INDIRA GANDHI UNIVERSITY
MEERPUR

Scheme of Examination and Syllabus
for
Under-Graduate Programme
(Subject: Biotechnology)

ıder Multiple Entry-Exit, Internship and CBCS-
OCF in accordance to NEP-2020 w.e.f. 2024-25
(in phased manner)

DEPARTMENT OF BIOTECHNOLOGY, IGU UNIVERSITY, MEERPUR

Scheme of Examination for Under-Graduate Program
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2024-25 (In phased manner)

Subject: Biotechnology

1st YEAR: SEMESTER-I									
Applicable Scheme	**Course**	**Course Code**	**Nomenclature of Course**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A, B & C	**CC-1** **MCC-1** **4 credits**	24 L4.5-BTY-101	Introduction of Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	**MCC-2** **4 credits**	24 L4.5-BTY-102	Basics of Biomolecules	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & D	**CC-M1** **2 credits**	24 L4.5-BTY-103	Laboratory Techniques & Practices	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A, B, C & D	**MDC-1** **3 credits**		Basic Biology-I	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme C only	**CC-M1** **4 credits**	From Available CC-M1 of 4 credits as per NEP							
Scheme A, B & C	**AEC-1** **2 credits**	From Available pool of AEC-1 of 2 credits as per NEP							
	SEC-1 **3 credits**	From Available pool of SEC-1 of 3 credits as per NEP							
	VAC-1 **2 credits**	From Available pool of VAC-1 of 2 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course

CC-M: Minor Course
AEC: Ability Enhancement Course
VAC: Value Added Course

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Subject: Biotechnology

1st YEAR: SEMESTER-II

Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-2 MCC-3 4 credits	24 L4.5-BTY-201	General Microbiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme C only	DSEC-1 4 credits	24 L4.5-BTY-202	Diagnostic Laboratory Techniques	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & D	CC-M2 2 credits	24 L4.5-BTY-203	Introduction of Biological Chemistry	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	4 hrs.
Scheme A, B, C & D	MDC-2 3 credits		Basic Biology-II	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme A, B, & C	Internship* (4 credits)	24 L4.5-BTY-205	*Internship of 4 credits of 4-6 weeks duration						
Scheme C only	CC-M2 4 credits	From Available CC-M2 of 4 credits as per NEP							
Scheme A, B & C	AEC-2 2 credits	From Available pool of AEC-2 of 2 credits as per NEP							
	SEC-2 3 credits	From Available pool of SEC-2 of 3 credits as per NEP							
	VAC-2 2 credits	From Available pool of VAC-2 of 2 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course
DSEC: Discipline Skill Enhancement Course
CC-M: Minor Course
AEC: Ability Enhancement Course
VAC: Value Added Course
***Applicable for those students who wish to exit after 2nd semester**

Note: UG Certificate in Life Sciences (with credits 52)/ Biotechnology (with 48 Credits) will be provided, if student want to exit after 2nd Semester, on submitting 4-6 weeks Internship Report (4 Credits).

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w.e.f. 2024-25 (In phased manner)

Subject: Biotechnology

2nd YEAR: SEMESTER-III

Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-3 MCC-4 4 credits	24 L5.0-BTY-301	Cell Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B only	MCC-2 4 credits	24 L4.5-BTY-102	Basics of Biomolecules	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B, C & D	MDC-3 3 credits		Basic Biology-III	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	4 hrs.
Scheme B & C	MCC-5 4 credits	24 L5.0-BTY-302	Genetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A & C	CC-M3 4 credits	From Available CC-M3 of 4 credits as per NEP							
Scheme B only	CC-M3(V) 4 credits	From Available pool of VOC-1 of 4 credits as per NEP							
Scheme A, B & C	AEC-3 2 credits	From Available pool of AEC-3 of 2 credits as per NEP							
	SEC-3 3 credits	From Available pool of SEC-3 of 3 credits as per NEP							
Scheme C only	VAC-3 2 credits	From Available pool of VAC-3 of 2 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course

CC-M: Minor (Vocational)
AEC: Ability Enhancement Course
VAC: Value Added Course

Note: [illegible] other [illegible] UC 2.

DEPARTMENT OF BIOTECHNOLOGY, IGU UNIVERSITY, MEERPUR

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w.e.f. 2024-25 (In phased manner)
Subject: Biotechnology

2nd YEAR: SEMESTER-IV

Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-4 MCC-6 4 credits	24 L5.0-BTY-401	Recombinant DNA Technology-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-7 4 credits	24 L5.0-BTY-402	Bioinformatics-I	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-8 4 credits	24 L5.0-BTY-403	Metabolism	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-1 4 credits (Select anyone)	24 L5.0-BTY-404	IPR, Biosafety and Bioethics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		24 L5.0-BTY-405	Foundations of Forensic Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	Internship* (4 credits)	24 L5.0-BTY-406	*Internship of 4 credits of 4-6 weeks duration						
Scheme A, B & C	CC-M4 (V) 4 credits	From Available pool of CC-M4(V) of 4 credits as per NEP							
	AEC-4 2 credits	From Available pool of AEC-3 of 2 credits as per NEP							
Scheme Conly	VAC-4 2 credits	From Available pool of VAC-4 of 2 credits as per NEP							
Scheme A & B	VAC-3 2 credits	From Available pool of VAC-3 of 2 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course
DSE: Discipline Specific Elective course

CC-M(V): Minor (Vocational)
AEC: Ability Enhancement Course
VAC: Value Added Course

Note: UG Diploma in Life Sciences (with credits 96)/ Biotechnology (with 94 Credits) will be provided, if student want to exit after 4th Semester on submitting the 4-6 weeks Internship Report (4 Credits).

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Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2024-25 (In phased manner)

Subject: Biotechnology

3rd YEAR: SEMESTER-V									
Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-5 MCC-9 4 credits	24 L5.5-BTY-501	Immunology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-10 4 credits	24 L5.5-BTY-502	Molecular Genetics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-2 4 credits Select one Option	24 L5.5-BTY-503	Fundamentals of Enzymology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		24 L5.5-BTY-504	Food Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-3 4 credits Select one Option	24 L5.5-BTY-505	Foundations of Environment and Ecology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		24 L5.5-BTY-506	Foundations of Nano-Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A, B & C	Internship* 4 credits	24 L5.5-BTY-507	*If not done in II and 1V semester						
Scheme A & C	CC-M5 (V) 4 credits	From Available pool of VOC-1of 4 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course
DSE: Discipline Skill Elective Course

CC-M (V): Minor (Vocational)
AEC: Ability Enhancement Course
VAC: Value Added Course

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Subject: Biotechnology

3rd YEAR: SEMESTER-VI

Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme A, B & C	CC-6 MCC-11 4 credits	24L5.5 -BTY-601	Microbial Technology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	MCC-12 4 credits	24 L5.5-BTY-602	Bio-analytical Techniques	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-4 4 credits Select one Option	24 L5.5-BTY-603	Medical Microbiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		24 L5.5-BTY-604	Medical Biotechnology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme B & C	DSE-5 4 credits Select one Option	24 L5.5-BTY-605	Biostatistics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
		24 L5.5-BTY-606	Bio-entrepreneurship	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.
Scheme A only	CC-M6 4 credits	From Available CC-M6 of 4 credits as per NEP							
Scheme A only	CC-M7(V) 4 credits	From Available pool VOC-3 of 4 credits as per NEP							
Scheme B only	CC-M5(V) 4 credits	From Available pool of VOC-3 of 4 credits as per NEP							
Scheme C only	CC-M6(V) 4 credits	From Available pool of VOC-3 of 4 credits as per NEP							
Scheme C only	SEC-4 2 credits	From Available pool of SEC-4 of 2 credits as per NEP							

CC: Core Course
MDC: Multidisciplinary Course
SEC: Skill Enhancement Course
DSE: Discipline Skill Elective Course
CC-M(V): Minor (Vocational)
AEC: Ability Enhancement Course
VAC: Value added Course

Note: Bachelor's degree in Life Sciences/Biotechnology will be awarded if student want to exit after 6th Semester.

