread across the globe. The graduate attributes reflect both disciplinary knowledge and understanding, generic skills, including global competitiveness all students in different academic fields of study should acquire/attain and demonstrate. Some of the characteristic attributes that a graduate should demonstrate are as follows

- Leadership Readiness
- Moral and ethical awareness/reasoning.
- Multicultural Competence.
- Life–long Learning.
- Communication Skills.
- Critical thinking.
- Problem-solvingng.
- Research-related skills.
- Scientific reasoning.
- Self-directed learning.
- Disciplinary knowledge.

Qualification Descriptors:

Upon successful completion of the course, the students receive an M.Sc. degree in Biotechnology. Biotechnology postgraduates of this department are expected to branch out into different paths of seeking advanced research-based knowledge, professional employment, or entrepreneurship that they find fulfilling. They will be able to demonstrate knowledge as well as skills in diverse fields of Biotechnology. This will provide a foundation, which shall help them to embark on research careers by attaining doctoral positions in coveted institutions, as well as securing employment in research projects in industry or institutes. Besides research, they can get suitable teaching positions in Colleges and Universities as Assistant professors after qualifying National Eligibility Test (NET). It is expected that besides the skills specific to the discipline, the wider life skills of analysis, logical reasoning, scientific aptitude, communication skills, research and life ethics, and moral values will be inculcated in the students. The list below provides a synoptic overview of possible career paths provided by postgraduate training in Biotechnology:

- Biotechnology entrepreneurship
- Patents and Law
- Scientific Writing and Editing
- Document preparation and publication
- Research
- Industry
- Teaching
- Administration and Policy Making
- Scientific Communication

Teaching-learning process

The Learning Outcomes-Based Approach to curriculum planning and transaction requires that the teaching-learning processes are oriented towards enabling students to attain the defined learning outcomes relating to the courses within a programme. The outcome-based approach, particularly in the context of undergraduate studies, requires a significant shift from teacher-centric to learner-centric pedagogies, and from passive to active/participatory pedagogies. Planning for teaching therein becomes critical. Every programme of study lends itself to a well-structured and sequenced acquisition of knowledge and skills. Practical skills, including an appreciation of the link between theory and experiment, will constitute an

important aspect of the teaching-learning process. Teaching methods, guided by such a framework, may include:

✓ **Classroom Teaching** for intensely information-based topics. This is a very regular feature of all the courses in Biotechnology.

✓ **PowerPoint slides** for topics that involve information and use of PowerPoint presentations are also made whenever the lectures are to be summarized in a crisp and point-wise manner to highlight salient/important conclusions from the topics.

✓ **Classroom Discussions** are a regular feature while teaching. The students are drawn into impromptu discussions by the teacher during the process of teaching.

✓ **Video Displaying**, both real-time and animations, are used for topics that require 3D dimensional viewing of the biological mechanisms to drive the point home. These have proved to be very helpful while teaching concepts of molecular biology like DNA replication, transcription and translation.

✓ **Model Making** is also used especially for understanding and building a perception of the students.

✓ **Laboratory Practical** are an integral part of every course included in the PG programme in Biotechnology. The is also a daily affair for PG students of Biotechnology.

✓ **Problem Solving** is encouraged during the laboratory work.

✓ **Group Activity** as well as discussions with the laboratory supervisor/ among the students themselves/ Mentor is also encouraged during laboratory work.

✓ **Project Work** is included in the programme where students work individually or in groups to design experiments to solve/answer a problem suggested by the Mentor or identified by the students in consultation with the Mentor. The students are mentored regularly during the duration of the project.

✓ **Presentations by the Students** are regularly done. The students are mentored in the presentation of data, interpretation of data and articulation with the students/teachers/Research Scholars during their presentation.

✓ **Presentations by Experts** in different specialties of Biotechnology are arranged to broaden the horizons of the students.

✓ **Interaction with Experts** is also encouraged during/after presentations to satisfy/ignite the curiosities of the students related to developments in the different areas of Biotechnology.

