INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

(A State University Established under Haryana Act No. 29 of 2013)
Recognized u/s 12 (b) & amp; 2(f) of UGC Act, 1956

Scheme and Syllabus of Examination
(As per NEP 2020)
For
M.Sc. Biotechnology

Curriculum and Credit Framework for Postgraduate Programme
with
Multiple Entry-Exit, Internship and CBSE-LOCF with effect from the session 2024-25 (in phased manner)

DEPARTMENT OF BIOTECHNOLOGY
(FACULTY OF LIFE SCIENCES)

Approved by:	**Discussed in DC Meeting**	**BOS**	**Academic Council**
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VISION AND MISSION OF THE UNIVERSITY

VISION

To be a globally renowned university, recognized for excellence in the Teaching, Innovative research, and Welfare of the society, imbibing thespirit of "Vasudhaiv Kutumbkam".

MISSION

1. To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.

2. To develop a mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University.

3. To offer academic programs at PG, doctoral, post-Doctoral levels which are learner-centric, industry focused, and adhere to outcome based international models.

4. To create an ambiance that is conducive for undertaking sponsored research, innovation and consultancy services to a wide spectrum of societal and industrial requirements while encouraging interdisciplinary approach of learning, teamwork, and research.

5. To establish state of art centers of excellence in frontier areas of research and design innovation through industry collaboration to innovate and incubate the products and services.

6. To establish smart campus and promote e-governance activities in the university for the digitally empowered society and knowledge economy.

7. To provide a hygienic, modern, environment friendly and vivacious campusattuned to the urgent needs of Green Technology.

8. To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of university system and achieve quality certifications by National and International bodies.

9. To make society self-reliant by organizing various programmes including literacy, gender sensitization, health awareness, and dissemination of information about livelihood generation.

VISION AND MISSION OF THE DEPARTMENT

VISION

To train the students to be highly effective instructors, researchers, and contributors to Biotechnology based industries and stakeholders globally. Be regarded as a prestigious centre of scholarly achievement worldwide

MISSION

1. To advance the Biotechnology based research and education.
2. To create skilled manpower for businesses and industries based on Molecular, Microbial, Medicinal, Computational (bioinformatics) experimental methods and methodologies.
3. To offer learning environments that are centered on the needs of the students in order to help them develop as people as a whole.
4. To introduce summer training and research projects to strengthen academicdelivery.
5. To establish smart classrooms and well-equipped laboratory for assessing and improving the quality in every aspect of academic and research.
6. To make students and researchers self-reliant by organizing various programmes like workshop, seminars, national and international conferences, educational tours and industrial visit.

BACKGROUND

CBCS and LOCF an integrated Approach

Considering the curricular reforms as instrumental for desired learning outcomes, the academic departments of Indira Gandhi University Meerpur, Rewari, Haryana made a rigorous attempt to revise the curriculum of postgraduate programmes in alignment with UGC Quality Mandate for Higher Education Institutions-2021. The revised curricula of various programmes could be devised with concerted efforts of the faculty and Heads of the Departments. The draft prepared by each department was discussed in series of discussion sessions conducted at Department level and at the University level. The leadership of the University has been a driving force behind the entire exercise of developing the uniform template and structure for the revised curriculum. The Vice Chancellor of the University held series of meetings with Heads and Deans to deliberate upon the vital parameters of the revised curriculum to formulate a uniform template featuring Background, Programme

Educational Objectives, Course Outcomes, Programme Specific Outcomes, Structure of Master's Course, Semester- wise Courses and Credit Distribution, Teaching-Learning Process, Assessment and Evaluation, Keywords, References and Appendices. The experts of various Boards of Studies contributed to a large extent in giving the final shape to the revised curriculum of each programme.

To ensure the implementation of curricular reforms envisioned in CBCS- LOCF, the University has decided to implement various provisions in a phased manner.

BACKGROUND

About The Department of Biotechnology

The Department of Biotechnology at IGU was established in 2019 under the Faculty of Life Sciences with an aim for providing quality education and performing cutting edge technological research. With faculties from different backgrounds and skill set in modern technologies, the department is aimed at training the students in the field of Biotechnology and related subjects by encouraging interdisciplinary and multidisciplinary approaches. The focus of the department is also to develop technologies that seek solutions to real life problems related to society. Therefore, the department provides an opportunity for students seeking training in an advanced course in Biotechnology in the form of MSc Biotechnology. The programme is of two years duration (four semesters) and the curriculum is designed to cater the needs of basic training needed in modern Biotechnological research and development all over the world.

About the Programme (Nature, Extent and Aims)

The M.Sc. Biotechnology programme is of two years duration. Each year is divided into two semesters. Each semester will be of sixteen weeks duration. The teaching and learning in the M.Sc. Biotechnology programme will involve theory classes (lectures), tutorials, practical and dissertation. The curriculum will be taught through formal lectures with the aid of ICT tools like power-point presentations, audio and video tools and other teaching aids can be used when required. The specialized subjects could be augmented by special lectures from the eminent experts in the relevant fields, which can be incorporated along with regular teaching. The latest developments in the field involving emerging technologies could be incorporated in the form of seminars, workshops, training, conferences etc.

Postgraduate Attributes

On completion of the course, the students are expected to be proficient in the fundamental, applied and modern areas of Biotechnology. They are expected to have acquired the skills of theoretical and practical aspects of different branches of Biotechnology; to be able to develop rationale thinking skills, logical interpretation and analytical skills. Effective communication of scientific developments to the society at large is very critical attribute expected from the students of this course.

The attributes expected from the post- graduates of M.Sc. Biotechnology Programme are:

- **PA1:** Fundamental and advanced knowledge of Biotechnology and its different branches.
- **PA2:** Orientation and specialization in at least one specific branch of Biotechnology and related fields.
- **PA3:** Proficiency in theoretical and practical aspects of traditional as well as modern tools and techniques in the fields of Biotechnology.
- **PA4:** Awareness and sensitization about various societal problems related to Biotechnology.
- **PA5:** Effective communication of scientific knowledge and recent developments with the society.
- **PA-6:** Acquiring skills of writing, editing and publication of research findings in reputed journals and magazines.
- **PA7:** Acquire skills and training in scientific communications and presentation.
- **PA8:** Ability to design and undertake research projects to solve societal problems.
- **PA9:** Proficiency in ICT technologies for personal, academic and professional purposes.

Aims of M.Sc. Biotechnology Degree Programme

The objective of this course is to provide fundamental and advanced knowledge of Biotechnology and its related subjects.

- To generate competent human resources skilled to contribute towards the sustainable development of industry, teaching, and research in different areas of Biotechnology.
- To develop a set of interdisciplinary professional skills that will enable the students in research and development in Biotechnology.
- To bring social, ethical, and professional awareness among the students about various issues of contemporary practices in Biotechnology and related fields.

Possible Carrier Prospects

Upon successful completion of the course, the students receive a M.Sc. degree in Biotechnology. The 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 an Assistant Professor 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 a postgraduate training in Biotechnology:

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

Programme Outcomes

Basic and applied knowledge:

Interdisciplinary knowledge to find solutions for the complex biological problems (related to agriculture, medical, environment etc.) prevalent in the society.

Problem analysis:

Ability to analyze society related/ applied research problem, design and execute experiments to find relevant solutions.

Advanced Usage of Technology:

Ability to apply advanced instrumentation/ tools, online resources for troubleshooting with an understanding of the limitations.

Ethics:

Commitment towards professional ethics and responsibilities as a social endeavour to bring harmony with nature.

Lifelong learning:

Scientific skills for industrial applications and entrepreneurship.

Programme Educational Objectives (PEOs)

The Department of Biotechnology has formulated the Programme Educational Objectives (PEO's) with those in fields. The Programme educational objectives (PEO) are the statement that describes the career and professional achievement after receiving the degree.

The PEO's of the Master's degree in Biotechnology are as follows:

PEO1: To have fundamental as well as advanced knowledge of the Biotechnology domain.

PEO2: To provide the professional services to industries, Research Organization, in the domain of super specialization.

PEO3: To opt for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

Programme Specific Outcomes

After completion of M.Sc. Biotechnology, the students will be able:

PSO1: To understand the basic concepts and applications of biotechnology.

PSO2: To understand the principles of Microbiology, Cell Biology, Biochemistry, Molecular Biology, Genetics and Immunology involved in biotechnology to identify crucial biological problems.

PSO3: To realize the Biotechnology Management and importance of laws and ethics in biotechnological practices and be able to practice good laboratory practices.

PSO4: To handle basic, sophisticated advanced instruments needed in a research laboratory with ability to design and execute experiments with precision in a logical manner.

PSO5: To understand theoretical as well as practical aspects of genecloning, expression of recombinant proteins, tissue culture, and transgenic development and metabolic pathways.

PSO6: To understand the basics of statistics and computational methods used in biological processes.

PSO7: To understand the principles and applications of geneticengineering to address healthcare, disease diagnostics, crop improvement and environment.

PSO8: To understand the principles and applications of bioprocess designing, biotechnology, and nanotechnology for solving problems of biology and other related sciences.

PSO9: To launch start-ups and become entrepreneurs for novel biotechnology products and processes in various industries.

PSO10: To understand Biosafety measures, Ethical issues and regulatory compliances in the field of Biotechnology.

Courses Articulation Matrix: Mapping of Course Outcomes (COs) with PSOs

Semester 1

PSO	Cell and Molecular Biology	Biomolecules and Metabolism	Tools and Techniques in Biotechnology	Microbiology	Lab Course-I	Lab Course-II
PSO-1	√	√	√	√	√	√
PSO-2	√	√	√	√	√	√
PSO-3			√			√
PSO-4	√		√			√
PSO-5		√	√		√	√
PSO-6				√		√
PSO-7	√					
PSO-8					√	
PSO-9						
PSO-10				√	√	

Semester 2

PSO	Immunology	Fundamental of Data Analysis	Genetic Engineering	Virology & Vaccinology	Lab Course-III	Lab Course-IV
PSO-1	√		√			
PSO-2	√		√	√		
PSO-3			√		√	√
PSO-4		√	√		√	√
PSO-5			√		√	√
PSO-6		√				√
PSO-7	√		√	√		√
PSO-8	√			√		
PSO-9			√			
PSO-10	√		√	√		

Semester 3

PSO	Animal Cell Culture	Molecular Diagnostics	Plant Cell &Tissue Culture	Bio-informatics	Bioprocess Technology	Food Biotechnology	Biology of Infectious disease	Lab Course-V	Lab Course-VI
PSO-1	√	√	√	√				√	
PSO-2	√	√					√	√	
PSO-3	√		√					√	√
PSO-4	√		√					√	√
PSO-5		√						√	√
PSO-6	√			√					
PSO-7		√	√				√	√	
PSO-8					√	√		√	√
PSO-9	√	√			√	√		√	
PSO-10			√						√

Semester 4

PSO	Molecular Genetics	Biosafety, Bioethics and IPR in Biotechnology	Enzyme Technology	Plant Biotechnology	Drug Designing and Pharmaco-genomics	Nano Biotechnology	Dissertation
PSO-1	√	√		√		√	√
PSO-2	√			√			√
PSO-3		√		√			
PSO-4	√			√			
PSO-5	√			√			
PSO-6					√		
PSO-7	√			√			
PSO-8			√			√	
PSO-9		√	√	√	√		
PSO-10		√					√

Indira Gandhi University, Meerpur, Rewari

Department of Biotechnology

Scheme of the Examination for Post-Gradute Programme

As per NEP-2020 w.e.f. 2024-2025 Batch (in phased manner)

Framework-2 (Scheme P)

Semester I

Total Credit-26 | **Total Marks - 650**

Course Type	Course Code	Nomenclature of Course	Theory (T) / Practical (P)	Credits		Contact hours per week				Marks			Examination hours
				Course	Total	L	T	P	Total	Internal Assessment	End Term Examination	Total	
CC-1	24L6.0-BTY-101	Cell and Molecular Biology	T	4	26	4	0	0	4	30	70	100	3
CC-2	24L6.0-BTY-102	Biomolecules and Metabolism	T	4		4	0	0	4	30	70	100	3
CC-3	24L6.0-BTY-103	Tools and Techniques in Biotechnology	T	4		4	0	0	4	30	70	100	3
CC-4	24L6.0-BTY-104	Microbiology	T	4		4	0	0	4	30	70	100	3
PC-1	24L6.0-BTY-105	Lab Course-I (Based on CC1 & CC2)	P	4		0	0	8	8	30	70	100	4
PC-2	24L6.0-BTY-106	Lab Course-II (Based on CC3 & CC4)	P	4		0	0	8	8	30	70	100	4
SEMINAR	24L6.0-BTY-107	Seminar	S	2		0	0	0	2	0	50	50	1

Indira Gandhi University, Meerpur, Rewari

Department of Biotechnology

Scheme of the Examination for Post-Gradute Programme

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Framework-2 (Scheme P)

Semester II

Total Credit-26 | **Total Marks - 650**

Course Type	Course Code	Nomenclature of Course	Theory (T) / Practical (P)	Credits		Contact hours per week				Marks			Examination hours
				Course	Total	L	T	P	Total	Internal Assessment	End Term Examination	Total	
CC-5	24L6.0-BTY-201	Immunology	T	4	26	4	0	0	4	30	70	100	3
CC-6	24L6.0-BTY-202	Fundamental of Data Analysis	T	4		4	0	0	4	30	70	100	3
CC-7	24L6.0-BTY-203	Genetic Engineering	T	4		4	0	0	4	30	70	100	3
CC-8	24L6.0-BTY-204	Virology & Vaccinology	T	4		4	0	0	4	30	70	100	3
PC-3	24L6.0-BTY-205	Lab Course-III (Based on CC5 & CC6)	P	4		0	0	8	8	30	70	100	4
PC-4	24L6.0-BTY-206	Lab Course-IV (Based on CC7 & CC8)	P	4		0	0	8	8	30	70	100	4
*CHM	24L6.0-BTY-207	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
Internship	M24-INT-200	An internship course of 4 Credits of 4-6 weeks duration during summer vacation after IInd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.								50	50	100	

Note: 1. If a student takes exit after the successful completion of first two semesters after earning 56 Credits, then a **Post Graduate Diploma in Subject** will be awarded to that candidate.

2. *One course of 2 Credits on Constitutional, Human and Moral values and IPR (CHM) will be compulsory for all the PG programmes.