DEPARTMENT OF BIOTECHNOLOGY, IGU UNIVERSITY, MEERPUR

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Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020
w.e.f. 2024-25 (in phased manner)
Subject: Biotechnology

4th YEAR: SEMESTER-VII (FOR HONOURS/HONOURS WITH RESEARCH IN BIOTECHNOLOGY)

Applicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
Scheme B & C	CC-H1 4 credits	24 L6.0-BTY-701	Recombinant DNA Technology-II	4	4	30	70	100	3 hrs.
	CC-H2 4 credits	24 L6.0-BTY-702	PharmaceuticalBiotechnology	4	4	30	70	100	3 hrs.
	CC-H3 4 credits	24 L6.0-BTY-703	Molecular Cell Biology	4	4	30	70	100	3 hrs.
	DSE-H1 4 credits Select one Option	24 L6.0-BTY-704	Molecular diagnostics	4	4	30	70	100	3 hrs.
		24 L6.0-BTY-705	Environmental Biotechnology	4	4	30	70	100	3 hrs.
	PC-H1 4 credits	24 L6.0-BTY-706	Practical Based on 24 L6.0-BTY-701 to 703, and One out of 24 L6.0-BTY-704, 24 L6.0-BTY-705	4	8	30	70	100	6 hrs.
	CC-HM1 4 credits	From Available Minor of 4 credits as per NEP							

CC- H: Core Course in Honours Subject
DSE: Discipline Skill Elective Course in Honours Subject
CC-HM: Core course in Minor Subject of Honours Program
PC: Practicum Course in Honours Subject

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w.e.f. 2024-25 (in phased manner)

Subject: Biotechnology

4th YEAR: SEMESTER-VIII (FOR HONOURS IN BIOTECHNOLOGY)

pplicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
	CC-H4 4 credits	24 L6.0-BTY-801	Animal Cell Culture	4	4	30	70	100	3 hrs.
	CC-H5 4 credits	24 L6.0-BTY- 802	Plant Cell Culture	4	4	30	70	100	3 hrs.
	CC-H6 4 credits	24 L6.0-BTY-803	Enzyme Technology	4	4	30	70	100	3 hrs.
Scheme B & C	DSE-H2 4 credits Select oneoption	24 L6.0-BTY- 804	Bioinformatics-II	4	4	30	70	100	3 hrs.
		24 L6.0-BTY- 805	Calculations in Biotechnology	4	4	30	70	100	3 hrs.
	PC-H2 4 credits	24 L6.0-BTY- 806	Practical Based on 24 L6.0-BTY-801 to 803, and One out of 24 L6.0-BTY-804, 24 L6.0-BTY- 805	4	8	30	70	100	6 hrs.
	CC-HM2 4 credits	From Available Minor of 4 credits as per NEP							

OR

4th YEAR: SEMESTER-VIII (FOR HONOURS WITH RESEARCH IN BIOTECHNOLOGY)

pplicable Scheme	Course	Course Code	Nomenclature of Course	Credits	Hours/ Week	Internal marks	External Marks	Total Marks	Exam Duration
	CC-H4 4 credits	24 L6.0-BTY-801	Animal Cell Culture	4	4	30	70	100	3 hrs.
	CC-H5 4 credits	24 L6.0-BTY-802	Plant Cell Culture	4	4	30	70	100	3 hrs.
Scheme B & C	Project/ Dissertation 12 credits	24 L6.0-BTY-807	Dissertation/ Project	12	-	-	-	-	-
	CC-HM2 4 credits	From Available Minor of 4 credits as per NEP							

C: Core Course
C: Practicum Course
CC-HM: Minor

ote: Bachelor (Hons.) Degree in Biotechnology with 184 credits will be awarded.
ote: Bachelor (Hons.) Degree (With Research) in Biotechnology with 184 credits will be awarded.

Pool of Value-Added Courses (VACs)

VAC-1		VAC-2		VAC-3	
Course Code	Nomenclature of Course	Course Code	Nomenclature of Course	Course Code	Nomenclature of Course
	Human Values and Ethics		Environmental Studies		Biotechnology and Human Welfare VAC-3
	Environmental Studies		Human Values and Ethics		
50% of students of 1st semester of Department/College/Institute will be offered a course on Human Values and Ethics and the remaining 50% will be offered course on Environmental Studies		The students, who have taken Human Values and Ethics course in the 1st semester, will study a course on Environmental Studies and vice-versa		Students will opt for one VAC course from the pool in this category offered by Department/ College/ Institute. Department/College/Institute can offer any other value-added course after getting approval from the University	

Pool of Skill Enhancement Courses (SECs)

SEC-2 @ 3 credits		SEC-3 @ 3 credits		SEC-4 @ 2 credits	
Course Code	Nomenclature of Course	Course Code	Nomenclature of Course	Course Code	Nomenclature of Course
	Bioanalytical Techniques		Dairy Processing		Immunological Techniques

Pool of Minor (Vocational) Courses (VOC)

VOC-1 @ (Semester III and V)		VOC -2 (Semester IV)		VOC-3 (Semester VI)	
Course Code	Nomenclature of Course	Course Code	Nomenclature of Course	Course Code	Nomenclature of Course
	Biomedical Waste Management (VOC-1)		DNA Fingerprinting (VOC-2)		Cell Culture (VOC-3)

CC-1 / MCC-1

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**I**		
Name of the Course	**Introduction of Biotechnology**		
Course Code	**24 L4.5-BTY-101**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**CC-1 / MCC -1**		
Level of the course (As per Annexure-I	**100-199**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	**After completing this course, the learner will be able to:** 1. Understand the concepts in biotechnology. 2. Gain the knowledge of scope and applications of plant biotechnology. 3. Gain the knowledge of scope and applications of animal biotechnology. 4. Get an insight of scope and applications of biotechnology in environment, food and chemical industries. 5. Gain knowledge of structure, working, maintenance/calibration and safety measures during handling of biotech lab instruments and biochemicals. Also get insight of maintenance of hygiene/ aseptic conditions and proper disposal of biochemicals.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting

One question from each unit. All questions carry equal marks.		
Unit	**Topics**	**Contact Hours**
I	Introduction to Biotechnology – an interdisciplinary pursuit; Main areas of application of biotechnology; Biotechnology research in India, and biotechnology in context of developing world; Public perception of biotechnological products; Brief account of safety guidelines, risk assessment and ethics in biotechnology; Very brief account of intellectual property rights; Substrates (raw materials) and the future of biotechnology. In brief scope and techniques of preservation. Introduction of fermentation technology.	12
II	Introduction of animal tissue culture (brief of history, culture media, substrate surfaces, culture procedures, primary cultures, cell lines, organ culture and tissue engineering etc.). Introduction of plant tissue culture (in brief history, culture media, explants, totipotency, dedifferentiation and types of cell & tissue culture etc.). Scope and applications of animal biotechnology and plant biotechnology. Brief account of Immuno-Technology: immune system (immune cells, types of immunity and general structure of immunoglobulins), hybridoma technology and monoclonal antibodies. *In vitro* fertilization and embryo transfer technology in brief.	12
III	Genetics and Biotechnology: Introduction of genetic engineering, gene and genomes, proteins and proteome, history of genetic manipulations, DNA fingerprinting and forensic analysis. Industrial genetics, Potential laboratory biohazards of genetic engineering. Introduction to molecular markers and genetic mapping. Introduction of enzyme technology: nature of enzymes, application of enzymes and immobilized enzymes.	11
IV	Environmental Biotechnology: An overview, scope and market of biological control of environment. Brief account on bioremediation and waste treatment biotechnology, microbial insecticides, biofertilizers, microbes in oil recovery and bioleaching. Application of biotechnology in medicine (pharmaceutical industry, vaccines, antibiotics etc.), food industry, biofuels and chemical industry.	10
V*	List of Practical: 1. Study of structure and working of laminar air flow cabinets. 2. Study of working, maintenance and safety measures during handling of autoclaves. 3. To study working, maintenance/calibration and precautions during handling of pH-meter, weighing balance, microscopesand other miscellaneous biotech lab instruments. 4. To study maintenance of hygiene/ aseptic conditions of biotech labs, instruments and glassware /plasticwares. 5. Precautions in handling of biochemicals and study of their proper disposal after use.	30

Evaluation Methods	
Internal Assessment: **Theory: 20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum: 10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination** **Theory:** 50 Marks **Practical:** 20 Marks. Evaluation of the practical skill willbe done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Elements of Biotechnology - PK Gupta
2. Gene Biotechnology - S.N. Jogdand
3. Biotechnology 5th Edition (Cambridge) - John E. Smith
4. Biotechnology for beginners – Reinhard Renneberg Academic Press

MCC -2

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**I**		
Name of the Course	**Basics of Biomolecules**		
Course Code	**24 L4.5-BTY-102**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**MCC -2**		
Level of the course (As perAnnexure-I	**100-199**		
Pre-requisite for the course (ifany)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand physical and chemical basis of biomolecules involved in life processes. 2. Demonstrate the knowledge of chemical basis of biomolecules, Classify, define, draw structures and correlate to various properties, functions of carbohydrates. 3. Classify, draw structures and correlate the chemical structures of lipids, amino acids, and nucleic acids to their organization, properties and functions. 4. Gain fundamental knowledge of proteins biochemistry. 5. *Practically analyze the samples qualitatively and quantitatively for the presence of various biomolecules.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	
Part B- Contents of the Course			
Instructions for Paper- Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.			