✓ **Visit to Industries/Laboratories** related to Biotechnology like fermentation, food, pharmaceuticals; diagnostics etc. are organized to acquaint the students with real-life working environments of the professional biotechnologist with a view to broadening their perspective on the subject of Biotechnology.

Assessment methods

The students of PG Biotechnology program must achieve the desired results in terms of the learning outcomes to be professionally sound and competitive in a global society. Achieving the desired learning outcomes is also imperative in terms of job employment leading to a happy and prosperous individual further leading to a happy and prosperous family and thereby a happy and prosperous society or nation. The assessment tasks are pivotal to getting authentic feedback for the teaching-learning process and mid-course corrections and further improvements in the future. The assessment tasks are carried out at various stages of the duration of the PG Biotechnology programme like Mid-term assessments, End-term assessments, Semester examinations, Regular assessments, viva-voce, etc. The assessment tasks are listed below:-

- ✓ **Short-Answer Questions** during term and semester examinations are used to assess the ability of the student to convey his thoughts in a coherent way where prioritization of the information in terms of their significance is tested.
- ✓ **Problem Solving questions** are generally given during the laboratory work.
- ✓ **Surprise Quizzes** are regularly used during continuous assessment while the teaching-learning process is continuing which prepares the student to quickly recall information or quickly analyze a problem and come up with proper solutions.
- ✓ **Impromptu Opinions** on biotechnological problems are sought from student during regular teaching-learning which help them to think quickly in a given context. This help build their ability to come up with solutions to problems that the students might not have confronted previously.
- ✓ **Data Interpretation** is also another assessment task that is used to develop the analytical skills of the students. This assessment is used during laboratory work as well as during project work.
- ✓ **Analytical Skills** are assessed during work related to several experiments like enzyme kinetics, growth of bacteria and Bacteriophages, and mutation frequencies.
- ✓ **Paper/ Project presentations** are used to assess the articulation skills of the student. These are carried out both during the duration of the teaching-learning processes as well as during end-Semester examinations.
- ✓ **Report Writing** is used to assess the keenness of the students for details related to Biotechnology while visiting laboratories/industries as students invariably are required to submit a report after such visits.
- ✓ **Assignment Writing** is used to assess the writing abilities of the students during midterm vacations.
- ✓ **Viva-voce** during the laboratory working hours and during laboratory, examinations are used to assess the overall knowledge and intelligence of the students.

Key Words:

Biotechnology, Teaching, Learning outcomes, Curriculum, Curriculum Framework, Programme outcomes, Course outcomes, PG Programme, Postgraduate programme, Teaching-learning processes, Assessment Tasks, Evaluation Tasks, Online Courses, MOOCS, SWAYAM, UGC, India, Higher Education Institutions.

COURSE OF STUDY AND SCHEME OF EXAMINATIONS

FIRST SEMESTER

S.No.	Course Components	Name of Course	Inst. Hours	Credits	Exam HRS	Max. Marks	
						CIA	External
1	Core Paper-1	422C1A: Biochemistry	3	4	3	25	75
2	Core Paper-2	422C1B: Molecular Genetics	3	4	3	25	75
3	Core Paper-3	422C1C: Molecular Cell Biology	3	4	3	25	75
		Practical – I * (A) Biochemistry (B) Molecular Genetics (C) Molecular Cell biology	15	Practical will be conducted at the end of even Semester			
4	Elective -1	422E1A: Bioinstrumentation	3	2	3	25	75
5	Elective-2	422E1B: Enzymology	3	2	3	25	75
Total Credits : 16							