Indira Gandhi University, Meerpur, Rewari

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Scheme of the Examination for Post-Gradute Programme

As per NEP-2020 w.e.f. 2024-2025 Batch (in phased manner)

Framework-2 (Scheme P)

Semester III

Total Credit-26 | **Total Marks - 650**

Course Type	Course Code	Nomenclature of Course	Theory (T) / Practical (P)	Credits		Contact hours per week				Marks			Examination hours
				Course	Total	L	T	P	Total	Internal Assessment	End Term Examination	Total	
CC-9	24L6.5-BTY-301	Animal Cell Culture	T	4	26	4	0	0	4	30	70	100	3
CC-10	24L6.5-BTY-302	Molecular Diagnostics	T	4		4	0	0	4	30	70	100	3
DEC-1 Any one	24L6.5-BTY-303	Plant Cell and Tissue Culture	T	4		4	0	0	4	30	70	100	3
	24L6.5-BTY-304	Bioinformatics	T	4		4	0	0	4	30	70	100	3
DEC-2 Any one	24L6.5-BTY-305	Bioprocess Technology	T	4		4	0	0	4	30	70	100	3
	24L6.5-BTY-306	Food Biotechnology	T	4		4	0	0	4	30	70	100	3
PC-5	24L6.5-BTY-307	Lab Course-V (Based on CC-9 & CC-10)	P	4		0	0	8	8	30	70	100	4
PC-6	24L6.5-BTY-308	Lab Course-VI (Based on DEC-1 & DEC-2)	P	4		0	0	8	8	30	70	100	4
OEC*	24L6.5-BTY-309	Biology of Infectious Disease	T	2		2	0	0	2	15	35	50	3

OEC* offered by Dept. of Biotechnology, and to be chosen by students of other departments only.

Note: OEC course by Biotechnology students will be opted from the pool of OEC courses offered by other departments.

Indira Gandhi University, Meerpur, Rewari

Department of Biotechnology

Scheme of the Examination for Post-Gradute Programme

As per NEP-2020 w.e.f. 2024-2025 Batch (in phased manner)

Framework-2 (Scheme P)

Semester IV

Total Credit-26 | **Total Marks - 650**

Course Type	Course Code	Nomenclature of Course	Theory (T) / Practical (P)	Credits		Contact hours per week				Marks			Examination hours
				Course	Total	L	T	P	Total	Internal Assessment	End Term Examination	Total	
DEC-3* **Anyone**	24L6.5-BTY-401	Molecular Genetics	T	4	26	4	0	0	4	30	70	100	3
	24L6.5-BTY-402	Biosafety, Bioethics and IPR in Biotechnology	T	4		4	0	0	4	30	70	100	3
DEC-4* **Anyone**	24L6.5-BTY-403	Enzyme Technology	T	4		4	0	0	4	30	70	100	3
	24L6.5-BTY-404	Plant Biotechnology	T	4		4	0	0	4	30	70	100	3
DEC-5* **Anyone**	24L6.5-BTY-405	Drug Designing and Pharmacogenomics	T	4		4	0	0	4	30	70	100	3
	24L6.5-BTY-406	Nano Biotechnology	T	4		4	0	0	4	30	70	100	3
EEC	24L6.5-BTY-407	Research Ethics	T	2		1	0	1	2	15	35	50	3
Dissertation	24L6.5-BTY-408	Dissertation	D	12		0	0	0	-	100	200	300	-
Grand Total			**Credits-108**						**Marks-2700**				

Note:

1. ***Students can opt up to 40% of total elective courses (**up to 3 courses**) mentioned in the Scheme available on SWAYAM/NPTEL/MOOCs Portal, or other online portal recognized by the UGC and the University.
2. A student will be awarded with **Master Degree in the Subject** after successful completion of 2 year PG Programme by earning 108 Credits.

OR

3. A student will be awarded with **Master Degree in the Subject** after successful completion of 1 year PG Programme by earning 52 Credits, in the case of lateral entry after 4 year UG Programme with Honours/ Honours with Research/ one year PG Diploma in the Subject

Abbreviations: -

L	:	Lecture
P	:	Practical
T	:	Tutorial
CC	**:**	Core Course
PC	**:**	Practicum Courses
DEC	:	Discipline Centric Elective Course
EEC	:	Employability & Entrepreneurship Skills Course
CHM	**:**	Constitutional, Human and Moral values, and IPR
OEC	**:**	Open Elective Course

Internal Assessment Marks will be further distributed as per following tables:

Course Composition- Theory/(Theory +Tutorial)			
Course Credit	**Internal Assessment Marks**	**End-Term ExamMarks**	**Total Marks**
2	15	35	50
4	30	70	100

Course Composition- Theory + Practical						
Course Credit		**Theory**		**Practical**		**Total Marks**
Theory	**Practical**	**Internal Assessment Marks**	**End-Term Exam Marks**	**Internal Assessment Marks**	**End-Term Exam Marks**	
1	1	10	20	5	15	50
2	0	15	35	-	-	50
4	0	30	70	-	-	100
0	4	-	-	30	70	100

Breakup of Internal Assessment Marks of Theory			
Total Internal Assessment Marks (Theory)	**Class Participation**	**Seminar/Presentation/ Assignment/Quiz/Class Test, etc.**	**Mid-Term Examination**
10	4	0	6
15	4	4	7
20	5	5	10
30	5	10	15

Breakup of Internal Assessment Marks of Practicum			
Total Internal Assessment Marks (Practicum)	**Class Participation**	**Seminar/Demonstration/ Viva-Voce/Lab record/Fieldwork/Survey etc.**	**Mid-TermExam**
5	0	5	0
10	5	5	0
30	5	10	15

Contents of the Syllabi

Course Name: Cell and Molecular Biology					**Course Code:** 24L6.0-BTY-101		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: I**	**L**	**T**	**P**	**Credits**	**Exam Course Code-101**
			4	0	0	4	**Course Type: CC-1**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	Objective of the course is to make the students to understand the basic concepts of cell biology, protein sorting, cell signaling, cell cycle, DNA replication, repair, recombination, transcription, translation and gene expression in both prokaryotes and eukaryotes at molecular level.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.**Common features of cytoskeleton, and the process of protein sorting in different cell organelles. **CLO2.**Cell cycle, and how the cell cycle is regulated, and how signals transducers and their receptors work together. **CLO3**. Basic knowledge about the structure of DNA & how it replicates, transcription and translation in prokaryotes and eukaryotes. **CLO4.**Various ways in which these biological processes are regulated and the significance of regulation in maintaining life forms.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Cytoskeleton and Cell Movement:** Structure and organization of actin filaments,myosin and cell movements, Muscle contraction. **Protein Sorting and Transport:** Protein uptake into the ER, Membrane proteins and Golgi sorting, mechanism of vesicular transport, Lysosomes, molecular mechanism of secretory pathway. **Cell Cycle:** The eukaryotic cell cycle and its regulations, events of M phase, meiosis and fertilization.	25
II	**Cell–Cell Signaling:** Signaling molecules and their receptors, function of cell surface receptors, pathways of intracellular signal transduction, signaling networksProgrammed cell death, biology of Cancer. **Replication:** Prokaryotic and eukaryotic DNA replication, mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication and DNA repair.	25

III	**Transcription:** Prokaryotic and eukaryotic transcription, RNA polymerase, general and specific transcription factors, regulatory elements in mechanisms of transcription regulation, transcriptional and post-transcriptional modifications, nuclear export of mRNA, mRNA stability. **Translation:** Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation, co- and post translational modifications of proteins.	25
IV	**Antisense and Ribozyme Technology:** Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, biochemistry of ribozyme, hammer head, hairpin and other ribozymes, strategies for designing ribozymes, applications of antisense and ribozyme technologies. **Homologous Recombination:** Holliday junction, gene targeting, gene disruption, *FLP/FRT* and *Cre/Lox* recombination, *RecA* and other recombinases.	25

Suggested Readings:

1. Molecular Biology of the Cell. Darnell, J., Lodish, H. and Baltimore, D. Scientific American Book, Inc., USA.
2. The Cell: A Molecular Approach. (2018), 8th ed., Cooper, G.M., Sinauer Associates is an imprint of Oxford University Press, ISBN: 1605357073.
3. Molecular Biology of the Cell. (2014) 6th ed., Alberts, B., Johnson, A., Lewis J., Raff, M., Roberts, K.,and Walter, P., Garland Science Publishing.
4. The World of the Cell. (2017), 10th ed., Becker, W.M., Klein, L.J. and Hal din, J., Pearson Education
5. Karp's Cell Biology. (2019), 9thed. Iwasa, J., Marshal, W., Wiley publication.
6. Essentials of Molecular Biology. Friefilder, D., Jones and Barllett Publication.
7. Gene XII. (2017), 12th ed., Lewin, B. Oxford University Press, U.K.
8. Molecular Biology of the Cell. (2008), 6th ed., Alberts, B., Johnson, A., Lewis, J. and Enlarge, M., Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN: 0-8153-1620-8.
9. Lehninger's Principles of Biochemistry. (2017), 7th ed., Nelson, D.L., Cox, M.M., W.H. Freeman andCompany, New York, USA. ISBN-10: 1-4641-2611-9.
10. Biochemistry. (2019), 9th ed., Stryer, L., Berg, J.M., Tymoczko, J.L., Gatto, Jr., G.J., W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9
11. Molecular Biology of the Gene. (2013), 7th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A.M., Levin, R.L. and Cumming, B., San Francisco, ISBN: 0321905377.
12. Encyclopedia of Molecular Biology. Kendrew, J., Blackwell Scientific Publications, Oxford.

Course Name: **Biomolecules and Metabolism**					**Course Code:** **24L6.0-BTY-102**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: I**	**L**	**T**	**P**	**Credits**	**Exam Course Code-102**
			4	0	0	4	**Course Type: CC-2**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**					**Examination Duration :** 3 Hrs.		
Course Objectives	The objective of the course is to give basic knowledge of biochemistry to the students. This course covers structure and function of biomolecules, and details of the metabolism of biomolecules involved in life processes.						
Course Outcomes	**After completing this course, students are expected to learn the following:** **CLO1.** About basics of biochemistry. **CLO2.** About classification of sugars and metabolism of carbohydrates. **CLO3.** How pH is maintained in body fluids, different kinds of lipids and their functions in life and their oxidation. **CLO4.** It enhances the knowledge about different types of amino acids and protein Structures, disease related to metabolic defects.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Chemical Foundations of Biology**: pH, pK, acids, bases, buffers, stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interactions, weak bonds, covalent bonds). **Organic Compounds:** Classes of organic compounds and functional groups atomic and molecular dimensions, space filling and ball and stick models. Water and its properties.	25
II	**Carbohydrates:** Sugars - classification and reactions, Polysaccharide types, Primary, secondary and tertiary structural features, and metabolism of carbohydrate (Glycolysis, pentose-phosphate pathway, glycogen metabolism, gluconeogenesis, Citric acid cycle). **Bio-energetics -** Oxidative Phosphorylation.	25

III	**Blood Clotting:** biochemistry, body fluids –pH and acid base balance and their importance in clinical biochemistry, muscle contraction. **Lipids:** classification, functions and metabolism (β-Oxidation)	25
IV	**Proteins:** Amino acids and peptides-classification, chemical reactions and physical, properties, Ramachandran map. **Enzymes:** Enzymes (MM equation, Km, Vmax, LB plots), Co-enzymes **In born errors of metabolism**	25

Suggested Readings:

1. Leininger's Principles of Biochemistry. (2021), 8th ed., Nelson, D.L. and Cox, M.M., Freeman, W.H. and Company (New York), ISBN: 978-1319108243.
2. Biochemistry. (2017), 6th ed., Garrett, R.H. and Grisham, C.M., Brooks & Cole, ISBN: 9781305577206.
3. Harper's Illustrated Biochemistry. 32nd ed., Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P.J. and Weil, P.A., McGraw-Hill, ISBN: 9781259837937.
4. Lippincott's Illustrated Reviews Biochemistry. (2017), 7th ed., Ferrier, Wolters Kluwer India Pvt. Ltd., ISBN: 978-9351297949.
5. Biochemistry. (2019), 9th ed., Stryer, L., Berg, J.M., Tymoczko, J.L., Gatto Jr., G.J., Freeman,W.H. and Company, New York, USA. ISBN:10-1-319-11467-9.
6. Essentials of Biochemistry. (2022), 6th edition by Satyanarayana and Chakrapani. Elsevier, India.
7. Biochemistry. (2018), 5th ed.,Voet,D. ,Voet, G. ,John Wiley & Sons.

Course Name: **Tools and Techniques in Biotechnology**					**Course Code:** **24L6.0-BTY-103**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: I**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 103**
			4	0	0	4	**Course Type: CC-3**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**					**Examination Duration :** 3 Hrs.		
Course Objectives	The objective of this course is to create a broad understanding of principles, applications, and instrumentation used in biotechnology.						
Course Outcomes	**After completing this course, students are expected to learn the following:** **CLO1.** Have knowledge of instruments work on which principles and their application. **CLO2.** Capable of analyzing different biological samples/products by choosing appropriate tools/Techniques while handling different samples/products.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Microscopy:** Principles and applications of light, phase contrast, fluorescence, scanning tunneling and transmission electron microscopes. **Centrifuge Technique:** Principle, types of centrifuges, density gradient centrifuge in isolation of cell, cell organelles and biomolecules, ultracentrifugation (velocity and buoyant density).	25
II	**Chromatography:** Principles and applications of gel filtration, ion exchange, affinity, thin layer, gas chromatography and high-pressure liquid chromatography (HPLC) and FPLC, application of chromatographic technique in biology. **Electrophoresis:** Principles and applications of agarose and polyacrylamide gel electrophoresis, 2D gel electrophoresis, DIGE (Differential in gel electrophoresis),sequencer**.**	25
III	**Spectroscopy:** Fluorescence, UV, visible, Infrared, atomic absorption spectroscopy, circular dichroism, NMR, and ESR spectroscopy, mass spectrometry (LC-MS, GC-MS), PMF (Protein mass fingerprinting), X-ray diffraction. application of different spectroscopic techniques in biology. **Principles and Applications of Tracer Techniques in Biology:** Radioactive isotopes and half-life of isotopes, autoradiography. CHIP, N-terminal sequencing and peptide synthesis.	25

IV	**Nature and Types of Radiation:** Preparation of labeling biological sample detection and measurement of radiation, calorimetry, GM counter, scintillation counter, Safety measurement in handling radioisotopes. **Immunological Evaluation technique:** Flow Cytometry**,** ELISA, RIA and non-radiolabeling, Recent advances in the field.	25

Suggested Readings:

1. Principles and Methods of Plant Molecular Biology Biochemistry and Genetics. (2000), Devi, P. Agrobios, Jodhpur, India.
2. Tools in Biochemistry. (2010), Cooper, T. G. Wiley, J. New York, USA.
3. Experimental Biochemistry. (1989), Dryer, R. L. and Lata, G. F., Oxford University Press, New York.
4. Gel Electrophoresis of Proteins: A Practical Approach. (1998), 8th ed., Hames, B.D. PAS, OxfordUniversity Press, Oxford, UK.
5. Techniques and Practice of Chromatography. (2020), Scott, R.P.W. Marcel Dekker, Inc., New York.
6. Practical Biochemistry: Principles and Techniques.9th ed. Wilson, K. and Walker, J. Cambridge University Press, Cambridge, UK.