Unit	Topics	Contact Hours
I	**Carbohydrates**: Definition, classification, nomenclature of carbohydrates. Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoproteins and their biological functions.	12
II	**Lipids**: Classification, nomenclature and properties of fatty acids. Essential fatty acids. Structure and properties of phospholipids, sphingolipids, glycolipids, gangliosides, prostaglandins. Terpenoids and isoprenoids - definition and representative structures, steroids. Concept of acid value, saponification value and iodine value.	11
III	**Amino Acids and Proteins**: Common structural features of amino acids. Classification by R group, Zwitter ion structures, acid-base properties and titration curves of amino acids. Essential amino acids. Physico chemical properties of amino acids (solubility, boiling and melting points, reactions like Edman's, Sanger's, ninhydrin). Basic introduction to terms: domains & motifs. Forces that stabilize the protein's structure (electrostatic forces, hydrogen and disulfide bonds, hydrophobic associations). Primary, secondary, tertiary & quaternary structures of proteins. Determination of amino acid sequences of proteins.	12
IV	**Nucleic acids**: Chemical structure and base composition of nucleic acids. Chargaff's rules, Watson Crick Model (B-DNA) and other forms of DNA (A- and Z- DNA). Nucleosides & Nucleotides. Biologically important nucleotides. Structural polymorphism of RNA. Denaturation and renaturation of DNA.	10
V*	List of Practical: 1. Quantitative estimation of proteins by Biuret method/Lowry's method. 2. Estimation of DNA by Diphenylamine method. 3. Estimation of RNA by Orcinol method. 4. Estimation of amino acids using ninhydrin reaction. 5. Qualitative analysis of sugars and proteins. 6. Quantitative estimation of sugars (Di-nitro-salicylic acidmethod). 7. Extraction and quantification of total lipids. 8. Determination of saponification value of fats. 9. Determination of acid value of fats. 10. Determination of iodine value of fats.	30

Evaluation Methods	
Internal Assessment: **Theory: 20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum: 10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination** **Theory:** 50 Marks **Practical:** 20 Marks. Evaluation of the practical skill willbe done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lehninger: Principles of Biochemistry, 7th edition, by David L. Nelson and M. M. Cox (2017) Maxmillan/ Worth publishers/W.H. Freeman &Company
2. Biochemistry, 5th edition, by R.H. Garrett and C.M. Grisham (2012). Michal Sabat, University of Virginia.
3. Outlines of Biochemistry by E. E. Conn, P. K. Stumpf, G. Bruenimg and Ray H. Doi (1987),John Wiley
4. Biochemistry: Internationals edition by Jeremy M Berg, John L Tymoczko and Lubert Stryer. (2015). W.H. Freeman & Co., N.Y.
5. Biochemistry by J.L. Jain, S. Chand & Co.
6. Essentials of Biochemistry, 5th edition by Satyanarayana and Chakrapani. (2019)Elsevier, India
7. Chemistry of Biomolecules: An Introduction, by R. J. Simmonds. Royal Society of Chemistry

CC-M1

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**I**		
Name of the Course	**Laboratory Techniques & Practices**		
Course Code	**24 L4.5-BTY-103**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M1**		
Level of the course (As per Annexure-I	**100-199**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Acquire knowledge of analytical tools and techniques of biotechnology & understanding of good laboratory practices. 2. Handle general & specific problems while processing of experimental material and learn to devise solution by choosing appropriate methodology/biotechnique for processing of biomaterials/products. 3. Exhibit the knowledge of testing the potency of antibiotics / disinfectants / antiseptics and learn aseptic conditions for working in Biotechnology Lab. 4. Understand the biochemical and microbiological techniques essential for working in a biotechnological laboratory. 5. *Acquire knowledge of working and hands-on training of tools and techniques of biotechnology labs.		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 **Internal Assessment Marks: 15** (10 Theory + 5 Practical) **End Term Exam Marks: 35** (20 Theory + 15 Practical)		**Time:** **Theory: 3h** **Practical:4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Lab rules and safety measures to be taken in Biotechnology Lab., Commonly used equipments for Biotechnological work- Laminar airflow, Centrifuge, pH meter, Incubator, Fermenter, Colony-counter, Autoclave, Inoculating loop and needle, Use of bright-field microscope, Colorimeter and spectrophotometer.	3
II	Qualitative and quantitative estimation of various biomolecules- sugars, proteins; determination of various metabolites in given biological samples, Preparation of standard curve, Preparation of buffers, Preparation of normal, molar, percent solutions, buffer solutions and determination of their pH, Thin-layer, Paper and Two-dimensional Chromatography, Paper electrophoresis.	3
III	Sterilization techniques followed in biotechnology lab. dry and wet sterilization techniques, Preferred method of sterilization for different materials, Biological indicators for checking the efficiency of sterilization process, Evaluation of different disinfectants and antiseptics and their usage.	3
IV	Microorganisms, Preparation of cotton plugs and different types of culture media for growth of microorganisms, animal and plant cell culture media, Preparation of dilutions and isolation of micro-organisms from air, water and soil, sub- culturing/ Picking off technique- streaking, pour-plate, spread plate methods.	3
V*	List of Practical: 1. Lab rules and safety measures to be taken inBiotechnology Lab. 2. Sterilization techniques followed in biotechnology lab. 3. Paper and Thin Layer Chromatography. 4. Preparation of media for cultivation of bacteria. 5. Preparation of dilutions and isolation of micro-organisms. 6. Sub-culturing/ Picking off technique. 7. Evaluation of different disinfectants and antiseptics.	8

Evaluation Methods	
Internal Assessment: **Theory: 10 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.: NA Mid-Term Exam: 5 Marks **Practicum: 5 Marks** Class Participation: NA Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks Mid-Term Exam: NA	**End Term Examination** **Theory:** 20 Marks **Practical:** 15 Marks. Evaluation of the practical skill willbe done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Elements of Biotechnology; Gupta PK, Rastogi Publications, Meerut.
2. Gene Biotechnology - S.N. Jogdand
3. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
4. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and MolecularBiology of Plants. American Society of Plant Biologists.
5. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4thEdition, WH Freeman and Company, New York, USA
6. Mahajan, R., Sharma, J., Mahajan, R.K. (2010). Practical Manual ofBiotechnology, Vayu Education of India.