***Practical examination shall be conducted independently at the end of even semester.**

SECOND SEMESTER

S. No.	Course Components	Name of Course	Inst. Hours	Credits	Exam HRS	Max. Marks	
						CIA	External
6	Core Paper-4	422C2A: Microbiology	3	4	3	25	75
7	Core Paper-5	422C2B: Plant and Animal Biotechnology	3	4	3	25	75
8	Core Paper-6	422C2C: Genetic Engineering	3	4	3	25	75
9	Core Paper-7	422C2D: Practical – I (A) Biochemistry (B) Molecular Genetics (C) Molecular Cell biology	--	4	6	40	60
10	Core paper 8	422C2E: Practical – II (A) Microbiology (B) Plant and Animal Biotechnology (C) GeneticEngineering	15	4	6	40	60
11	Elective Paper-3	422E2A: Regulatory affairs and Industrial standards 422E2B: Pharmaceutical Biotechnology	2	2	3	25	75
12	Elective Paper-4	422E2C: Environmental Biotechnology	2	2	3	25	75
13	Skill Enhancement -I	422S2A: Good Laboratory Practices	2	2	3	25	75
		Total	**30**	**26**			

Candidate can opt for one subject from elective paper-3

** Internship will be carried out during the summer vacation of II Semester and the report will be evaluated by two examiners within the Department of the college/ institution. The marks should be sent to the University by the College and the same will be included in the Third Semester Marks Statement.

THIRD SEMESTER

S. No.	Course Components	Name of Course	Inst. Hours	Credits	Exam HRS	Max. Marks	
						CIA	External
14	Core Paper-9	522C3A: Bioinformatics	3	4	3	25	75
15	Core Paper-10	522C3B: Immunology	3	4	3	25	75
16	Core Paper-11	522C3C: Bioprocess Technology	3	4	3	25	75
		Practical – III (A) Bioinformatics (B) Immunology (C) BioprocessTechnology	15	Practical will be conducted at the end of even Semester			
17	Elective Paper-5	522E3A: Nano Biotechnology 522E3B: Molecular Developmental Biology	2	2	3	25	75
18	Elective Paper-6	522E3C: Tissue Engineering	2	2	3	25	75
19	Skill Enhancement Course-II	522S3A: Herbal Technology	2	2	3	25	75
20	**Internship	522S3B: Internship in Biotechnology Industries (food / clinical trial/ dairy/ aqua sciences, pharmaceutical) CSIR/DBT/DST research laboratories	0	4	-	-	100
		Total	**30**	**22**			

FOURTH SEMESTER

S. No.	Course Components	Name of Course	Inst. Hours	Credits	Exam HRS	Max. Marks	
						CIA	External
21	Core Paper-12	522C4A: Research Methodology	4	4	3	25	75
22	Core Paper-13	522C4B: Practical – III (A) Bioinformatics (B) Immunology (C) BioprocessTechnology	15	4	6	40	60
23	Core Paper-14 Project Work &*Vivo Voce*	522C4C: Dissertation	22	14		60	240 (40-work book, 150 Dissertation +50- Viva)
24	Elective Paper-7	522E4A: Stem Cell Biology 522E4B: Bioethics, Human Rights and Social Issues	2	2	3	25	75
25	Skill Enhancement Course-III	522S4A: Bio-Entrepreneurship	2	2		25	75
26		522V4A: Extension Activity	-	1			
		Total	**30**	**27**			

DISSERTATION EVALUATION:

Dissertation Work should be carried out as an individual Dissertation and actual bench work.The Dissertation work will begin from IIIrd Semester, and will continue through the IVth Semester.The Dissertation report (also work book shall be presented at the time of presentation and viva voce) will be submitted at the end of the IVth Semester and evaluated. For the conduct of the End.

Semester Examination and evaluation of Dissertation Work, the University will appoint External Examiners.Since the dissertation is by research, dissertation work carries a total of 300 marks and evaluation will be carried out by both internal and external evaluators.

The average marks awarded by them will be considered. Project work book consisting of daily research activities, methods adopted, results recorded and maintained by the candidate shall also be submitted along with dissertation for evaluation. The viva-voce examination is part of dissertation which carries marks as specified below.

The assignment of marks for Project is as follows:

Continuous Internal Assessment Marks

Best 2 out of 3 presentations(Literature survey,
Methodology and Results of the project work) - 60marks
Project work book - 40marks
Dissertation - 150marks
Viva-voce - 50marks

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