Course Name: Microbiology					**Course Code: 24L6.0-BTY-104**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: I**	**L**	**T**	**P**	**Credits**	**Exam Course Code-104**
			4	0	0	4	**Course Type: CC-4**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	Objective of this course is to introduce students to the Microbial world and to understand the microbial evolution, systematic classification and taxonomy, interaction with environment.						
Course Outcomes	**After completing this course, students are expected to learn the following:** **CLO1**. This course will make the students to understand the microbial evolution, systematicclassification and taxonomy. **CLO2**. About different cultures methods and microbial growth and how different factors affectthe growth of microbes. **CLO3**. It gives knowledge about diversity of microbes, Action of antibiotics. **CLO4**. The Virus structures and Phages.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%).
I	**The Beginning of Microbiology:** Discovery of the microbial world by Antony vanLeeuwenhoek, controversy over spontaneous generation, developments of microbiology in the twentieth century. **Microbial Evolution, Systematic and Taxonomy:** characteristics of primary domains taxonomy, nomenclature and Bergey's Manual, new approaches to bacterial taxonomy classification including ribotyping, ribosomal RNA sequencing.	25
II	**Microbial Culture Methods:** Development of pure culture methods, enrichment culture methods, Pure culture techniques, principles of microbial nutrition construction of culture media, theory and practice of sterilization, culture collection and maintenance of cultures**.** **Microbial Growth:** The definition of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen. **Metabolic Diversity among Microorganisms:** Photosynthesis in microorganisms, chemolithotrophy, methanogenesis and acetogenesis,nitrogen metabolism, nitrogen fixation.	25

III	**Prokaryotic Cells:** Capsule, glycocalyx, S-Layer, detailed structure of cell walls of Gram positive and Gram negative bacteria, LPS, protoplasts, spheroplasts, L - forms, flagella and motility, cell membranes of eubacteria and archaeobacteria. **Endospores-** structure, functions and stages, mesosomes, bacterial chromosomes, pili, Ames test for mutagenesis, Bacterial transformation, conjugation, transduction.	25
IV	**Prokaryotic Diversity Bacteria:** Genetic systems of Yeast and Neurospora Purple and green bacteria, cyanobacteria, homoacetogenic bacteria, acetic acid bacteria, budding and appendaged bacteria, spirilla, spirochaetes, gliding and sheathed bacteria, pseudomonas, endospore forming rods and cocci, mycobacteria and mycoplasma. archaea, archaea as earliest life forms, halophiles, methanogens, hyperthermophiles, urchaea, thermoplasma. **Eukaryotic**: Brief introduction of Algae, Fungi, Slime molds and Protozoa.	25

Suggested Readings:

1. An Introduction to Microbiology. (2019), 3rd ed., Tauro, P., Kapoor, K.K., Yadav, K.S., and Sequeira, M.G. New Age International Publishers. ISBN: 0852268785.
2. Brock Biology of Microorganisms. (2018), 15th ed., Madigan, M.T, Martinko, J.M., Bender, K.S., Buckley, D.H., Stahl, D.A. Pearson Education, ISBN: 9781292235103.
3. Prescott's Microbiology. 11th ed., Sherwood, L.M., Woolverton, C.J., McGraw-Hill Education. ISBN:9781259281594.
4. A textbook of Microbiology. 3rd ed. Dubey, R.C. and Maheshwari, D.K. Revised S. Chand and Company Ltd, New Delhi. ISBN: 9788121926201.
5. Microbiology. (2007), Pelczar Jr. M., McGraw Hill Education ISBN: 9780074623206.
6. Microbiology. Lim, D. V. West Publishing Company, New York.
7. Microbiology: An introduction. (2022), 13th ed., Tortora, G. J., Funke, B. R. and Case, C. L. Pearson Education.
8. Microbiology: Fundamental and Applications. (1998), Atlas, R.M. Macmillan Publishing company, New York.
9. Microbiology in action. (1999), Heritage, J., Evance, E.G.V. and Killington, R.A. Cambridge University Press.
10. General Microbiology. 5th ed., Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., Painter, P. R. MacMillan Press Ltd.

<table>
<tr><td colspan="4">Course Name:
Lab Course I</td><td colspan="4">Course Code:
24L6.0-BTY-105</td></tr>
<tr><td rowspan="2">Batch:
2024-2026</td><td rowspan="2">Programme:
M.Sc. Biotechnology</td><td rowspan="2">Semester: I</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Exam Course Code-105</td></tr>
<tr><td>0</td><td>0</td><td>8</td><td>4</td><td>Course Type: PC-1</td></tr>
<tr><td colspan="8">Level of the Course: 400-499</td></tr>
<tr><td colspan="4">End Semester Exam : 70 marks
Internal Assessment : 30 marks
Total : 100 marks</td><td colspan="4">Examination Duration : 4 Hrs.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">Objective of this course to understand the working & handling of various equipment in the lab, safety measures and protocols for lab work.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">After completing this course, the students are expected to learn the following:
CLO1. Learn about different separation techniques of biomolecules.
CLO2. Understand the principle, working and handling of various equipment for biotechnology work, safety measures, and protocols for microbial and molecular work.
CLO3. Imbibe the value of team spirit while working together in team during practical sessions.</td></tr>
<tr><td colspan="8">COURSE SYLLABUS</td></tr>
<tr><td>Unit No.</td><td colspan="6">Contents</td><td>Weightage (%)</td></tr>
<tr><td></td><td colspan="6">Suggested Practicals:

1. To study the mitosis and meiosis in cell division by the permanent slides.
2. To prepare the slides of mitotic chromosomes.
3. To study the calculation of morphometric data and preparations of idiogram.
4. To determination of chiasma frequency and terminalization coefficient.
5. To prepare the polytene chromosomes and mapping.
6. To identify the reducing and non-reducing sugars by various methods.
7. To determine the pK by molorimetric method.
8. Demonstration of Paper chromatography techniques.
9. To study the model building using space filling/ball and stick models.
10. To demonstrate the separation of proteins with the help of electrophoresis
11. To study the reactions of amino acids, sugars and lipids.
12. To study the quantitation of Proteins and Sugars.
13. To analyze the oil’s-iodine number, saponification value, acid number.
14. Quantification of Nucleic Acids.

Note: Any other relevant practical can be offered</td><td>100</td></tr>
</table>

Course Name: **Lab Course II**					**Course Code:** **24L6.0-BTY-106**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: I**	**L**	**T**	**P**	**Credits**	**Exam Course Code-106**
			0	0	8	4	**Course Type: PC-2**

Level of the Course: 400-499	
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**	**Examination Duration: 4** Hrs.

Course Objectives	Objective of this course to understand the working & handling of various equipment in the lab, safety measures and protocols for lab work.
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Acquire comprehensive knowledge and practical skills in a wide range of laboratory techniques essential for microbiological and biochemical analyses. **CLO2.** Develop proficiency in using advanced instruments and equipment such as microscopes, spectrophotometers, chromatographs, and electrophoresis systems. **CLO3.** Gain hands-on experience in microbiological cultivation, isolation, and characterization techniques, enhancing understanding of microbial growth, physiology, and diversity. **CLO4.** Improved skills to perform various tests/assays and experiments on different instrumentsof lab.

COURSE SYLLABUS

Unit No.	**Contents**	**Weightage (%)**
	Suggested Practicals: 1. Demonstration of different types of microscopes. 2. Demonstration of chromatography techniques i.e., HPLC, GC. 3. Demonstration of various molecular biology techniques i.e., PCR, RT-PCR, Western Blot. 4. Demonstration of spectrophotometer, ELISA. 5. Purification of protein by column chromatography. 6. To study the UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra. 7. To study the separation techniques - Centrifugation, Chromatography (Gelpermeation, Ion exchange, TLC etc.). 8. Visit of laboratories in various university and, preparation and submission of visit report. 9. To prepare the liquid and solid media for growth of various microorganisms. 10. To study the isolation and maintenance of microorganisms by plating, streaking, and serial dilution method. 11. To study the storage and of microorganisms by different methods.	100

	12. To study the isolation of pure cultures from various soil and water samples. 13. To study the Growth curve, and measurement of bacterial population by turbidometry and serial dilution methods. 14. To study the effect of temperature, pH and carbon and nitrogen sources on microbial growth. 15. To study the microscopic examination of bacteria/spores by staining methods. 16. To study the microscopic examination of yeast and molds/spores by various staining methods. **Note: Any other relevant practical can be offered**	

<table>
<tr><td colspan="5">Course Name:
Seminar</td><td colspan="3">Course Code:
24L6.0-BTY-107</td></tr>
<tr><td rowspan="2">Batch:
2024-2026</td><td rowspan="2">Programme:
M.Sc. Biotechnology</td><td rowspan="2">Semester: I</td><td>S</td><td>T</td><td>P</td><td>Credits</td><td>Exam Course Code-107</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>Course Type: Seminar</td></tr>
<tr><td colspan="8">Level of the Course: 400-499</td></tr>
<tr><td colspan="4">Total Evaluation Marks: 50
(Internal Evaluation Only)</td><td colspan="4">Seminar Duration: 30 mins (Each Student)</td></tr>
<tr><td>Course Objectives</td><td colspan="7">Objective of this course to develop Presentation skills, Oration skill.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">After completing this course, the students are expected to learn the following:
CLO1: Knowledge of Power Point Presentation
CLO2: Develop Confidence
CLO3: Enhance Oration and analytical Skill.</td></tr>
<tr><td colspan="8">COURSE SYLLABUS</td></tr>
<tr><td></td><td colspan="6">Guideline</td><td></td></tr>
<tr><td></td><td colspan="6">The students are required to present a seminar the theme/ topic allotted/given to him/her from the Review articles/original research articles published in International/Reputed National journals in his/her area of interest. The topic will be selected by the student in consultation with the teacher allotted to him/her by the department. An Internal committee of teachers headed by the Chairperson of the Department will evaluate the seminar presented by the students. The evaluation (Internal evaluation only) will be based on the presentation (30 min.) of student, depths of subject knowledge and answer to questions.</td><td></td></tr>
</table>

Course Name: Immunology					**Course Code: 24L6.0-BTY-201**		
Batch: 2024-2026	**Programme:** M.Sc.Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 201**
			4	0	0	4	**Course Type: CC-5**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The objectives of this course are to learn about structural features of components of immune system as well as their function & mechanisms by which our body elicits immune response.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** This course will make the students to understand when and how immune system responds. **CLO2.** About different types of immune cells and when and how specific type of immune cell activates. **CLO3.** It gives knowledge about basic mechanism of hypersensitivity responses. **CLO4.** Types of transplantation, immunological tolerance and monoclonal antibodies and how vaccine works.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Introduction:** Phylogeny of immune system, Innate and acquired immunity, clonalnature of immune response. **Lymphoid organs:** Structure and function of primary lymphoid organs- Bone Marrow and Thymus and secondary lymphoid organs-Lymph node, Spleen etc. Hematopoiesis. **Antigens:** Types, properties, immunogenicity versus antigenicity, epitopes, haptens, super antigens.	25
II	**Cells of the immune system:** B-Lymphocytes, T-Lymphocytes, BCR & TCR, macrophages, dendritic cells, natural killer and, eosinophils, basophils, neutrophils and mast cells. **Antibody**: structure and function, antigen-antibody interactions Affinity, Avidity, Cross reactivity, - Precipitation Tests, Agglutinations tests Enzyme linked immunosorbent assays (ELISAs), Radio immunoassay (RIA) **Major Histocompatibility Complex (MHC):** Organization of Class I, II, III, **Complement cascade system**: complement components, functions, activation pathways	25

III	**Cell mediated immune response:** Antigen processing and presentation, Induction and mechanism, antibody-dependent cell mediated cytotoxicity (ADCC) **Cytokines a**nd their role in immune regulation; Toll-like receptors (TLRs). **Hypersensitivity**: Type I, II, III and IV hypersensitivity reactions.	25
IV	**Immunological Tolerance:** Autoimmunity, Transplantation, immunity t **Tumor Immunology:** AIDS and other Immunodeficiency, Hybridoma technologyand monoclonal antibodies, **Concept and mechanism of Vaccines**, **Recent advances and application in the field.**	25

Suggested Readings:

1. Cellular and Molecular Immunology. (2019), 6th ed., Abbas, A.K., Lichtman, A.H., Pillai, S. ISBN: 978-0323549431.
2. Kuby's Immunology. (2018), 8th ed., Punt, J., Stranford, S., Jones, P. and Owen, J.A., Freeman, W.H. &Company, ISBN: 978-1319114701.
3. Janeway's Immunobiology. (2017), 9th ed., Murphy, K.M. and Beaver, C. W.W. Norton and Company,ISBN: 978-0815345510.
4. Roitt's Essential Immunology. (2017), 13th ed., Delvis, P.J., Martin, S.J., Burton, D.R. and Roitt, I.M.,Wiley-Blackwell, ISBN: 978-1118415771.
5. Lippincott's illustrated Reviews Immunology. (2012), 2nd ed., Doan, T., Melvold, R., Viselli, S., and Waltenbaugh, C., Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.
6. Immunology – An introduction, 4th ed., Tizard,I.R, Philadephia Sauders College press.
7. Fundamentals of immunology. William,P. Lippincott Williams & Wilkins.