MDC-1

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**I**		
Name of the Course	**Basic Biology-I**		
Course Code	**24 L4.5-BTY-104**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-1**		
Level of the course (As per Annexure-I	**100-199**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. 2. Know about features of biodiversity in the living world and their biological classification describing the principal theories of taxonomy. 3. Describe the unique characteristics of Kingdom Plantae and classify Kingdom Plantae into different groups. 4. Demonstrate knowledge of the principles of animal nomenclature and terminology by explaining the process, procedures, and purpose of the scientific classification of animals. 5. *Learn practical skills on basic Biology practical like parts of microscope, slide preparation, identify plants and animals using models and specimens.		
Credits	Theory	Practical	Total
	2	1	**3**
Contact Hours	2	2	4
Max. Marks: 75 **Internal Assessment Marks: 20** (15 Theory+ 5 Practical) **End Term Exam Marks: 55** (35 Theory+ 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Cell: Structure and Function:** Cell theory and cell as the basic unit of life, structure of prokaryotic and eukaryotic cells: Plant cell and animal cell; cell envelope; cell membrane, cell wall; cell organelles - structure and function; endomembrane system, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles, mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus, Cell cycle, mitosis, meiosis and their significance.	10
II	**The Living World Biodiversity**: Need for classification; three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature. **Biological Classification**: Five kingdom classification, salient features and classification of Monera, Protista and Fungi into major groups; Lichens, Viruses and Viroids.	9
III	**Plant Kingdom:** Classification of plants into major groups; Salient and distinguishing features and a few examples of Algae, Bryophyta, Pteridophyta, Gymnosperms, Angiosperms, Plant Life Cycle and Alternation of Generations.	8
IV	**Animal Kingdom**: Salient features and classification of animals, levels of organization (cellular/tissue/organ), symmetry (radial, bilateral), phylum, Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arhropoda, Mollusca, Echinodermata, Hemichordata, Chordata.	8
V*	**List of Practical:** **A:** List of Experiments 1. Study and describe locally available common flowering plants, from family Solanaceae, Poaceae, Asteraceae orBrassicaceae. 2. Dissection and display of floral whorls, anther and ovary to show number of chambers (floral formulae and floral diagrams), 3. Study of types of roots (tap and adventitious). 4. Study of types of stems (herbaceous and woody); 5. Study of leaf (arrangement, shape, venation, simple andcompound). 6. Isolation of Chlamydomonas, paramecium and spirogyra from nearby pond and study its structure and movement under microscope.	20

	7. Study of structure of algae under microscope 8. Study of different part of fungi **B:** Study and Observe the following (spotting): 1. Parts of a compound microscope. 2. Specimens/slides/models and identification with reasons - Bacteria, Oscillatoria, Spirogyra, Rhizopus, mushroom, yeast, liverwort, moss, fern, pine, one monocotyledonous plant, one dicotyledonous plant and one lichen. 3. Virtual specimens/slides/models and identifying features of - Amoeba, Hydra, liver fluke, Ascaris, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.	

Evaluation Methods

Internal Assessment: **Theory: 15 Marks** • Class Participation: 5 Marks • Seminar/presentation/assignment/quiz/class test etc.:5 Marks • Mid-Term Exam: 5 Marks **Practicum: 5 Marks** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks • Mid-Term Exam: NA	**End Term Examination** **Theory:** 35 Marks **Practical:** 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Suggested Readings:

1. Biology Textbook for class XI published by NCERT. https://ncert.nic.in/textbook.php?kebo1=0-19
2. Pradeep's A Textbook of Biology for Class 11 (Vol. 1 & 2) - Examination 2022/23Paperback – by P.S. Dhami, G. Chopra, H.N. Srivastava.
3. S. Chand's Biology for XI by P.S. Verma and B.P. Pandey.
4. I.S.C. Practical Biology (Including Viva-Voce & Project Work) Class- XI by V.P. Aggarwal and S.C. Maheshwari
5. Fundamentals of Biology: CBSE Class 11 published by Wiley

CC-2 /MCC -3

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**General Microbiology**		
Course Code	**24 L4.5-BTY-201**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-2 /MCC -3**		
Level of the course (As per Annexure-I	**200-299**		
Pre-requisite for the course (ifany)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Illustrate the knowledge of history, scope, classification and various approaches of study of microbes. Compare and characterize prokaryotic and eukaryotic cells based on morphology, different groups of microorganisms based ontheir structures. 2. Illustrate the knowledge of microbial growth, reproduction and exhibit skill of isolation, purification, and preservation of microbial cultures. 3. Gain the knowledge of characteristics of viruses, their types and mode of multiplication. Also understand the various control measures of microbes. 4. Understand the role of micro-organisms in the environment, for making industrially important fermented foods and gain the knowledge of spoilage of food andfood borne diseases. 5. Exhibit practical skills in preparation of media and staining of microbes, Isolate bacteria from different sources and determine their count and cell size. Testing of antibiotic sensitivity and MIC value.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)	**Time:** **Theory: 3h** **Practical: 4h**

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	History and evolution of microbiology with special reference to the contribution of the scientists: A. V. Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming. Introduction to classification of microorganisms: Microbial taxonomy, different criteria including molecular approaches, Microbial phylogeny and current classification of bacteria. **Stains and staining procedures**: Acidic, basic and neutral stains, Gram staining, Acid fast staining, Flagella staining, Endospore staining. **Distribution and characterization:** Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms e.g., Bacteria, Algae, Fungi and Protozoa.	13
II	**Cultivation and Maintenance of microorganisms**: Nutritional requirements of microorganisms. Methods of isolation, purification and preservation of microorganisms. **Microbial growth:** Study of growth curve, generation time, quantitative measurement of growth and factors affecting growth of bacteria. **Bacterial Reproduction**: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.	12
III	**Viruses:** General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny. **Control of microorganisms:** By physical and chemical antimicrobial agents including antibiotics and their mode of action.	10
IV	**Food and Water Microbiology:** Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Microbial spoilage of foods. Major food born infections and intoxications. Microbiology of fermented Foods. **Microbial ecology**: Microenvironment & Niche. **Soil microbiology**: Types & functions of microorganisms in soil.	10

V*	**List of Practical:** 1. Lab rules and safety measures in microbiology lab. 2. Isolation of bacteria from different sources. 3. Study of different staining methods: simple staining,Gram staining, spore staining, negative staining etc. 4. Determination of bacterial cell size by micrometry. 5. Enumeration of microorganism - total & viable count. 6. Measurement of the growth of microbial culture. 7. Study of thermal death point and thermal death time of microbes. 8. Antibiotic sensitivity test and MIC value. 9. Pure culture of micro-organisms. 10. Study of growth curve of bacteria.	30

Evaluation Methods

Internal Assessment: **Theory-20 Marks** • Class Participation: 5 Marks • Seminar/presentation/assignment/quiz/class test etc.:5 Marks • Mid-Term Exam: 10 Marks **Practicum-10 Marks** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks • Mid-Term Exam: NA	**End Term Examination** **Theory:** 50 Marks **Practical:** 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology.7thedition,CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology.2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms.12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology.5th edition. McGraw HillBook Company.
6. Stanier RY, Ingraham JL, Wheel is ML, and Painter PR. (2005). General Microbiology.5th edition. McMillan.
7. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An introduction, Pearson Education.
8. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's microbiology, McGraw-Hill Education

DSEC-I

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**Diagnostic Laboratory Techniques**		
Course Code	**24 L4.5-BTY-202**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSEC-I**		
Level of the course (As per Annexure-I	**200-299**		
Pre requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Comprehensive introduction to various laboratory techniques used in diagnostics. 2. To learn essential skills, specimen collection and handling. 3. Microscopy, hematology, clinical biochemical tests, microbiology and infectious disease testing, as well as point-of-care testing and emerging technologies. 4. The course emphasizes hands-on laboratory experience,safety protocols, and quality control measures to ensure accurate and reliable diagnostic results. 5. Hands-on laboratory experience, safety protocols, and quality control measures to ensure accurate and reliable diagnostic results.		
Credits	Theory: 3	Practical: 1	Total: 4
Contact Hours	3	2	5
Max. Marks: 100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) ***End Term Exam Marks:70*** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	
Part B: Contents of the Course			
Instructions for Paper-Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type			

questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Overview of diagnostic laboratory techniques and their significance in healthcare. Basic principles of diagnostics: sensitivity, specificity, accuracy, precision. Quality control and assurance in diagnostic laboratories. Laboratory skills, safety guidelines and procedures. Laboratory equipment and instrumentation. Pipetting techniques and measurement accuracy. Laboratory documentation and record-keeping.	11
II	Specimen Collection and Handling Different types of clinical specimens and their collection methods. Specimen transportation and storage. Quality assessment of specimens. Biosafety precautions during specimen handling. Future trends and advancements in diagnostics.	10
III	Hematology and Coagulation Tests. Blood cell morphology and identification. Hematological tests (e.g., complete blood count, erythrocyte sedimentation rate) Coagulation tests and interpretation. Automated hematology analyzers and coagulation instruments. Clinical Chemistry and Biochemical Tests. Basics of clinical chemistry and biochemical analysis Common biochemical tests (e.g., liver function tests, kidney function tests). Enzyme assays and immunoassays.	12
IV	Microscopy and Staining Techniques. Light microscopy and its applications in diagnostics. Basic principles of staining techniques (e.g., Gram stain, acid-fast stain). Microscopic examination and interpretation of stained specimens. Digital imaging and image analysis in microscopy. Microbiology and Infectious Disease Testing. Microbiological culture techniques. Identification of pathogens using biochemical and molecular methods. Antimicrobial susceptibility testing. Rapid diagnostic tests for infectious diseases.	12
V*	**List of Practical:** 1. To learn various sterilization techniques necessary duringsampling and working conditions in laboratory. 2. To learn various collection methods of clinical samples (Urine, blood, sputum, stool, CSF, Tissue biopsy Precautions). 3. Hematological tests: Automated hematology analyzers andcoagulation instruments.	30

Evaluation Methods	
Internal Assessment: **Theory-20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory:** 50 Marks **Practical:** 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "Textbook of Medical Laboratory Technology" by Praful B. Godkar and Darshan P. Godkar.
2. "Practical Clinical Biochemistry: Methods and Interpretations" by S. Ashfaq Ahmed.
3. "Clinical Pathology and Clinical Biochemistry" by Abhijit B. Chaudhari.
4. "Clinical Biochemistry: Theory and Practical" by Dr. B. Ramesh, Dr. R. Nandini, and Dr. R. Anuradha.

CC-M2

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**Introduction of Biological Chemistry**		
Course Code	**24 L4.5-BTY-203**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M2**		
Level of the course (As per Annexure-I	**200-299**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1 Gain a firm foundation in fundamentals of chemistry. 2 Understand chemical reactions and energy changes during reactions. 3 Exhibit knowledge of light and matter interactions, chemical bonding, states of matter, acids, bases and buffers. 4 Understand types of organic reactions, concept of isomerism and redox reactions. 5 5. Hands-on chemistry laboratory experience and safety protocols along with preparation of chemicals stocks and working solutions		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 **Internal Assessment Marks: 15** (10 Theory + 5 Practical) **End Term Exam Marks: 35** (20 Theory + 15 Practical)	**Time:** **Theory- 3h** **Practical-4h**		
Part B- Contents of the Course			
Instructions for Paper- Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.			

Unit	Topics	Contact Hours
I	Basic constituents of matter - elements, atoms, isotopes, atomic weights, atomic numbers, basics of mass spectrometry, molecules, Avogadro number, Molarity, Molality, Normality, gas constant, molecular weights, structural and molecular formulae, ions and polyatomic ions.	3
II	Chemical reactions, reaction stoichiometry, rates of reaction, rate constants, order of reactions, Arrhenious equation, Maxwell Boltzmann distributions, rate-determining steps, catalysis, free-energy, entropy and enthalpy changes during reactions; kinetic versus thermodynamic controls of a reaction, reaction equilibrium (equilibrium constant).	3
III	Light and matter interactions (optical spectroscopy, fluorescence, bioluminescence); Chemical bonds (ionic, covalent, Van der Walls forces); States of matter - vapor pressure, surface tension, boiling and melting points, solubility, capillary action, suspensions, colloids and solutions; Acids, Bases and pH - Arrhenious theory, Ionic product of water, weak acids and bases, conjugate acid-base pairs, buffers.	3
IV	Types of organic reactions (Substitution, Addition, Elimination, Rearrangement etc.). Concept of isomerism: Types of isomerism, Optical isomerism, elements of symmetry, molecular chirality, enantiomers, chiral and achiral molecules. Geometric isomerism: Configuration of geometric isomers, Cis-Trans nomenclature. Redox reactions and electrochemistry - oxidation-reduction reactions.	3
V*	**List of Practical:** 1. Preparing various stock solutions of different molaritiesand working solutions that will be needed for the course. 2. To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbalch equation. 3. To prepare phosphate buffer of pH 7.0. 4. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law. 5. Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography. 6. Identification of an unknown sample as DNA, RNA or protein using available laboratory tools. 7. Analyze green fluorescence using green fluorescent proteins. 8. Conductometric titration (determination of the strength of asolution of hydrochloric acid (or other acids) by a standard solution of sodium-hydroxide. 9. Study of the role of emulsifying agents in stabilizing the	8

	emulsion of different oils. 10. Study of reaction rates of any one of the following: (i) Reaction of Iodide ion with Hydrogen Peroxide at room temperature using different concentrations of Iodide ions. (ii) Reaction between Potassium Iodate, (KIO_3) and Sodium Sulphite: (Na_2SO_3) using starch solution as an indicator (clock reaction). 11. Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of Rfvalues.	

Suggested Evaluation Methods

Internal Assessment: **Theory-10 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.: NA Mid-Term Exam: 5 Marks **Practicum -5 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory**: 20 Marks **Practical:** 15 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Ebbing, D. D., & Wrighton, M. S. (1990). General Chemistry. Boston: Houghton Mifflin.
2. Averill, B., & Eldredge, P. (2007). Chemistry: Principles, Patterns, and Applications. San Francisco: Benjamin Cummings.
3. Mahan, B. H. (1965). University Chemistry. Reading, MA: Addison-Wesley Pub.
4. Cantor, C. R., & Schimmel, P. R. (2004). Biophysical Chemistry. San Francisco: W.H. Freeman.
5. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
6. Outlines of Biochemistry by E. E. Conn, P. K. Stumpf, G. Bruenimg and Ray H. Doi (1987), JohnWiley.

MDC-2

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**Basic Biology – II**		
Course Code	**24 L4.5-BTY-204**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-2**		
Level of the course (As per Annexure-I	**200-299**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Students will understand the physiological processes taking place at the level of the cell, organ and the whole plant; will get knowledge of Interaction of light with green plant parts, preparation of food etc. 2. Students will describe how plants obtain the reactants needed for respiration, including the role of the roots and the stomata, functions of various plant hormones inplant development. 3. Students will learn the structure of major human organs surrounding respiratory, circulatory and excretory systems and explain their role in the maintenance of healthy individuals. 4. Students will learn the structure of major human organssurrounding musculoskeletal and nervous system and explain their role in the maintenance of healthy individuals. 5. Students will be able to learn practical skills on basic Biology practical like root slide preparation, chromatography, biochemical tests, mitosis and various models.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

Max. Marks:75 **Internal Assessment Marks: 20** (15 Theory+ 5 Practical) **End Term Exam Marks: 55** (35 Theory+ 20 Practical)	**Time:** **Theory- 3h** **Practical-4h**

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Plant Physiology: Plant water relations**; osmosis, plasmolysis, imbibition, mineral nutrition; plant nutrients, micro and macro nutrients, role of nutrients. **Photosynthesis in Higher Plants**: Photosynthesis as a means of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis; photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4 pathways; factors affecting photosynthesis.	8
II	**Respiration in Plants:** Exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient. **Plant - Growth and Development:** Seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA;	8
III	**Human Physiology: Breathing and Exchange of Gases**: Respiratory organs in animals (recall only); Respiratory system in humans; mechanism of breathing and its regulation in humans - exchange of gases, transport of gases and regulation of respiration, respiratory volume; disorders related to respiration - asthma, emphysema, occupational respiratory disorders. **Body Fluids and Circulation**: Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system - Structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system - hypertension, coronary artery disease, angina pectoris, heart failure. **Excretory Products and their Elimination:** Modes of excretion - ammonotelism, ureotelism, uricotelism; human excretory system –	10