Course Name: Fundamentals of Data Analytics					**Course Code: 24L6.0-BTY-202**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 202**
			4	0	0	4	**Course Type: CC-6**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The aim of the course to enhance the knowledge of Data analytics i.e., science of analyzing data to convert information to useful knowledge.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** This knowledge could help us understand, analyze and interpret results in many contextsus to make better decisions. **CLO2.** This course seeks to enable the students get an insight into data analytic technique by gathering, storing, and processing the data, creating an even stronger for the use of empirical approaches to problem solving motivation. **CLO3.** It is structured around the broad contours of the different types of data analytics, namely,descriptive, influential, predictive and prescriptive analytics.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Data Analytics:** Introduction, types, characteristics, and advantages of data analytics. **Descriptive Statistical Techniques:** Central tendency, dispersion, skewness andkurtosis. **Correlation and Regression:** Simple, partial and multiple.	25
II	**Probability Theory:** Concept and approaches, application of additive and multiplication laws, Bay's theorem, mathematical expectations, probability distribution- binomial, poisson, normal. **Inertial Statistics:** Sampling parameter and statistic, sampling and non-sampling errors, sampling distribution of the mean, proportion and difference of means, central limit theorem, Hypothesis testing, level of significance.	25
III	**Parametric Test**: t-test and analysis of variance - one way classification, two-wayclassification, Chi- square and its application. **Non-Parametric Test:** The run test of randomness: test of two –matched samples- Wilcoxon signed-rank-sum tests, test involving two independent sample- the Mann-Whitney U test, test for K related samples- the Kruskal-Wallis or H test, Friedmann test.	25

IV	**Overview of Analytic Tools:** Excel as analytical tool, SPSS, STATA data visualization tools, elementary idea and use of R programming and Python in analytics, data mining, big data. Introduction and applications of artificial intelligence.	25

Suggested Readings:

1. Biostatistics. Arora and Malhan, P.K. Himalaya Publishing House.
2. Experimental Design and Data Analysis for Biologists. Gerry, P., Quinn & Michael, J. Keough Cambridge University Press.
3. Principles of Biostatistics (with CD-ROM) (Hardcover). Pagano,M. and Kimberlee, G. Duxbury Press.
4. Biostatistics: Experimental Design and Statistical Inference (Hardcover). Zolman., J.F. Oxford University Press.
5. Intuitive Biostatistics. Harvey, M. Oxford University Press.
6. Introduction to Biostatistics. Robert, R., Sakal & James., F., Rohlf Dover Publications, Inc.Mineola, New York.
7. Introductory Biostatistics. Chap, T. Le, John, A., Wiley & Sons Publication.

Course Name: **Genetic Engineering**					**Course Code:** **24L6.0-BTY-203**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code-203**
			4	0	0	4	**Course Type: CC-7**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**				**Examination Duration :** 3 Hrs.			
Course Objectives	This course aims to teach students with various approaches to conducting recombinant DNA technology and their applications in biological research as well as in the biotechnology industries.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Understand the different techniques and procedures to manipulate genetic material. **CLO2.** Basic concepts and different methodologies used for isolation, purification and manipulation of nucleic acids, gene cloning, transformation, selection of desired clones, protein-protein interactions, Site-directed mutagenesis, gene expression and regulation, andnucleic acid sequencing. **CLO3.** Methodology and types of PCR and its applications in diverse fields of life sciences. **CLO4.** Work in the latest research areas of biotechnology like microbial, industrial, plant,animal, environmental, health, etc. using genetic engineering techniques.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Scope and Milestones in Genetic Engineering:** Genetic engineering guidelines, molecular tools and their applications, restriction enzymes, modification enzymes,DNA and RNA markers. **Nucleic Acid:** Purification, yield analysis, nucleic acid amplification and its applications, restriction mapping of DNA fragments and map construction. **Gene Cloning Vectors:** Prokaryotic vectors (Plasmid, Bacteriophage, Lambda Phage, Cosmid, Phagemid), eukaryotic vectors (Yeast Episomal Plasmid, YAC, SV40, Adenoviruses, Retroviruses, Ti Plasmid, Ri Plasmid).	25

II	**Sequencing:** Nucleic acid sequencing, DNA primers, linkers, adaptors and their chemical synthesis, alternative strategies of gene cloning. **Library Construction and Screening:** Generation of genomic library, reverse transcription, cDNA Library.	25
III	**Cloning interacting genes:** Two-and three hybrid systems, cloning differentially expressed genes, nucleic acid microarray arrays, site-directed mutagenesis and protein engineering, study of gene regulation, DNA transfection, northern blot, primer extension, S1 mapping, RNase protection assay, reporter assays. **Expression Strategies for Heterologous Genes:** Vector engineering and codon optimization, host engineering, in vitro transcription and translation, expression in bacterial system, expression in yeast, expression in insect cells, expression in mammalian cells, and expression in plants.	25
IV	**Processing of Recombinant proteins:** Purification and refolding, characterization of recombinant proteins, stabilization of proteins, T-DNA and transposon tagging, role of gene tagging in gene analysis, identification and isolation of genes through T-DNA or transposon. chromosome engineering **Gene Therapy:** Vector engineering strategies of gene delivery, gene knockout technologies gene replacement/augmentation, gene correction, gene editing, CRISPER, gene regulation, and silencing.	25

Suggested Readings:

1. Principles of Gene Manipulation and Genomics. (2016), 8th ed., Primrose, S.B. and Twyman, R., WileyBlackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction. (2019), 7th ed., Brown, T.A., Wiley Blackwell, ISBN:978-1119072560.
3. Genome 4. (2017), 4th ed., Brown, TA, Garland science, ISBN 13: 978-0815345084.
4. Introduction to Genomics. (2015), 2nd ed., Lesk, A.M., Oxford university Press India, ISBN: 9780198745891.
5. Genomics and Personalized Medicine: What Everyone needs to Know. (2016) ,1st ed., Snyder, M., OUP-USA, ISBN: 978-019023476.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA.3rd ed., Bernard, R. G. and JPasternak, J.J. ASM press, Washington.
7. Gene XII. (2017), 12th ed., Lewin, B. Oxford University Press, U.K
8. Biochemistry. (2019), 9th ed., Stryer, L., Berg, J.M., Tymoczko, J.L., Gatto, Jr., G.J., W.H. Freeman and Company, New York, USA. ISBN-10: 1-319-11467-9

Course Name: Virology & Vaccinology					**Course Code: 24L6.0-BTY-204**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 204**
			4	0	0	4	**Course Type: CC-8**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The aim of the course to enhance the knowledge about viruses						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Learn the discovery, nature, origin and evolution of viruses and the physical, biochemical, and biological properties of viruses, criteria used for nomenclature and classification of bacterial, plant and animal viruses. **CLO2.** Describe the methods used for isolation, cultivation, and purification of viruses and criteria of purity. **CLO3.** Define biological, physical, biochemical, and serological methods used for quantization of viruses, major characteristics of important plant and animal virus families and biology and applications of major RNA and DNA viruses. **CLO4.** Different types of vaccine & their working.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting at least four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**History:** History and Evolution of viruses; Properties of viruses. **Classification of viruses:** Classification of viruses. virus taxonomy, Virus structure and morphology, Biological-Host range (Human, Animal, Zoonotic, Plant, Bacteriophages, oncolytic viruses and viroids) Bio-safety, containment facilities, maintenance and requirements of virological laboratory **Transmission of viruses:** Non-vector and vector mode of transmission of viruses. **Virus-cell Interaction:** Definition, structure and methods of discovery of viral receptors. Cellular interactions, virus –cytoskeletal interactions, Host cell 'shut off', apoptosis, necrosis, stress response, alteration of signaling pathways. Mechanism of viral persistence and latency	25
II	**Replication**: Introduction to virus replication strategies, Replication sites and their characterization, IRES, replicons, transport of viral proteins; Replication of positive sense and negative sense RNA viruses dss/ss RNA virus, retroviruses dss/ss DNA virus; Prion proteins, replication of plant virus (Poty). **Isolation, cultivation and maintenance of viruses:** Isolation and cultivation of viruses (experimental plants and tissue culture, experimental animals,	25

	embryonated eggs, organ cultures, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines).	
III	**Purification of viruses:** Extraction of viruses from tissues, clarification, and concentration of viruses in clarified extracts by physical and chemical methods. Criteria of virus purity, Quantitation and preservation of purified virus preparations. **Assay of viruses:** Infectivity assay methods (plaque, pock, end point, local /systemic assay of plant viruses), physical (EM), serological (HA, HAI, Immunofluorescence, ELISA) and molecular (viral protein and nucleic acid based) approaches. **Management of viruses:** Cultural practices, Surveillance for viral diseases, Public health strategies for prevention and control of viral diseases, Sanitation, control of vectors,	25
IV	**Anti-Viral drugs:** Search for antiviral drugs. Mechanism based screens. Cell based screen. Antiviral screening. Resistance to antiviral drugs. **Vaccinology:** Herd Immunity. Requirement of an effective vaccine; Conventional approaches to vaccine development- Live attenuated and Killed vaccines; Adjuvants, Subunit vaccines, Synthetic vaccines, DNA/RNA vaccines, Virus like particles (VLPs), recombinant vaccines, Edible vaccines, Polio eradication. **Quality control** in vaccinology (in preservation and monitoring of microorganisms in seed lot systems), Nanoparticles in vaccine delivery systems.	25

Suggested Readings:

1. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiogy.
2. DNA Virus Replication. Alan J. Cann. Latest edition / Pub. Date: March 2000. Publisher: Oxford University Press.
3. Principles of Molecular Virology. Alan Cann J. Cann. Latest edition/ Pub. Date: June 2005. Publisher: Elsevier Science & Technology Books.
4. Fields Virology, 7th ed., All Volumes- RNA Viruses; by David M Knipe, and Peter M Howley, 2023.
5. Fields Virology, 7th ed., Volume 1 - Emerging Viruses; by David M Knipe, and Peter M Howley, 2023.
6. Virology (2017) Ren Warom, Titan Books.
7. A Planet of Viruses: (2015) 2nd ed, by Carl Zimmer (2015) University of Chicago Press.
8. Schaechter's Mechanisms of Microbial Disease (2012). Fifth, North American Edition, by N. Cary Engleberg MD, Terence Dermody, Victor DiRita Publisher: LWW
9. Plant Virology. (2001). 4th edi. By R. Hull. Academic Press.
10. Principles of Virology: (2000). by S.J. Flint et al., ASM Press.
11. Plotkin's Vaccines, 8th Edition (2022), By Walter A. Orenstein, Paul A. Offit, Kathryn M. Edwards, Stanley A. Plotkin
12. The new generation vaccines. (2004) 3rd ed. Levine, M.M., Kaper, J.B., Rappuoli, R., Liu, M.A., Good, M.F. Informa Healthcare.
13. Modjarrad's Human Vaccines: Emerging technologies in design and development.1st ed. ISBN: 9780128023020.

Course Name: **Lab Course III**					**Course Code:** **24L6.0-BTY-205**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code-205**
			0	0	8	4	**Course Type: PC-3**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 4 Hrs.				
Course Objectives	Objective of this course to understand the working & handling of various equipment in the lab, safety measures and protocols for lab work.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1**. Gain proficiency in hematological techniques such as blood film analysis, and cell counting, crucial for clinical diagnostics and research. **CLO2**. Develop understanding of immunological methods including immunization, serum collection, and various immunoassays like ELISA and immune-electrophoresis. **CLO3.** Acquire practical skills in statistical analysis using Excel, covering descriptive statistics, measures of central tendency, correlation, dispersion, and tests of significance, enhancing data interpretation capabilities. **CLO4.** Master techniques for analyzing biological data and interpreting results, preparing students for advanced studies and professional applications in biomedical sciences.						

COURSE SYLLABUS

Unit No.	Contents	Weightage (%)
	Suggested Practical Works: 1. To study the blood film and identification of cells. 2. To study the lymphoid organs and their microscopic organization. 3. To study the Immunization, Collection of Serum. 4. To study the double diffusion and Immune-electrophoresis. 5. To study the radial Immune diffusion. 6. To study the ELISA. 7. To study the cell counting and cell viability. 8. To study the graphical representation of data by Excel software. 9. To study the descriptive statistics: Systemic tabular summarization of data. 10. To study the measures of central tendency. 11. To study how to measures of Correlation & Dispersion. 12. To study the Tests of significance (Mean, Standard Deviation, proportion. 13. To study the Chi Square Test of Goodness of fit. 14. To study the Test of independence of attributes. 15. To study the Analysis of Variance (One way and two ways). **Note: Any other relevant practical can be offered**	100

Course Name: **Lab Course IV**					**Course Code:** **24L6.0-BTY-206**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: II**	**L**	**T**	**P**	**Credits**	**Exam Course Code-206**
			0	0	8	4	**Course Type: PC-4**
Level of the Course: 400-499							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 4 Hrs.				
Course Objectives	Objective of this course to understand the working & handling of various equipment in the lab, safety measures and protocols for lab work.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1:** Essential molecular biology techniques for DNA and RNA analysis, including isolation, quantification, and sequencing. **CLO2:** Develop proficiency in gene cloning, gene expression analysis, and protein characterization methods. **CLO3:** Acquire skills in virology techniques such as virus isolation, cell culture maintenance, and various virus detection assays. **CLO4:** Apply theoretical knowledge to practical scenarios, fostering critical thinking and problem-solving abilities in molecular biology and virology.						