	structure and function; urine formation, osmoregulation; regulation of kidney function - renin - angiotensin, atrial natriuretic factor, ADH and diabetes insipidus; role of other organs in excretion; disorders - uremia, renal failure, renal calculi, nephritis; dialysis and artificial kidney, kidney transplant.	
IV	**Locomotion and Movement** Types of movement - ciliary, flagellar, muscular; skeletal muscle, contractileproteins and muscle contraction; skeletal system and its functions; joints; disorders of muscular and skeletal systems - myasthenia gravis, tetany, muscular dystrophy, arthritis, osteoporosis, gout. **Neural Control and Coordination:** Neuron and nerves; Nervous system in humans - central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse. **Chemical Coordination and Integration:** Endocrine glands and hormones; human endocrine system - hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary idea); role of hormones as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goiter, exophthalmic goitre, diabetes, Addison's disease. Note: Diseases related to all the human physiological systems to be taught in brief.	9
V*	**PRACTICALS** **A. List of Experiments:** 1. Preparation and study of T.S. of dicot andmonocot roots and stems (primary). 2. Study of osmosis by potato osmometer. 3. Study of plasmolysis in epidermal peels (e.g., Rhoeo/lily leaves or flashy scale leaves of onion bulb). 4. Study of distribution of stomata on the upper and lower surfaces of leaves. 5. Comparative study of the rates of transpiration in the upper and lower surfaces of leaves. 6. Test for the presence of sugar, starch, proteins and fats in suitable plant and animal materials. 7. Separation of plant pigments through paper chromatography. 8. Study of the rate of respiration in flower buds/leaf tissue and germinating seeds. 9. Test for presence of urea in urine. 10. Test for presence of sugar in urine. 11. Test for presence of albumin in urine. 12. Test for presence of bile salts in urine. **B. Study and Observe the following (spotting):** 1. Mitosis in onion root tip cells and animal`s cells	20

	(grasshopper) from permanent slides. 2. Human skeleton and different types of joints with thehelp of virtual images/models only. 3. Differentiate between monocot and dicot plants on thebasis of venation patterns. 4. Rib cage 5. Heart Model 6. Calendar of circulatory, muscular and excretorysystem. 7. Process of plasmolysis in onion cells 8. Study of transpiration in leaves	

Evaluation Methods

Internal Assessment: **Theory-15 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 5 Marks **Practicum- 5 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory**: 35 Marks **Practical**: 20 Marks Evaluation of the practicalskill will be done by an external examiner.

Part C-Learning Resources

1. Biology Textbook for class XI published by NCERT. https://ncert.nic.in/textbook.php?kebo1=0-19
2. Pradeep's A Textbook of Biology for Class 11 (Vol. 1 & 2) Paperback – by P.S. Dhami, G. Chopra, H.N. Srivastava.
3. S. Chand's Biology for XI by P.S. Verma and B.P. Pandey.
4. I.S.C. Practical Biology (Including Viva-Voce & Project Work) Class- XI by V.P. Aggarwal and S.C. Maheshwari
5. Fundamentals of Biology: CBSE Class 11 published by Wiley

CC-3/ MCC-4

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the Course	**Cell Biology**		
Course Code	**24 L5.0-BTY-301**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**CC-3/MCC-4**		
Level of the course (As per Annexure-I	**300-399**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the structures and functions of basic components of plant and animal cell, especially macromolecules, membranes and organelles. 2. Understand how these cellular components are synthesized and degraded in cells. 3. Explain the structure and function of prokaryotic cell& its components. 4. Describe the various models and solute transporter systems belonging to cell membrane and will explaincell cycle and apoptosis. 5. Prepare slides of animal and plant cells and cell division and conduct the morphometric analysis of chromosomes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will beset taking two questions from each unit. The candidates will be required to attempt Q.No.1 &four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Basics of Cell Biology** – Discovery of cell and Cell Theory; Comparison between plant and animal cells. Structure and function of Protoplasm, Cell wall, Plasma membrane, Modification of plasma membrane and intracellular junctions, Cytoskeleton, Mitochondria, Chloroplast, ER, Golgi complex.	10
II	Structure and function of Lysosome, endosome and microbodies, Ribosome, Centriole, Nucleus, Chromosomes, Chemical components of a cell, Catalysis and use of energy by cells. **Biogenesis of Cellular organelles** – Biogenesis of mitochondria, chloroplast, ER, Golgi complex, Biosynthetic process in ER and Golgi apparatus, Protein synthesis and folding in the cytoplasm, Degradation of cellular components.	11
III	**Structure and function of Prokaryotic cell and its components** - The Slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of Gram-negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulfur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores, exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocyst and akinete of Cyanobacteria, Gliding and motility.	12
IV	**Membrane structure and transport** – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solutetransport by Simple diffusion, Facilitated diffusion and Active transport. **Cell cycle -** An overview of cell cycle, Components of cell cycle control system, Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis).	12
V*	List of Practical: 1. Cell division: Permanent slides of animal and plant cellsand cell division; 2. Mitotic studies in onion root tip 3. Meiotic studies in grasshopper testes/flower buds 4. Chromosomes: Mounting of polytene chromosomes 5. Effect of different osmotic concentration solutions on animaland plant cells 6. Buccal smear – Barr bodies	30

Suggested Evaluation Methods	
Internal Assessment: **Theory-20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory**: 50 Marks **Practical**: 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Biology of cell – Bruce Alberts et al, Garland publications
2. Animal Cytology & Evolution – MJD, White Cambridge University Publicatins
3. Molecular Cell Biology – Daniel, Scientific American Books.
4. Cell Biology – Jack D. Bruke, The William Twilkins Company.
5. Cell Biology – Ambrose & Dorouthy M Easty, ELBS Publications.
6. Fundamentals of Cytology – Sharp, Mc Graw Hill Company
7. Cytology – Wilson &Marrision, Reinform Publications
8. Molecular Biology – Smith Faber & Faber Publications
9. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.

MCC -5

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the Course	**Genetics**		
Course Code	**24 L5.0-BTY-302**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MCC -5**		
Level of the course (As per Annexure-I	**300 – 399**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Exhibit conceptual understanding of laws of inheritance, genetic basis of loci and their linkage. 2. Develop critical understanding of allelic variation and cytoplasmic inheritance. 3. Comprehend the effect of chromosomal abnormalities leading to genetic disorders. 4. Analyze the effect of mutations on gene functions, dosage and their interactions at population and evolutionary levels. 5. Identify various stages of mitotic and meiotic cell cycles, analyze the effect of mutations on gene functions, karyotype analysis, chromosome mapping and pedigreeanalysis.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Genetics** - Definition, history and scope **Mendelism & Chromosome Theory** – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Mitochondrial, Unifactorial, Multi-factorial). Deviation from Mendel's Dihybrid phenotype, Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson& Punnett's Coupling & Repulsion hypothesis. **Linkage & crossing over** - Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.	12
II	**Allelic Variation & Gene function** – Multiple alleles, Genetic interaction, Epistatic interactions, Non-Epistaticinter- allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes. **Non-Mendelian inheritance** – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast)	10
III	**Chromosomal variation in Number & Structure** – Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Giant chromosome, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution. Gene Mutation **Chromosome Mapping** - Haploid mapping (2 point & 3-point cross). Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.	12
IV	**Human Cyto-Genetics** – Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in medical science, Chromosomal abnormalities in spontaneous abortions, viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, Genomic position effects on Gene expression, Inborn diseases **Pedigree analysis** – Symbols of Pedigree, Pedigrees of Sex- linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.	11

V*	**List of Practical:** 1. Cell division: Permanent slides of animal and plant cellsand cell division. 2. Mitotic and meiotic studies in grasshopper testes, onionroot tips and flower buds 3. Chromosomes: Mounting of polytene chromosomes 4. Buccal smear – Barr bodies 5. Karyotype analysis – Man and Onion 6. Man – Normal and Abnormal – Down and Turner's syndromes (with the help of slides) 7. Simple genetic problems (Problems and Interaction ofgenes) 8. Chromosome mapping using three-point test cross; tetrad analysis. 9. Induction and detection of mutations through genetic tests. 10. Pedigree analysis in humans.	30

Evaluation Methods

Internal Assessment: **Theory-20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination**: **Theory:** 50 Marks **Practical:** 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.
2. Elements of Genetics – PK Gupta, Rastogi Publications
3. Molecular Biology and Genetic Engineering – PK Gupta
4. Cytogenetics, Evolution and Plant Breeding – PK Gupta
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006).
6. Principles of Genetics. VIII Edition John Wiley & Sons. 2. Snustad, D.P., Simmons, M.J. (2009).
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
8. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. Griffiths, A.J.F., Weissler, S.R., Leontine, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

MDC-3

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the Course	**Basic Biology – III**		
Course Code	**24 L5.0-BT-303**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-3**		
Level of the course (As per Annexure-I	**300 – 399**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Identify and explain the two types of reproduction; sexual and asexual and explain each stage of fertilization in plants and animals. 2. Demonstrate the ability to predict outcomes in monohybrid and dihybrid crosses using Mendelian genetics, a basic understanding of DNA mutation and of horizontal gene transfer and their role in evolution. 3. Learn the role of pathogens in different diseases, role of microbes in sewage treatment, biogas production, preparation of antibiotics, biofertilizers etc. 4. Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation. 5. *Learn practical skills on basic Biology practical like pollen germination, quadrant method, meiosis, slidepreparation and studying models etc.		
	Theory	Practical	Total
Credits	2	1	3
Contact Hours	2	2	4
Max. Marks:75 **Internal Assessment Marks: 20** (15 Theory+ 5 Practical) **End Term Exam Marks: 55** (35 Theory+ 20 Practical)		**Time:** **Theory- 3h** **Practical-4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Reproduction; Sexual Reproduction in Flowering Plants**: Flower structure; development of male and female gametophytes; pollination - types, agencies and examples; out breeding devices; pollen-pistil interaction; double fertilization; post fertilization events- development of endosperm and embryo, development of seed and formation of fruit; special modes- apomixis,parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation. **Human Reproduction:** Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilization, embryo development up to blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).	9
II	**Genetics and Evolution: Heredity and variation**: Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination - in humans, birds and honey bee; linkage and crossing over; sex linked inheritance - hemophilia, color blindness; Mendelian disorders in humans - thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes. **Molecular Basis of Inheritance:** Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central Dogma; transcription, genetic code, translation; gene expression and regulation - lac operon; Genome, Human and rice genome projects; DNA fingerprinting. **Evolution**: Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy - Weinberg's principle; adaptive radiation; human evolution.	10

III	**Biology and Human Welfare: Human Health and Diseases:** Pathogens; parasites causing human diseases (malaria, dengue, chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug andalcohol abuse. **Microbes in Human Welfare: Microbes** in food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics; production and judicious use.	8
IV	**Ecology and Environment: Organisms and Populations:** Population interactions - mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution, Organism and its Environment, Major Abiotic Factors, Responses to Abiotic Factors, Adaptations). **Ecosystem:** Ecosystems: Patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy (Topics excluded: Ecological Successionand Nutrient Cycles). **Biodiversity and its Conservation**: Biodiversity-Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, Sacred Groves, biosphere reserves, national parks, wildlife, sanctuaries and Ramsar sites.	8
V*	**PRACTICALS** **A) List of Experiments: -** 1. Prepare a temporary mount to observe pollengermination. 2. Study the plant population density by quadrat method. 3. Study the plant population frequency by quadratmethod. 4. Prepare a temporary mount of onion root tip to studymitosis. 5. Isolate DNA from available plant material such asspinach, green pea seeds, papaya, etc. **B) Study and observe the following (Spotting):** 1. Flowers adapted to pollination by different agencies (wind, insects, birds). 2. Pollen germination on stigma through a permanent slide or scanning electron micrograph. 3. Identification of stages of gamete development, i.e., T.S. of testis and T.S. of ovary through permanent slides (from grasshopper/mice). 4. Meiosis in onion bud cell or grasshopper testis throughpermanent slides. 5. T.S. of blastula through permanent slides(Mammalian). 6. Mendelian inheritance using seeds of differentcolor/sizes of any plant. 7. Prepared pedigree charts of any one of the genetic traits such as	20

rolling of tongue, blood groups, ear lobes, widow's peak and color blindness.

7. Controlled pollination - emasculation, tagging andbagging.
8. Common disease-causing organisms like *Ascaris, Entamoeba, Plasmodium*, any fungus causing ringworm through permanent slides, models or virtual images or specimens. Comment on symptoms of diseases that theycause.
9. Models' specimen showing symbolic association inroot modules of leguminous plants, Cuscuta on host, lichens.
10. Flash cards models showing examples of homologous and analogous organs.

Evaluation Methods

Internal Assessment:

Theory-15 Marks
Class Participation: 5 Marks
Seminar/presentation/assignment/quiz/class test etc.: 5 Marks
Mid-Term Exam: 5 Marks

Practicum -5 Marks
Class Participation:
Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks
Mid-Term Exam: NA

End Term Examination:
Theory: 35 Marks
Practical: 20 Marks
Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

1. Biology Textbook for class XI published by NCERT. https://ncert.nic.in/textbook.php?kebo1=0-19
2. Pradeep's A Textbook of Biology for Class 11 (Vol. 1 & 2) - Examination 2022/23 Paperback – by P.S. Dhami, G. Chopra, H.N. Srivastava.
3. S. Chand's Biology for XI by P.S. Verma and B.P. Pandey.
4. I.S.C. Practical Biology (Including Viva-Voce & Project Work) Class- XI by V.P. Aggarwal and S.C. Maheshwari
5. Fundamentals of Biology: CBSE Class 11 published by Wiley

CC-4 /MCC -6

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
Name of the Course	**Recombinant DNA Technology-I**		
Course Code	**24 L5.0-BTY-401**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-4 /MCC -6**		
Level of the course (As per Annexure-I	**400-499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand concept and scopes of Genetic Engineering and central role of recombinant DNA technology in all fields of Biotechnology. 2 Acquire the knowledge of basic concepts and different methodologies used for isolation, purification and manipulation of nucleic acids, gene cloning, transformation, selection of desired clones. 3. Understand the concepts and methodology of PCR and its uses in diverse fields of life sciences. 4. Work in the latest research areas of biotechnology like microbial, industrial, plant, animal, environmental, health etc. using genetic engineering techniques. 5. Get acquainted with different tools and techniques used in Genetic Engineering experiments and manipulateDNA for its diverse use in different Biotechnology areas.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Genetic Engineering:** Introduction and scope of Genetic Engineering, Miles stones in Genetic engineering, Central role of E. coli in genetic engineering. **Nucleic Acids:** Purification of total cell DNA, plasmid DNA, phage DNA, Yield Analysis **Nucleic acid blotting:** Blotting techniques, Southern blotting, northern blotting, western blotting Hybridization techniques- In-situ hybridization, FISH.	10
II	**Gene Modifying Enzymes**: DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Methylases Terminal deoxynucleotidy1 transferase, Reverse transcriptase, Restriction endonucleases (R.E.) - Host controlled restriction and modification, Nomenclature, types, Recognition sequence, blunt and sticky ends, applications, Ligases, Linker, Adaptor, Homopolymer tailing, Nick translation system. **Gene Cloning Vectors:** General features, Types of cloning vectors- Plasmids, bacteriophage, phagemids, cosmids. Plasmid Biology: Structural and Functional Organization of Plasmids, Plasmid Replication, Stringent and Relaxed Plasmids, Incompatibility of Plasmid Maintenance, Ti plasmids, Biology of Bacteriophage Lambda: Lambda Phage as a natural *in vivo* vector, *in vitro* construction of lambda vector,Bacteriophage (ssDNA Phages), Cauliflower Mosaic Virus, Artificial chromosomes (YAC, BAC, PAC)	12
III	**Gene Recombination and Gene transfer**: Construction of recombinant DNA, Preparation of competent cell, Episomes, Gene transfer using Plasmids and other cloning vectors, other techniques of gene transfer: Microinjection, Electroporation, Ultrasonication **Cloning and Subcloning Strategy**: - Transformation, Transfection, Selection of transformed cells, Selection and Screening of Recombinants (bacteria and phages); Cloning strategies in yeast, *E. coli* and *B. subtilis* **Cloning of Specific Gene:** Direct selection, Preparation and comparison of Genomic and cDNA library, identification from a gene- genomic library, cDNA library. **Methods for Clone Identification:** Screening strategies- Probes, Colony and plaque hybridization.	12