COURSE SYLLABUS

Unit No.	Contents	Weightage (%)
	Suggested Practical Works: **Genetic Engineering** 1. To study the isolation of plasmid DNA/ genomic DNA. 2. To study the isolation of lambda phage DNA 3. To study the quantitation of nucleic acids. 4. To study the restriction mapping of DNA. 5. To perform the gene cloning. 6. To study the preparation of helper phage and its titration. 7. To prepare single stranded DNA template. 8. To study the Gene expression in E. coli and analysis of gene product. 9. To study the PCR and Reporter Gene assay (Gus/CAT/b-GAL). 10. To study the Western Blotting. 11. To study the Northern blotting.	100

	Virology and Vaccinology 1. Glassware washing, decontamination, sterilization, packing and sterile handling. 2. Media and reagents preparation, sterility checks. 3. Sample collection, transport and processing for virus isolation. 4. Maintenance of cell cultures. 5. Growth studies. cell count, mitotic index. 6. Preparation of primary cell culture (CEC) 7. Estimation of virus yields by plaque assay & TCID50 8. Preparation virus stocks 9. Determination of mouse LD50 10. Routes of inoculations in embryonated eggs 11. Virus/Antigen detection by ELISA 12. Direct and Indirect Immuno-Florescence Assay (DFA/IFA) for the virus detection. 13. Hemagglutination assay (HA) & Hemagglutination Inhibition assay (HAI) for the virus detection/characterization. 14. Agar gel diffusion Rapid test for virus detection. 15. PCR/ RT-PCR for virus detection. 16. Electron microscopy (Demonstration) **Note: Any other relevant practical can be offered**	

<table>
<tr><td colspan="5">Course Name:
Constitutional, Human and Moral Values and IPR</td><td colspan="3">Course Code:
24L6.0-BTY-207</td></tr>
<tr><td rowspan="2">Batch:
2024-2026</td><td rowspan="2">Programme:
M.Sc. Biotechnology</td><td rowspan="2">Semester: II</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Exam Course Code-207</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>Course Type: CHM</td></tr>
<tr><td colspan="8">Level of the Course: 400-499</td></tr>
<tr><td colspan="4">End Semester Exam : 35 marks
Internal Assessment : 15 marks
Total : 50 marks</td><td colspan="4">Examination Duration: 3Hrs.</td></tr>
<tr><td colspan="8">COURSE SYLLABUS</td></tr>
<tr><td>Unit No.</td><td colspan="6">Contents</td><td>Weightage (%)</td></tr>
<tr><td></td><td colspan="6">To be provided by Indira Gandhi University Meerpur, Rewari.</td><td></td></tr>
</table>

Course Name: **Animal Cell Culture**					**Course Code:** **24L6.5-BTY-301**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-301**
			4	0	0	4	**Course Type: CC-9**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The objective of this course is to teach students the different aspects of animal cell culture, how a culture is established, propagated & characterized, what are the applications of animal cell cultures.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Equipment and culture media used in animal cell culture. **CLO2.** Different factors affect the growth of animal cell culture &different techniques of scalingup/transformation and cryopreservation. **CLO3.** Students will learn about the Livestock Assisted Reproduction. **CLO4.** Students will learn about the embryo and organogenesis.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Lab Organization:**, Quality assurance and related areas, production techniques, **Media:** Introduction to the balanced salt solutions and simple growth medium, brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon dioxide, role of serum and supplements, serum & protein free defined media and their application.	25
II	**Cell Lines**: Types & primary and established cell line cultures. **Viability:** Measurement of viability and cytotoxicity, biology and characterization of the cultured cells, basic techniques of mammalian cell culture. ***In vitro* disaggregation** of tissue and primary culture maintenance of cell culture, Cell Separation.	25

III	**Scaling-up of Animal Cell Culture:** Cell synchronization, cell cloning and micromanipulation, Cell transformation, Application of animal cell culture, preservation techniques to maintain good antigen quality, freeze drying. **Biotechnology in Livestock Assisted Reproduction:** Biotechnology in conservation of livestock diversity, superovulation.	25
IV	**Embryo Biotechnology:** Implantation and formation of placenta in mammals, Gastrulation in mammals- formation of primitive streak, morphogenetic movements and neural induction. **Organogenesis** and fetal development. Embryo collection, evaluation and transfer. IVF and in vitro embryo production, cryobanking of germplasm, stem cells technology in livestock	25

Suggested Readings:

1. Elements of Biotechnology. (2019-20), 4th reprint, Gupta, P.K., Rastogi Publications.
2. Advances in Animal Biotechnology and its Applications. (2018). Gahlawat, S.K., Duhan, J.S., Salar, R.K., Siwach, P. and Kumar, S. and Kaur, P. Springer, Germany. pp. 1-401. ISBN:978-981-10-4701-5.
3. Principles of gene manipulation. (2016), 8th ed. Primrose Twyman, and Old. Blackwell Science, ISBN: 1405135441.
4. Biotechnology-Expanding Horizons. (2015), Singh, B.D., Kalyani Publishers.
5. Animal Biotechnology. (2013), Verma, A. and Singh, A., Elsevier, ISBN: 9780124160026.
6. Molecular Biotechnology. (2009), 4th ed. Glick and Pasternak, ASM Press, ISBN: 10 1555814980.
7. Recombinant DNA. (2006), 3rd ed., Watson, J.D., Richard, M., Meyers,A.C., Jan,A.W., Cold Spring Harbor Laboratory Press, ISBN: 0716728664.
8. Animal Cell Culture: Methods in Cell Biology. (1998), Vol. 57, 1st ed., Jenni, P.M. and David, B., Academic Press, eBook ISBN: 9780080859552.
9. Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Amanda Capes-Davis, R. Ian Freshney; John Wiley & Sons, 2021

Course Name: Molecular Diagnostics					**Course Code: 24L6.5-BTY-302**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-302**
			4	0	0	4	**Course Type: CC-10**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The purpose of the course is to teach the students about basics and advanced concepts in molecular medicine and diagnostics and ensuring that students acquire an extensive and sound knowledge base for future studies.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Diagnosis of infectious agents, chromosomal, gene and mitochondrial disorders, differentapproaches to detect these disorders. **CLO2.** Get insight into molecular basis of metabolic disorders, chromosomal and microbial infection and techniques to diagnose them. **CLO3.** Have a broad understanding of the biomedical research for biotechnological applications. **CLO4.** Get a springboard to develop their creative thinking and explore their ideas of molecular diagnostics.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%).
I	**Concept of QC in Lab:** Introduction to Molecular Diagnostics Laboratory, Quality control, GLP, Records. **Nucleic acid amplification methods:** PCR and its types-RT-PCR, PCR-ELISA, Ligase Chain Reaction, Applications of PCR and its applications for diagnosis of disease. **Diagnosis by genome Analysis:** Restriction analysis (ARDRA) culture independent analysis of bacteria- DGGE and TRFLP, RAPD for animal and plants-PCR in forensic science, AmpFLP, STR **Advanced tools for diagnosis:** FACs, MALDI, Next generation sequencing for Clinical Microbiology, Phage display.	25

II	**Infectious diseases and its diagnosis:** Respiratory diseases (Influenza, etc.) Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and mycobacterium diseases. **Clinical Disorders:** Biochemical disorders and Biochemical diagnostics, Immune disorders and Immunodiagnostics, Haemoglobinopathies, Neurological disorders, Glycogen storage disorders.	25
III	**Genetic Disorders:** Single gene disorders (Cystic Fibrosis, Marfan's syndrome), multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia). **Methods for Genetic Study in Man:** pedigree analysis, pedigree construction & family study complications in pedigree analysis (variable expressivity, heterogeneity, penetrance, anticipation, epigenetics, mosaicism), polyclonal and monoclonal antibodies. **Karyotype analysis:** G-banding, FISH, spectral karyotyping (SKY) and comparative genomic hybridization (CGH).	25
IV	**Genetic Profiling:** Single nucleotide polymorphism, molecular beacons and its variants for their applications in detection, rolling circle amplification, application of padlock and selector probes in molecular medicine. **Advances in Diagnosis:** DNA aptamers in diagnosis, diagnostics for point-of-care, smartphones in medical diagnostics, rapid diagnostic tests (lateral flow assays), concepts of microfluidics, BioMEMs in diagnostics, recent advances and applications in the field.	25

Suggested Readings:

1. Genes XII Ed. Lewin,B. Oxford University Press. 2018
2. Molecular Diagnostics: Fundamentals, Methods & Clinical applications. 2nd Edition; Lela Buckingham; 2012. F. A. Davis Publisher
3. Fundamentals of Molecular Diagnostics. David E. Bruns, Edward R. Ashwood, Carl A. Burtis; Elsevier Health Sciences, 25 May 2007
4. An Introduction to Genetic Analysis. Griffiths, A.J.F, Miller, J.H., Suzuki, D.T. et.al. Freeman, New York. 2000
5. Clinical Genomics: Practical applications in Adult Patient care. (2004), Michael F. Murray, Mark W. Babyatsky, Monica A. Giovanni, Fowzan S. Alkuraya, Douglas R. Stewart Disease & Diagnostic. Sandet, G. J. Cambridge hacker. 2014 by McGraw-Hill Education; ISBN 978-0-07-162244-8.
6. Genome Plasticity and Infectious Diseases; Editor(s): Jörg Hacker, Ulrich Dobrindt, Reinhard Kurth President Emeritus (2012); ISBN:9781119737711 |Online ISBN:9781683670933. ASM Press.
7. **Current Research/ Review Articles from PUBMED**

Course Name: **Plant Cell and Tissue Culture**					**Course Code:** **24L6.5-BTY-303**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-303**
			4	0	0	4	**Course Type: DEC-1**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	To gain expertise in plant tissue culture, including biosafety, applications, lab establishment, and effective communication, while also exploring entrepreneurship opportunities, hybrid plant production, and germplasm conservation techniques.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Understand the concepts, bio-safety measures, applications and recent knowledge of tools and techniques related to cell cultures and different modes of in vitro regeneration. Know how to develop and establish a PTC laboratory for small scale to industrial level. **CLO2**. Launch start-ups and become entrepreneurs in the field of micropropagation, somaclones and pathogen free plants production or other related industry. **CLO3**. Attain knowledge about production of novel hybrid plants and their significance in agriculture and plant breeding. **CLO4.** Learn techniques of germplasm conservation and protoplast culture and its usage in crops improvement,						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Introduction** to plant cell tissue culture and historical perspective. Laboratory organization setup (R & D level and industrial level, Aseptic manipulations and bio-safety aspects in PTC. **Culture media** – components, preparation and development/formulation of media for new plant system. **Callus culture**: characteristics, significance and limitations, Initiation and maintenance of cell cultures, static techniques of single cell culture, suspension culture and types, assessment of growth and viability of cultured cells. **Organogenesis** and factors influencing organogenesis. Somatic embryogenesis: process of somatic embryos production, factors influencing and its importance in plant breeding and propagation. Production of synthetic seeds	25
	Large scale plant micropropagation – technical stages of micropropagation, factors affecting in vitro culture of plants (physical, chemical, genotypic and	25

II	others), applications and limitations of micropropagation. **Meristem and Shoot tip** culture, methods of production of pathogen free plants and their limitations. Methods of indexing of virus free plants. **Somaclonal variations:** Genetic and epigenetic, molecular basis of variation, limitations and their significance in plant breeding.	
III	**In vitro production of haploid plants** – Androgenesis (anther and pollen culture) and Gynogenesis, Factors affecting androgenesis, ontogeny of androgenesis, diploidization of haploid plants. **Significance and uses of haploids in agriculture.** **Wide hybridization and embryo rescue technique.**	25
IV	**Protoplast culture and somatic hybridization:** Isolation, culture and fusion of protoplast, selection of fusion products, assessment of somatic hybrid plants, production of cybrids. **Applications** of protoplast culture and somatic hybridization in the improvement of crop plants. **In vitro germplasm conservation and cryopreservation.**	25

Suggested Readings:

1. Plant tissue culture – Theory and Practice (2005) by Bhojwani S. S. and Razdan M. K., Elsevier publication.
2. Elements of Biotechnology by P. K. Gupta, 4th Reprint (2nd Edition): 2019-2020, Rastogi pub.
3. Introduction to Biotechnology (2009) by H. S. Chawla, 3rd edition, Science publishers, USA
4. Plant cell, organ and tissue culture (1995) by Gamborg O.L. and Phillips G.C., Springer Verlag pub. Germany.
5. Plant Tissue Culture – Basic & Applied (2005) by Jha T.B. & Ghosh B., Universities press.
6. Plant cell culture – A practical approach (1994) Dixon R.A., Gonzales R.A. Oxford University press, UK.
7. Bhojwani S.S. (2003), Agrobiotechnology & Plant Tissue Culture
8. Smith R.H. (2000), Plant Tissue Culture, Academic Press
9. Evans D.A. (2003), Plant Cell Culture, Taylor & Francis.
10. Malik Z. A., Usha K., Kamaluddin and Athar A. (2017) Plant Biotechnology: Principles and Applications. Springer Nature, Singapore.

Course Name: Bioinformatics					**Course Code: 24L6.5-BTY-304**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-304**
			4	0	0	4	**Course Type: DEC-1**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The aim of this course is to introduce the students to the basics of bioinformatics. This includes teaching the basis of the biological system via information and technology.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1**. Understand, describe and use the biological databases, perform structured query and analyze and discuss the results in biologically significant way**.** **CLO2.** Acquire knowledge of computer languages to solve biological problems in silico. **CLO3.** Explain principle, algorithm and different methods of sequence alignments as well asexecute alignments to address research problems. **CLO4.** Familiar with a wide variety of bioinformatics tools and softwares and apply these toconduct basic bioinformatics research.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Computers:** An overview of computers, architecture, generations and concept of programming, algorithms, languages and packages- Introduction to MS Office, introduction to SQL (structured query language). **Database:** Introduction to computer networking, topology; networking protocol, colour, sound and graphics.	25
II	**Introduction to PERL:** Scalar variables, strings and numbers, assignment statements, arrays, hashes, operators, Input/output, standard Input. **Conditional and Logical Operators:** Input from file named in command line,loops, regular expression, pattern matching, subroutines. Applications of PERL in bioinformatics.	25
III	**Biological Sequence Databases:** Overview of various primary and secondary databases that deal with protein and nucleic acid sequences, databases to be coveredin detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences, databases like TIGR, Hovergen, TAIR, PlasmoDB, preliminary ideas ofquery and analysis of sequence information. **Sequence Comparison Methods:** Method for the comparison of two sequences viz., Dot matrix plots, Needleman Wusch & Smith Waterman algorithms, analysis of computational complexities, relative merits and demerits of each method, theoryof scoring matrices and their use for sequence comparison.	25

IV	**Database Search Algorithms:** Methods for searching sequence databases like FASTA and BLAST algorithms, statistical analysis and evaluation of BLAST results, CLUSTAL-W and phylogenetic analysis, secondary and tertiary structure prediction tools, the use of pattern databases like PROSITE and PRINTS, concept of position specific weight matrices and their use in sequence analysis, theory of profiles and their use with special reference to PSI-BLAST. **Concept of HMMS:** The forward backward and the Viterbi algorithm, use of profile HMM for protein family classification, homology modeling.	25

Suggested Readings:

1. Essential Bioinformatics. (2006), 1st ed., Xiong, J., Cambridge University Press, ISBN 13: 978-0521600828.
2. Fundamental concepts of Bioinformatics. (2003), Krane, D.E. and Raymer,M.L. Pearson, ISBN: 978-8177587579.
3. An Introduction to Bioinformatics. (2017), 1st ed., Knight, R., Larsen and Keller Education, ISBN:978-1635490459.
4. Concepts of Bioinformatics and Genomics. (2016),1st ed., Momand, J., McCardy, A., Heubah, S. andWarter-Perez, N., Oxford University Press, ISBN: 978-0199936991.
5. Bioinformatics- Methods and Applications: Genomics, Proteomics and Drug Discovery. (2013), 4thed., Rastogi,P. and Mendiratta,N. Prentice-Hall of India Pvt.
6. Bionformatics: Principles and Applications. (2008), Ghosh. Z., and Mallick, B. Oxford University Press publisher. ISBN: 978-0195692303.
7. Bioinformatics: Tools and Applications. (2009), Edwards, D. and Stajich, J. Springer.ISBN:978-0387927374.

Course Name: **Bioprocess Technology**					**Course Code:** **24L6.5-BTY-305**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-305**
			4	0	0	4	**Course Type: DEC-2**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	In sights offer mentation strategies to improve & enhance the production of various biotechnological products.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Knowledge of bioreactors, application and functioning of fermenter. **CLO2.** Knowledge of downstream processes and fermentation economics. **CLO3.** Enhance the production of various biological products. **CLO4**. Will acquire skill required in food & industrial biotechnology.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Basic Concepts of Processes:** Upstream and downstream processes, sources of industrially important microbes, strain development, different parts of bioreactor, aeration and agitation system (e.g., baffles, spargers, impellers), pH, temperature, redox potential and oxygen measurement and its control in a bioreactor, use of computers in a bioreactor, types of fermentation and fermenters. **Downstream Processing of Microbial Products:** Filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, drying (lyophilization and spray drying), and crystallization.	25
II	**Production Aspects:** Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids, antibiotics, enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants and recombinant products (insulin, somatostatin). **Large Scale Production:** Vaccines, microbial production of anti-cancer agents andantioxidant drug, production of CoQ10, beta carotenoid, microbial production ofmethanol and unsaturated fatty acid, microbial production and uses of vitamins, use of microbes in mineral recovery, microbial production and uses bacterial insecticides and xanthan gum.	25

III	**Microbes in Food Industries:** Preservation of foods by different methods such as high temperature, low temperature, chemical additives and irradiation, basic concepts of D-value, Z-value, 12-D concept and F-value. **Biochemical changes caused by microorganisms:** spoilage of various types of food product (Milk, meat, bread, fruits and vegetables), Botulism (*Staphylococcal aureus* infection, Salmonellosis, Shigellosis), food infections caused by microorganisms (*C. jejuni, H. pylori, Y. enterocolitica, V. cholerae, V. parahaemolyticus, B. cereus)* and microbial toxins, microbial standards for different foods.	25
IV	**Fermentation Economics:** Basic objective for successful economically viable fermentation process, cost break down for well-established fermentation processes, market potential of the products, cost aspects of various stages in the processes, development including effluent treatment.	25

Suggested Readings:

1. Principles of Fermentation Technology. Stanbury, P.F. *et. al*, Butterworth-Heinemann Ltd, Oxford
2. Industrial Microbiology. Casida.
3. Industrial Microbiology. Cruger.
4. Food Microbiology. Frazier.
5. Bioprocess Engineering: Basic Concepts. 3rded. Shuler, M.L., and Kargi,F., Pearson Prentice Hall. ISBN: 0137062702.
6. Principles of Fermentation Technology. 3rd ed., Stanbury, P., Whitaker,A. Stephen Hall. Imprint (Butterworth-Heinemann), ISBN:9780080999531.
7. Biochemical Engineering Fundamentals.5th reprint.,Bailey,J.E., and Ollis, D.F. McGraaw- Hill Education (India) Pvt Ltd. ISBN:0070701237
8. Bioprocess Engineering Principles.2nd ed. Doran, P.M, Academic Press, ISBN:978-0-12-220851-5.
9. Bioreactors Analysis and Design. Panda T, Tata McGraw Hill, ISBN:978-0-07-070424-4.

Course Name: **Food Biotechnology**					**Course Code:** **24L6.5-BTY-306**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-306**
			4	0	0	4	**Course Type: DEC-2**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	To provide a comprehensive understanding of food biotechnology, additives, preservation techniques fermented foods, packaging, and food safety regulations for ensuring quality and safety in the food industry.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** The student will be able to apply the principles of microbiology and biotechnology in handling wastes produced by the food industry **CLO2**. The student will be able to develop processes for utilization of food waste.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Biotech foods and supplements:** Introduction to food biotechnology and related industries; transgenic plant foods: carbohydrates, proteins, vitamins nutritional quality improvement of the food crops by genetic engineering, safety of GM food crops. Dietary supplements. Single cell Protein (SCP) production, mushrooms production technology, large scale production of algae and yeast.	25
II	**Food additives & preservation techniques:** Food additives- definitions, need for food additives. **Classification and functions of different additives:** thickeners, antioxidants, coloring agents, flavoring agents, sweeteners, emulsifiers, flour improvers. **Probiotics:** Production & importance of probiotics. **Preservation techniques:** refrigeration & freezing, dehydration, heating, irradiation, antimicrobial agents used in food preservation.	25
III	**Fermented foods and Food Packaging:** Cheese production technologies. **Fermented foods of India:** dairy products, cereal and legume foods, vegetables/fruits, meat and fish. **Introduction to Food Packaging:** definition, factors involved in the evolution and selection of a food package. Types of packaging materials and their functioning properties. **Aseptic packaging of foods:** sterilization techniques of packaging	25

	materials; Methods for the microbiological examination of foods. Advantages/ functions and disadvantages associated with packaging of foods.	
IV	**Food Safety and Quality Control:** Introduction to concepts of food safety and food quality assurance; Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Hazard analysis and critical control point (HACCP). **Role of international regulatory agencies:** USFDA and International Organization for Standards (ISO). **Indian food laws and standards:** Prevention of Food Adulteration (PFA) Act, Fruit Products Order (FPO), Meat Products Order (MPO), Cold Storage Order (CSO), Role of AGMARK Standard, Bureau of Indian Standards (BIS) and Food Safety and Standards Authority of India (FSSAI).	25

Suggested Readings:

1. Anal AK. 2017. Food Processing By-Products and their Utilization (IFST Advances in Food Science). Wiley Blackwell. Arvanitoyannis I. 2007. Waste Management for the Food Industries. First Edition. Academic Press. Bains W. 1993.
2. Biotechnology from A to Z. Third Edition. Oxford University Press Chawla HS. 2002. Introduction to Plant Biotechnology. Second Edition. Science Publishers. Doyle A and Griffiths JB. 1998.
3. Cell and Tissue Culture: Laboratory Procedures in Biotechnology. John Wiley and Sons, UK. El-Mansi EMT, Bryce CFA, Demain AL, and Allman AR. 2012.
4. Fermentation Microbiology and Biotechnology. Third Edition. CRC Press. Joshi VK and Singh RS. 2013.
5. Biotechnology: Principles and Practices. I.K. International Publishing House Pvt. Ltd. Knorr D. 1982.
6. Food Biotechnology. Marcel Dekker Oreopoulou V and Russ W. 2007. Utilization of By-Products and Treatment of Waste in the Food Industry. Springer.

Course Name: **Lab Course V**					**Course Code:** **24L6.5-BTY-307**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-307**
			0	0	8	4	**Course Type: PC-5**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 4 Hrs.				
Course Objectives	Objective of this course to understand the working & handling of various equipment in the lab,safety measures and protocols for lab work.						
Course Outcomes	**After completing, the students are expected to learn the following:** **CLO1.**Develop practical expertise in animal cell culture techniques, including medium preparation, cell counting, subculturing, and cryopreservation, essential for biotechnological and biomedical research. **CLO2.**Gain proficiency in bioinformatics tools and databases for retrieving nucleotide and protein sequences, performing sequence alignments, and predicting protein structures. **CLO3:** Able to design primer and are capable programming.						

COURSE SYLLABUS

Unit No.	Contents	Weightage (%)
	Suggested Practical Works: 1. To study the preparation of tissue culture medium and membrane filtration. 2. To study the preparation of single cell suspension from spleen and thymus. 3. To study the cell counting and cell viability. 4. To study the trypsinization of monolayer and subculturing 5. To study the cryopreservation and thawing. 6. Organ Grid Culture. 7. To study the retrieve Nucleotide sequences from NCBI serve 8. To study the retrieve protein sequences from protein databases. 9. BLAST/pBLAST/nrBLAST. 10. To predict protein secondary structures. 11. To study the multiple sequence alignment by using ClustalW. 12. To study the phylogenetic analysis. 13. To study how to design Primer. 14. Computational modeling of genomic, transcriptomic and proteomic. 15. How to use PERL programming for: a. Storing DNA sequence. b. DNA to RNA transcription. c. Counting nucleotides. d. Phylogenetic tree construction. **Note: Any other relevant practical can be offered**	100

Course Name: **Lab Course VI**					**Course Code:** **24L6.5-BTY-308**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code: 308**
			0	0	8	4	**Course Type: PC-6**

Level of the Course: 500-599

End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**	**Examination Duration : 4** Hrs.

Course Objectives	Objective of this course to understand the working & handling of various equipment in the lab,safety measures and protocols for lab work.
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1**. Master essential molecular diagnostic techniques such as real-time PCR, western blotting, and DNA fingerprinting for disease diagnosis and genetic analysis. **CLO2**. Acquire proficiency in bioprocess techniques including antibiotic and alcohol production, bioreactor operation, and biosafety protocols. **CLO3.** Develop skills in plant cell and tissue culture methods, covering media preparation, organogenesis, and genetic transformation with Agrobacterium. **CLO4.** Gain expertise in food biotechnology through microbial examination, pathogen detection, and analysis of microbial groups in food products, emphasizing food safety and quality control.

COURSE SYLLABUS

Nomenclature of Course	**Contents**	**Weightage (%)**
Molecular Diagnostics	**Suggested Practical Works:** 1. To study the use of real-time PCR in the diagnosis of a disease. 2. To study the Western Blot analysis of the proteins using antibodies. 3. To study the Metaphase chromosome preparation, and chromosome banding techniques. 4. To study the sister chromatid exchange assay using peripheral blood lymphocytes for genotoxicity studies. 5. To study the single Cell Gel Electrophoresis to detect DNA damage. 6. To study the analysis of Micronucleus as biomarker of genotoxicity using buccal epithelial cells. 7. To determine IC50 of a toxic compound. 8. To determine TLC and DLC in human blood smear.	100

	9. To study the isolation of Lymphocytes from peripheral blood. 10. To study the serum preparation and serological reactions- Agglutination and Precipitation. 11. Demonstration of Enzyme-linked Immunosorbent assay by performing immunodiffusion by Mancini and Ouchterlony method (single or double). 12. To study the how to perform immuno-electrophoresis with a given antigen-antibody system. 13. To study the analysis of DNA finger printing.	
Bioprocess Techniques	1. To study the production and estimation of antibiotics (Penicillin and Streptomycin). 2. To study the production and estimation of alcohol. 3. Operation of bioreactor. 4. Demonstration of different biosafety levels with at least one example ofpathogenic microorganism exploited in each group. 5. Demonstration of different sterilization techniques.	
Plant Cell and Tissue Culture	1. To study the preparation of different media for plant tissue culture. 2. To study the callus propagation and organogenesis. 3. To study the In vitro induction of roots and transplantation in soil. 4. To study the protoplast isolation and culture. 5. To study the Anther culture, production of Haploids. 6. To study the cytological examination of regenerated plants. 7. To study the Agrobacterium culture, selection of transformants, reporter genes (GUS) assay.	
Food Biotechnology	1. Microbial examination of milk. 2. Microbial examination of milk products. 3. Microbial examination of sugar, salts and spices 4. Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus) 5. Thermal death time determination 6. Detection of Salmonella from food sample 7. Detection of coliforms from milk by MPN method 8. Detection of Staphylococcus aureus from food sample 9. Enumeration of important groups of microorganisms in foods i.e., Proteolytic, lipolytic, acid producers 10. Enumeration of important groups of microorganisms in foods i.e., Psychrotrophic, thermoduric, thermophilic bacteria. **Note: Any other relevant practical can be offered**	

Course Name: **Biology of Infectious Diseases**					**Course Code:** **24L6.5-BTY-309**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: III**	**L**	**T**	**P**	**Credits**	**Exam Course Code-309**
			2	0	0	2	**Course Type: OEC**
Level of the Course: 500-599							
End Semester Exam: 35 marks **Internal Assessment: 15 marks** **Total: 50 marks**		**Examination Duration:** 3Hrs.					
Course Objectives	The aim of this course is to introduce the students to the basics of biology of infectious disease and causative agents of disease.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** This course will make understand different types of disease cause by Virus, Bacteria, Fungi, protozoa. **CLO2**. Aware of warfare agents, hospital-acquired infections (nosocomial). **CLO3**. Aware of water born disease and wastewater management. **CLO4.** Hospital-acquired infections, concepts of vaccines, National Immunization Programme (NIP).						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting at least four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Bacteria:** Representative diseases – Typhoid, Pneumonia and Meningitis, T.B., Cholera, Plague, UTIs, Gonorrhea and Syphilis. Infections caused by anaerobic bacteria e.g., Tetanus, Spirochetes, Rickettsiae.	25
II	**Viruses:** Representative diseases to be studied in detail are- Viral hepatitis, Influenza/ respiratory viruses, HPV, Rabies, Polio and viral cancers, Dengue, Chikungunya, and AIDS.	25
III	**Fungi**: Superficial, subcutaneous, systemic and opportunistic mycoses infections **Protozoa:** Toxoplasmosis, Trichomoniasis & Leishmaniasis. **Parasitic diseases:** Ascariasis, Liver fluke, Malaria.	25
IV	**Water Born Disease** and **Wastewater Management** **Disease Burden and Its Economic Impact:** Bacterial and viral vectors; Biologicalwarfare agents **Hospital-Acquired Infections (Nosocomial):** Immune compromised states. concepts of vaccines, National Immunization Programme (NIP) & other important vaccines.	25

Suggested Readings:

1. Jawetz, Melnick, & Adelberg's Medical Microbiology (Lange Basic Science).23rd ed.,Brooks, G.F., Butel, J.S., Stephen, A., Morse McGraw-Hill Medical.
2. Medical Microbiology: with Student Consult. 7thed., Patrick, R. M., Ken S. Rosenthal,K.S.
3. Mims' Medical Microbiology. Goering, R., Dockrell,H., Zuckerman,M. ,Ivan M. Roitt,J.M., Peter L. Chiodini Saunders (W.B.) Co Ltd.

Course Name: **Molecular Genetics**					**Course Code:** **24L6.5-BTY-401**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 401**
			4	0	0	4	**Course Type: DEC-3**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	Objective of this course to understand the Basic concept of inheritance, Gene interaction and development in plants and animals.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Basic knowledge about the Principles of Mendelian inheritance. **CLO2.** Enhance knowledge about the linkage, recombination, gene interactions. **CLO3.** Enhance knowledge about animal development. **CLO4.** Enhance knowledge about plant development.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Historical background**: Principles and findings of Mendelian inheritance, Modification of F_1 and F_2 Ratios, molecular basis of single gene inheritance, codominance, incomplete dominance, Gene interactions, pleiotropy. **Extra chromosomal inheritance:** Maternal inheritance (mitochondria and chloroplast), Sex linked inheritance, Sex influenced and Sex-limited traits, lethal genes, and multiple alleles, polygenic inheritance.	25
II	**Linkage:** complete and incomplete linkage, linkage analysis and genetic maps,Linkage and recombination of gene. **Genetic analysis:** calculating recombination frequencies, Linkage maps, Sex determination and Dosage compensation in Drosophila, Population Genetics - Hardy-Weinberg equilibrium.	25
III	**Structure and regulation:** capacitation, ovulation and hormonal control in mammals, acrosome reaction and signal transduction, monospermy and species-specificity, Egg activation, early cleavages and blastocyst formation in mammals	25

	Pattern forming genes: Pattern forming genes and expression in Drosophila and mammalian embryos, Growth Factors and Signal Cascades BMP, Nodal, Wnt, Notch and Retenoid signaling during gastrulation, Lens development-fibre differentiation.	
IV	**Genetics of Flower:** ABC model of flower development, function and regulation of homeotic gene expression, cadastral functions of homeotic genes, molecular functions of MADS box genes. **Flower Meristem:** developmental stages of the endosperm maturation and desiccation, genetic control over seed germination and dormancy (VP1 gene in Maize, ABI3, LEC1 and FUS3 gene in Arabidopsis). Pattern mutants. SAM organization, Developmental changes,Molecular biology of SAM by mutants.	25

Suggested Readings:

1. Principles of Genetics (2006) 8th ed. Gardner EJ, Simmons, MJ and Snustad DP, John Wiley & Sons Inc, ISBN: 8126510439.
2. Essentials of Genetics (2015) 9th ed. William S, Michael K, Cummings R, Spencer, CA and Palladino MA, Prentice Hall Internationals, ISBN-10: 0134047796
3. Genetics (2017) 9th ed. Daniel L. Hartal & B. Cochrane, ISBN: 128412293X
4. Introduction to Quantitative Genetics (1995) Falconer DS, and Mackay TFC, ISBN: 0582243025.
5. An Introduction to Population Genetics Theory and applications (2013) Nielsen R and Slatkin M, Oxford University Press, ISBN: 1605351539.
6. Developmental Biology. (2003), Gilbert S. F., Sinauer, A.
7. Principles of Development. (2002), Wolpert, L. et al., Oxford University Press.
8. The Art of the Genes-how Organisms Make Themselves. (1919) Coen, E. Oxford University Press.
9. Genetic Analysis of Animal Development. (1993), 2nd ed., Wilkins, A. S., Wiley-L.
10. Biological Physics of the Developing Embryo. (2005), Forgacs G. & Newman, S. A., Cambridge University Press.
11. Plant Growth and Development- A Molecular approach. (1998), Howell, S.H.Academic Press, San Diego.
12. Plant Development-The Cellular Basis. (1990), Lyndon, R.F. Unnin Hyman, London.
13. Plant Development. (1996), 2nded., Waisel, Y., Eshel, A. and Kafkaki, V. (eds). Cambridge University

Course Name: Biosafety, Bioethics and IPR in Biotechnology					**Course Code: 24L6.5-BTY-402**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code-402**
			4	0	0	4	**Course Type: DEC-3**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The purpose of the course is to teach the students about the basics of filing of patents and Biosafety and Bioethics						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CO1**. It will give knowledge about Intellectual property rights related to biotechnology. **CO2.** It will give knowledge about Prior arts and basics of patents. **CO3.** Aware various Biosafety levels & its regulatory committees. **CO4.** Awareness of Bioethical issues and regulations in biotechnological research applications.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting at least four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Biosafety:** Introduction, historical background, primary containment for biohazards, biosafety levels, biosafety guidelines of government of India, definition of GMOs & LMOs, Protection of new GMOs. **Roles of Institutional Biosafety Committee:** RCGM, GEAC etc. for GMO applications in food and agriculture, environmental release of GMO's, Overview of national regulations and relevant international agreements including Cartagena Protocol.	25
II	**Bioethics:** Introduction, ethical conflicts in biological sciences-interference withnature. **Bioethics in Health Care:** patient confidentiality, informed consent, euthanasia,artificial reproductive technologies, prenatal diagnosis.	25
III	**Types of IP**, patents, trademarks, copyright & related rights, traditional knowledge, geographical indications, international framework for the protection of IP. IP as a factor in R&D, IPs of relevance to biotechnology and few case studies, Introduction to history of GATT, WTO, WIPO and TRIPS. **Concept of 'prior art':** Invention in context of "prior art", patent databases, searching international databases, country-wise patent searches (USPTO, EPO, India etc.	25

IV	**Patent filing and Infringement:** Patent application- forms and guidelines, fee structure, time frames, types of patent applications-provisional and complete specifications, PCT and convention patent applications, international patenting requirement, procedures and costs, financial assistance for patenting-introduction to existing schemes, Publication of patents-gazette of India. **Basics of Patents:** Types of patents, Indian Patent Act 1970, recent amendments, filing of a patent application, precautions before patenting-disclosure/non- disclosure, procedure for filing a PCT application	25

Suggested Readings:

1. Anal AK. 2017. Food Processing By-Products and their Utilization (IFST Advances in Food Science). Wiley Blackwell. Arvanitoyannis I. 2007. Waste Management for the Food Industries. First Edition. Academic Press. Bains W. 1993.
2. Biotechnology from A to Z. Third Edition. Oxford University Press Chawla HS. 2002. Introduction to Plant Biotechnology. Second Edition. Science Publishers. Doyle A and Griffiths JB. 1998.
3. Cell and Tissue Culture: Laboratory Procedures in Biotechnology. John Wiley and Sons, UK. El-Mansi EMT, Bryce CFA, Demain AL, and Allman AR. 2012.
4. Fermentation Microbiology and Biotechnology. Third Edition. CRC Press. Joshi VK and Singh RS. 2013.
5. Food Biotechnology: Principles and Practices. I.K. International Publishing House Pvt. Ltd. Knorr D. 1982.
6. Food Biotechnology. Marcel Dekker Oreopoulou V and Russ W. 2007. Utilization of By-Products and Treatment of Waste in the Food Industry. Springer.

Course Name: Enzyme Technology					**Course Code: 24L6.5-BTY-403**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code-403**
			4	0	0	4	**Course Type: DEC-4**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	To understand, analyze, and apply enzyme functions, regulation, and their impact across various sectors, including production, purification, and stabilization strategies.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Understand and analyse the importance of enzymes, classification, their salient features & categories of enzymes and exhibit the knowledge of enzyme activity- specific activity calculation, correlate the structural framework with catalytic power of enzyme. **CLO2**. Describe what enzymes do and how they do and their regulation in the living system. **CLO3.** Describe and analyse the factors affecting enzyme activity, exhibit the knowledge of enzyme kinetics, & describe different types of enzyme inhibitions. **CLO4.** Judge the scope and importance of enzymes in various sectors, understand the various strategies for the production- purification of enzymes, and the techniques to modify and increase the stability and reusability of enzymes.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**History of Enzymology** General characteristics of enzymes, advantages of enzymes over chemical catalysts, Nomenclature and classification of enzymes, Si Determination of three-dimensional structure of enzyme by X-ray crystallography and NMR spectrometry, importance of 3-D structure of an enzyme. **Classification** of enzyme structures, structures adopted by enzymes, principles that govern the 3-D structure adopted by enzymes, Forces for stability of 3-D structure, Denaturation and renaturation, Isoenzymes, enzyme specificity, monomeric and oligomeric enzymes, multienzyme complex, holoenzyme, apoenzyme, cofactor, coenzyme, prosthetic group.	25
II	**Enzyme action:** Effect of enzyme on the rate and equilibrium of a reaction, principles that explain catalytic power and substrate specificity of enzymes, enzyme substrate complex (Lock & Key Model, Induced Fit Theory, Substrate Strain Theory).	25

	Factors responsible for catalytic efficiency of enzyme: proximity and orientation effect, acid-base catalysis, covalent catalysis, strain and distortion theory; Nature of active site, identification of functional groups at active sites; regulatory enzymes- covalently modulated enzymes, allosteric enzymes and their mode of action; regulation of enzyme activity in the living system.	
III	**Enzyme kinetics**: An introduction to enzyme kinetics and its importance, Methods used for investigating the kinetics of enzyme catalyzed reactions, factors that influence the velocity of enzyme catalyzed reaction(effect of substrate concentration, enzyme concentration, pH, temperature, presence of activator/inhibitor etc.); Michaelis-Menten equation, Vmax, Km and its significance; Lineweaver Burk plot- its advantages and limitations, Eadie-Hofstee and Hanes plots. **Enzyme inhibition**: Types of enzyme inhibitions, competitive, uncompetitive, noncompetitive, mixed type inhibition and determination of Ki, Determination of Km and Vmax in the presence and absence of inhibitor; feed- back inhibition; Bisubstrate reactions- brief introduction to sequential and Ping-Pong mechanism with examples	25
IV	**Strategies** used for enzyme production, isolation and purification at laboratory and industrial scale from plant, animal and microbial sources, method of calculating the purification fold, estimation of enzyme activity. **Characterization of an enzyme**: criteria of enzyme purity, determination of the molecular weight (MW) and the number of sub-units of an enzyme. **Enzyme immobilization** and its importance, protein engineering; enzyme therapy, enzyme inhibitors and drug design; enzymes as biosensors, enzyme reactors; Applications of enzymes in medicine, textile, leather, detergent, paper, bakery, dairy industry, beverage and fruit processing, food processing and preservation, clinical applications of enzyme estimation.	25

Suggested Readings:

1. Segal, L.H. (1975) Enzyme Kinetics, Wiley Interscience, USA
2. Walsh, C. (1979) Enzymatic reaction mechanism, Freeman and Company, USA.
3. Gerhartz, W. (1990) Enzyme in Industry, Production and Application, VCH.
4. Shultz, A.R. (1994) Enzyme Kinetics, Cambridge Press.
5. Fresht (1995) Enzyme structure and mechanism, 2nd edition, Freeman and Company.
6. Palmer, T. and Bonner P.L. (2007) Enzymes, Woodhead Publishing Limited.
7. Dixon, M and Webb E.C. (1997) Enzymes, 3rd edition, Academic Press, New York.
8. Price N.C. and Stevens L. (2001) Fundamentals of Enzymology, Oxford University Pres.

Course Name: **Plant Biotechnology**					**Course Code:** **24L6.5-BTY-404**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code-404**
			4	0	0	4	**Course Type:** **DEC-4**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	To develop trained and skilled manpower in the field of plant tissue culture and agriculture biotechnology.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1**. To understand different culture media used in plant cell culture and knowledge about organization of plant genome. **CLO2.** Strategies for biotic and abiotic stress to various crops. **CLO3.** Knowledge of plant as biofactories to produce various important plant products. **CLO4.** Aware of farmers and breeder rights.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Lab Organization:**, types of culture- protoplast, anther, pollen and ovary culture for production of haploid plantsand homozygous lines. **Plant Genetic:** Plant genetic transformation, organization of plant genome-nucleargenome, chloroplast genome and mitochondrial genome.	25
II	**Transformation:** Chloroplast transformation, *Agrobacterium* mediated transformation- Ti and Ri plasmids, role of virulence genes, mechanism of T-DNA transfer, vectors based on Ti and Ri plasmids- cointegrate and binary vectors, technique and factors affecting *Agrobacterium* mediated transformation of plants. **Transgenic Plant:** Analysis of transgenic plants for the presence, integration and expression of transgenes and by biological assays, gene silencing in transgenic plants, gene stacking in plants methods, advantages and drawbacks of each method.	25
III	**Strategies for Introducing Tolerance:** Biotic and abiotic stress resistance/tolerance, viral resistance, fungal resistance, insect resistance, herbicide resistance, various abiotic stresses (like drought, salinity, temperature). **Molecular Farming/Pharming:** Genetic engineering of plants for molecular	25

	Farming / pharming, production of antibodies, vaccines and other medically related proteins in plants, nutritional enhancement of plants (carbohydrates, seed storage proteins, vitamins), manipulation of flower colors and production of enzymes of industrial importance.	
IV	**Plant Cells as Bio Factories:** The production of secondary metabolites, types of cell culture systems used for production of secondary metabolites and advantages of their in vitro production. **Bioreactors for Plant Cell:** Organ and immobilized plant cell cultures, biotransformation, and permeabilization of cells and removal of secreted products. Plant breeder's rights (PBRs) and farmers rights, clean gene technology, current status of transgenic crops, bane and boon of GM crops, concerns about GM crop-environmental, biosafety and ethical issues.	25

Suggested Readings:

1. Plant Biotechnology: Principles and Applications. (2007), Malik, Z. A., Usha, K., Kamaluddin andAthar A. Springer Nature, Singapore.
2. Elements of Biotechnology. (2020) 2nd ed., Gupta, P.K. Rastogi pub.
3. Plant Genetic Engineering.Vol.1-6, Singh, R. P. and Jaiwal, P.K. (Eds), Scitech publishing LLC, USA.
4. Introduction to Biotechnology. (2009), 3rd ed., Chawla, H.S., Science publishers. USA.
5. Gene transfer to plants. Potrykus, I. and Spangenberg, G., Springer Verlag, Germany.
6. Plant tissue culture–Theory and Practice. Bhojwani, S.S. and Razdan, M.K., Elsevier publication.
7. Practical application of Plant Molecular Biology. Henry, R.J., Chapman and Hall.
8. Plants, genes and agriculture. 2nd ed., Chrispeels, M.J., Sadava, D.E, Jones & Bartlett pub., UK.
9. Crop Biotechnology: Genetic Modification and Genome Editing. Nigel, G. H., World Scientific Publishing Europe Ltd., London.

Course Name: **Drug Designing and Pharmacogenomics**					**Course Code:** **24L6.5-BTY-405**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code- 405**
			4	0	0	4	**Course Type: DEC-5**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	The aim of this course is to understand the students to the basic tools of pharmacogenomics and drug metabolism pathways.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Gain knowledge about drug designing. **CLO2.** Understand the drug metabolism pathways and ayurgenomics. **CLO3.** This course to understand about tools of pharmacogenomics.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**General Ideas of Drug Designing:** 2D and 3D QASR, concept of a pharmacophoreand pharmacophore-based searches of ligand databases. **Concepts of COMFA**: Methods for simulated docking.	25
II	**Drug Response to Patients:** Structural influence in the drug response, efficacy andmetabolism of drugs, drug metabolism pathways, adverse drug reactions and poisoning, drug discovery and approval. **Metabolic Changes of Drugs and Related Organic Compounds:** **Ayurgenomics:** Genomics and modern medicine, pharmacogenomics and pharmacognosy.	25
III	**Concepts of Pharmacogenetics:** Pharmacogenomics- Introduction, basic concepts about genetic diseases, personalized medicine- introduction and importance, the genetics of therapeutic targets and gene-based targets, pharmacogenomics necessityin drug designing. **Polymorphisms:** Introduction, types and importance in drug targets, prediction of structural changes among sequences by the influence of polymorphisms, genetic analysis of human variation, microsatellite for studying genetic variation.	25
IV	**Tools forPharmacogenomics Analysis:** Pharmacokinetics (PK), Pharmacodynamics (PD). **Process in Structural Pharmacogenomics:** Target structure optimization, validation, lead identification, ADME prediction, synthesis, assays and clinical trials.	25

Suggested Readings:

1. Molecular analysis and Genome discovery. Rapley, R. and Harbron, S. John Willey & Sons, Ltd.
2. Introduction to Quantitative Genetics. 4th ed., Falconer, D.S., Mackay, T.F.C.
3. A Required Course in Human Genomics, Pharmacogenomics and Bioinformatics. Daniel, A., Brazeau, D. and Gayle,A., Brazeau.
4. Rosenberg, N.A., Pritchard, J.K., Weber, J.L., Cann, H.M., Kidd, K.K., Zhivotovsky, L.A., Feldman,M.W. Science. (2002), Vol 298 (5602), 2381-2385.
5. Randomized Trial of Genotype-Guided Versus Standard Warfarin Dosing in Patients Initiating Oral Anticoagulation. (2007), Anderson, J.L., Horne, B.D., Stevens, S.L., *et al*. for the Couma-Gen Investigators. Circulation.116, 2563

Course Name: **Nano Biotechnology**					**Course Code:** **24L6.5-BTY-406**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code-406**
			4	0	0	4	**Course Type: DEC-5**
Level of the Course: 500-599							
End Semester Exam : 70 marks **Internal Assessment : 30 marks** **Total : 100 marks**			**Examination Duration :** 3 Hrs.				
Course Objectives	An objective of the program is to provide advance research and promote innovation through applications of nanobiotechnology to address issues in health, drug delivery, nano-bioanalytics.						
Course Outcomes	**After completing this course, the students are expected to learn the following:** **CLO1.** Understand biocompatibility and properties of nano biomaterial. **CLO2**. Learn the structural and functional principles of bio-nanotechnology. **CLO3**. Nanoparticles based drug delivery system. **CLO4**. Acquire knowledge of Nano-bioanalytical techniques.						

COURSE SYLLABUS

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting atleast four short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Students have to attempt one question from each unit. Each question shall carry equal marks.

Unit No.	Contents	Weightage (%)
I	**Nano Biotechnology:** An Overview from biotechnology to nanobiotechnology, bio-nanomachines in actions. **Molecular Recognition & Cellular Communication:** Natural bio-nanomachinery, protein folding, self-assembly and self- organization.	25
II	**Classification of Nanomaterials** **Inorganic nanomaterials:** carbon nanotubes and cones, nanofols and nonporous, zeolites**,** minerals, silicate minerals, montmorillonite and Laponite. **Organic nanomaterials:** dendrimers, micelles, liposomes, block copolymers, **Bionanomaterials:** Biomimtric, bioceramic and nanotherapeutics; nano materials for molecular eletronics and optoelectronics.	25
III	**Nanobioparticle:** Synthesis, properties & characterization carbon nanotubes, Gold-, Silver- and Zinc oxide – nanoparticles; Development of quantum structure, Finite size Zero, One- and Two-Dimensional Nanostructures, **Characterization:** Physical, Optical, magnetic, chemical, antimicrobial properties of Nanoparticles and their characterization with various techniques, FTIR, Photoluminescence spectroscopy etc.	25

IV	**Advances in Biomolecular Design:** Molecular modeling and biomolecular structure determination, DNA-Protein nanostructures, DNA directed immobilization, chip-based DNA detection assays, microarray technologies, luminescent quantum dots for biological labeling. **Nanobiotechnology Applications:** Agricultural productivity enrichment, disease diagnosis and screening, pharmacy & drug delivery systems, food processing and storage, vector and pest detection and control.	25

Suggested Readings:

1. Biomaterials: A Nano Approach. Ramakrishna,S., Ramalingam,M., Sampath Kumar,T.S., Winston, O., Soboyejo, CRC Press.
2. Molecular Cell Biology. Lodish,H. W.H. Freeman &Company.
3. Nanobiotechnology: Concepts, Applications and Perspectives, Edited by Christof, M. Niemeyer and Chad,A. ,Mirkin. Wiley-VCH, 2004, ISBN 3527306587, 9783527306589.
4. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley- VCH Verlag, GmbH & Co.5 Bio-nanotechnology: Lessons from Nature. (2004), 1st ed., Goodsell,D.S.Wiley-Liss,
6. Biomedical Nanotechnology, 1st ed., Malsch,N.H.CRC Press.
7. Introduction to Nanomaterials and Nanosciences. DAS, CBS Publication.

Course Name: **Research Ethics**					**Course Code:** **24L6.5-BTY-407**		
Batch: 2024-2026	**Programme:** M.Sc. Biotechnology	**Semester: IV**	**L**	**T**	**P**	**Credits**	**Exam Course Code-407**
			1	0	1	2	**Course Type: EEC**
Level of the Course: 500-599							
End Semester Exam : 35 marks **Internal Assessment : 15marks** **Total : 50 marks**			**Examination Duration:** 3Hrs.				

COURSE SYLLABUS

Unit No.	Contents	Weightage (%)
	To be provided by **Indira Gandhi University, Meerpur, Rewari**	

<table>
<tr><td colspan="5">Course Name:
Dissertation</td><td colspan="4">Course Code:
24L6.5-BTY-408</td></tr>
<tr><td rowspan="2">Batch:
2024-2026</td><td rowspan="2">Programme:
M.Sc. Biotechnology</td><td rowspan="2">Semester: IV</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td>Exam Course Code-408</td></tr>
<tr><td>0</td><td>0</td><td>12</td><td>12</td><td>Course Type-Dissertation</td></tr>
<tr><td colspan="8">Level of the Course: 500-599</td></tr>
<tr><td colspan="4">End Semester Evaluation
(By External Examiner) : 200 marks
Internal Assessment : 100 marks
Total : 300 marks</td><td colspan="4">Assessment Duration: 3Hrs.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">To inculcate/impart skills on experiment designing, experiment execution and research reporting. To provide skills on writing thesis dissertation.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">After completing this course, students are expected to learn the following:
CLO1: Improved skills to design, perform, report and present research outcomes.
CLO2: Improved skills in writing the research outcomes in the form of thesis dissertation.
CLO3: Acquiring skills to work independently as well as in group in order to solve are searchbased problem.</td></tr>
<tr><td>Unit No.</td><td colspan="6">Contents</td><td>Weightage (%)</td></tr>
<tr><td></td><td colspan="6">The guidelines and format for the dissertation is given

below:Dissertation Guidelines:

1. GENERAL:
The manual is intended to provide broad guidelines to the M.Sc. candidates in the preparation of the dissertation. It should be in organized and scholarly fashion an account of original research work of the candidate leading to the discovery of new facts or techniques or correlation of facts already known.

2. NUMBER OF COPIES TO BE SUBMITTED:
Students should submit three copies to the Chairperson/Head of the Department concerned on or before the specified date.</td><td>100</td></tr>
</table>

ARRANGEMENT OF CONTENTS OF DISSERTATION:

Dissertation material should be arranged as follows:

1. Cover Page & Title page
2. Certificate for Dissertation Approval and Supervisor/s
3. Declaration (See format below)
4. Acknowledgements
5. Table of Contents
6. List of Tables (optional)
7. List of Figures (optional)
8. List of Symbols, Abbreviations and Nomenclature (Optional)
9. Abstract (Hindi and English)
10. Chapters
11. References
12. Appendices
13. One page CV

The Tables and Figures shall be introduced at the appropriate places.

PAGE DIMENSIONS AND MARGIN:

The dimensions of the dissertation should be standard A4 size paper may be used for preparing the copies, standard margin with 1.5 line spacing.

MANUSCRIPT PREPARATION: The general text of thesis shall be typed in font style Times New Roman and font size 12 with 1.5 spacing. Same quality of paper should be used for the preparation of the entire thesis; except figure, photos are shown.

Cover Page & Title Page: A specimen copy of the Cover page & Title page for thesis are given in Annexure I.

Certificate: The Bonafide Certificate as per the format shown in Annexure II

Abstract: Abstract should be an essay type of narration not exceeding 500 words outlining the research problem, the methodology used for tackling it and a summary of the findings, typed in 1.5 line spacing.

Acknowledgements: The acknowledgements shall be brief and should not exceed one page. The student's signature shall be made at the right bottom above his / her name typed in capitals.

Table of contents: The table of contents should list all material following it as well as any material which precedes it. The title page, Bonafide Certificate and Acknowledgment will not find a place among the items listed in the Table of Contents but the page numbers in lower case Roman letters are to be accounted for them. One and a half spacing should be adopted for typing the matter under this head.

List of Table: The list should use exactly the same captions as they appear above the tables in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing the matter under this head.

List of Figures: The list should use exactly the same captions as they appear below the figures in the text and the caption shall follow 'sentence case'. One and a half spacing should be adopted for typing them at under this head

List of Symbols, Abbreviations and Nomenclature: One and a half spacing should be adopted for typing them at under this head. Standard symbols, abbreviations etc. should be used.

Chapters-The chapters may include

Chapter I- Introduction

Chapter II- Review of Literature

Chapter III- Materials and Methods

Chapter IV- Results and Discussion

Chapter V- Summary and Conclusions

Research output/outcome if any published or presented in conference/seminar/symposium may be included.

List of References: Any works of other researchers, if used either directly or indirectly, should be indicated at appropriate places in the thesis. The citation may assume any one of the following forms APA Style.

APA in-text citation style uses the author's last name and the year of publication, for example: (Field,2005).

Example:

Derwing, T. M., Rossiter, M. J., & Munro, M. J. (2002). Teaching native speakers to listen to foreign-accented speech. Journal of Multilingual and Multicultural Development, 23(4):245-259.

Thomas, H. K. (2004). Training strategies for improving listeners' comprehension of foreign-accented speech (Doctoral dissertation), University of Colorado, Boulder.

Typing Instructions: General this section includes additional information for final typing of the thesis. Some information given earlier under 'Manuscript preparation' shall also be referred. The impressions on the typed/duplicated/printed copies should be black in colour. Corrections, interlineations and crossing out of letters or words will not be permitted in any of the copies of the thesis intended for submission. Erasures, if made, should be neatly carried out in all copies. A sub-heading at the bottom of a page must have at least two full lines below it or else it should be carried over to the next page. The last word of any page should not be split using a hyphen. One and a half spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and FontSize12 with 1.5 spacing.

Single spacing should be used for typing:

(i) Long Tables
(ii) Long quotations
(iii) Footnotes
(iv) Multilane captions
(v) References

Chapters The format for typing chapter headings, division headings and subdivision headings shall be same as given in Table of Contents.

Binding specification: Thesis should be spiral or soft cover book bound, the cover of the thesis should be of sky blue color printed with dark blue/black ink and the text for printingshould be identical as prescribed for the title page.

Format for Declaration by the candidate:

DECLARATION

I…..... student of Biotechnology Department IGU Meerpur, Rewari hereby declare and certify with my signature that my thesis entitled…….
submitted to the Department of Biotechnology, Indira Gandhi University, Meerpur, Haryana, India in partial fulfillment of the requirements for the award of the Degree of Master's of Science is a record of original research work done by me and the dissertation has not been the basis for the award of any degree/diploma/associate ship/fellowship or similar title of any candidate of any University. I have faithfully and accurately cited all my sources, including books, journals, handouts and unpublished manuscripts, as well as any other media, such as the Internet, letters or significant personal communications.

I understand the concept of "plagiarism" and declare that while drafting this dissertation I have refrained from plagiarism. I know that plagiarism not only includes direct copying, but also the extensive use of other's ideas without proper referencing or acknowledgement (which includes the proper use of references and quotation marks). If my dissertation found to be plagiarized at any point of time, I'll be solely responsible and will be ready to accept any decision taken by the competent authority including rejection of my dissertation.

Signature of student

TEACHING-LEARNING PROCESS

- Lectures
- Discussions
- Participative Learning
- Interactive Sessions
- Assignments
- Research-based Learning/Project Work
- Technology-embedded Learning
- Hands on training

KEYWORDS

- LOCF
- CBCS
- Face to face (F to F) Learning
- Programme Outcomes
- Programme Specific Outcomes
- Course Outcome
- Formative Assessment and Evaluation
- Comprehensive and Continuous Evaluation

REFERENCES

- National Education Policy-2020. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

- The draft subject specific LOCF templates availableon UGC website. https://www.ugc.ac.in/ugc_notices.aspx?id=MjY5O Q==

APPENDICES

- Curricular Reforms — Extracts from National Education Policy-2020
  The draft subject specific LOCF templates available on UGC website. https://www.ugc.ac.in/ugc_notices.aspx?id=MjY5OQ==