IV	**Polymerase Chain reaction:** Principle and applications of Polymerase chain reaction (PCR),primer-design, and RT- (Reverse transcription) PCR **Applications of Genetic Engineering:** Genetic engineering in animals, Genetic engineering in plants, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each), DNA Fingerprinting, Gene therapy. Restriction mapping, Genome mapping.	11
V*	**List of practical:** 1. To perform plasmid isolation from *E. coli* and its quality determination by agarose gel electrophoresis. 2. Isolation of genomic DNA from bacteria and plants. 3. Designing primers in Gene Runner for PCR. 4. To perform PCR with given template and primers. 5. Demonstrate about RT-PCR 6. To perform Restriction digestion of given DNA sample. 7. Performing ligation reaction of two DNA fragments. 8. Transformation of E. coli with foreign DNA.	30

Evaluation Methods

Internal Assessment: **Theory-20 Marks** • Class Participation: 5 Marks • Seminar/presentation/assignment/quiz/class test etc.:5 Marks • Mid-Term Exam: 10 Marks **Practicum -10 Marks** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks • Mid-Term Exam: NA	**End Term Examination:** **Theory:** 50 Marks **Practical:** 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Singh B.D. Biotechnology: Expanding Horizon (2010)3rd edition. Kalyani Publishers.
2. Gupta P.K. Biotechnology and Genomics (2013) 1st Edition. Rastogi publishers
3. Clark D.V and Pazdernik, N.J Applying Genetic Revolution (2009) Academic Press
4. Gene cloning and DNA analysis – An Introduction (2015) 7th edition, T.A Brown, Blackwell publisher.
5. Essential genes (2006). Benzamin Lewin, Pearson education international.
6. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, New York.
7. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
8. Principles of Genetic Engineering (2009). Mousumi Debnath, pointer publisher, Jaipur.
9. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd

edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
10. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.
11. Molecular Biology of Gene (2008) 6th edition, Watson, Baker, Bell. Gann, Levine and Losick. Pearson education Inc.
12. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
13. Molecular Cloning: A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York
14. DNA Cloning: A Practical Approach (1995), D.M. Glover and B.D. Hames, IRL Press, Oxford.

MCC -7

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
Name of the Course	**Bioinformatics-I**		
Course Code	**24 L5.0-BTY-402**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MCC -7**		
Level of the course (As per Annexure-I	**400 -499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the basic principles and concepts of bioinformatics. 2. Conceptualization in applying bioinformatics tools tosolve biological problems. 3. Critically evaluate bioinformatics research papers and studies. 4. Understanding of various databases available to explicit further research in Biology. 5. To develop familiarity with various interfaces, search functionalities, and data retrieval processes. It will enhance the skills in accessing and interpreting biological information, which is essential for research and analysis in the field of biology.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4hr**	
Part B- Contents of the Course			
Instructions for Paper- Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 &			

8 or others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Overview of bioinformatics: history, scope, and detailed applications. Introduction to biological databases and data types, Bioinformatics resources and tools. Detailed Overview of NCBI Homepage. Virtual library.	12
II	Basic structural introduction of Biomolecules studied in Bioinformatics (polynucleotide, polypeptides, Gene, Protein). Format of Sequence databases. Introduction to Pairwise Sequence Analysis and Sequence alignment. Introduction and applications of Multiple sequence alignment.	12
III	Basic introduction to following terms: *In silico* drug design, Genomics, proteomics, transcriptomics, metabolomics, chemo informatics, pharmacogenomics.	10
IV	Introduction to various biological techniques required for Bioinformatics analysis (DNA, RNA, Protein- isolation and sequencing etc). Human Genome Project objectives and applications.	11
V*	**List of practical:** 1. Visit NCBI homepage / URL is https://www.ncbi.nlm.nih.gov/ 2. -Familiarize with the different sections on the homepage to provide access to various databases and resources related to biomedical research and information. 3. Study the, Human Genome Project/ NHGRI website, navigate to the Human Genome Project section tounderstand the goals, history, and achievements of the project. 4. Visit PubMed database. Explore search based on various criteria and using Boolean Operators.	30

Evaluation Methods

Internal Assessment:

Theory: 20 Marks

Class Participation: 5 Marks
Seminar/presentation/assignment/quiz/class test etc.:5 Marks
Mid-Term Exam: 10 Marks

Practicum: 10 Marks

Class Participation:
Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks
Mid-Term Exam: NA

End Term Examination:

Theory: 50 Marks
Practical: 20 Marks
Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. "Bioinformatics: Principles and Applications" by Zhumur Ghosh and Bibekanand Mallick.
2. "Introduction to Bioinformatics" by S. Jawahar and S. Arumugam.
3. "Bioinformatics: A Practical Handbook" by Rashmi S. Shenoy and Ajay S. Verma.
4. "Bioinformatics: Concepts, Skills, and Applications" by Rastogi S. C.
5. "Practical Bioinformatics" by B. Jayaram and R. K. Shyamasundar.
6. "Bioinformatics For Dummies" by Jean-Michel Claverie and Cedric Notredame.
7. "Introduction to Bioinformatics" by Arthur M. Lesk
8. "Understanding Bioinformatics" by Marketa J. Zvelebil and Jeremy O. Baum.
9. "Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools" by Supratim Choudhuri.

MCC -8

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
Name of the Course	**Metabolism**		
Course Code	**24 L5.0-BTY-403**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MCC -8**		
Level of the course (As per Annexure-I	**400 – 499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Apply the knowledge of biological redox reactions, coupled reactions, energy rich compounds and the energy transactions in studying metabolism. 2. Describe the metabolic pathways *i.e.*, glycolysis (catabolism), gluconeogenesis (anabolism), and TCA cycle and their regulations. Discuss the reactions, regulation and importance of pentose phosphate pathway, glycogen metabolism, glyoxylate. 3. Describe ETC and apply the concept of oxidative phosphorylation to calculate energy production by oxidation of carbohydrates. Describe the reactions and regulation of lipid biosynthesis and catabolism by beta, alpha and omega oxidative pathways: ketone bodies metabolism and integration to the metabolism of other biomolecules. 4. Analyze how amino acid catabolism leads to formation of diverse type molecules including ketone bodies, glucose, urea: discuss the catabolism and anabolism of nucleic acids and porphyrins. 5. Isolation and determination of biomolecules from the samples quantitatively.		
	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5

Max. Marks: 100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)	**Time** **Theory: 3h** **Practical: 4h**

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Bioenergetics:** Concept of free energy, standard free energy, relation between equilibrium constant and standard free energy change and coupled reactions. Biological oxidation- reduction: redox potentials, relation between standard reduction potentials and free energy change (numericals included). High-energy compounds: phosphate group transfer potential, free energy of hydrolysis of ATP, PEP and glucose-6 phosphate along with reasons for high ΔG.	10
II	**Carbohydrate Metabolism:** Reactions and energetics of glycolysis, Alcoholic and lactic acid fermentations. Feeder pathways, Entry of fructose into glycolysis. Reactions and energetics of TCA cycle, Regulation of glycolysis and TCA cycle. Gluconeogenesis, Glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway.	11
III	**Electron Transport Chain and Oxidative Phosphorylation:** Structure of mitochondria, organization and sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Oxidative phosphorylation: chemiosmotic theory, structure of ATP synthase. Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing equivalents from cytosol into mitochondria. **Lipid Metabolism:** Introduction, hydrolysis of triacylglycerols, activation of fatty acids, transport of fatty acylCoA into mitochondria, beta-oxidation of saturated, and odd chain fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated fatty acids. Triglycerides. Metabolism of ketone bodies.	12
IV	**Amino acid Metabolism:** General reactions of amino acid metabolism: transamination, oxidative and non-oxidative deamination and decarboxylation. Urea cycle. Glycogenic and ketogenic amino acids. Biosynthesis of aromatic amino acids. Glucose-Alanine cycle. **Nucleotide Metabolism:** Sources of the atoms in the purine and pyrimidine molecules, de-novo biosynthesis and degradation of purine and pyrimidine nucleotides. Regulation of purine and pyrimidine biosynthesis. Salvage pathways of purines and pyrimidines.	12

V*	**List of practical:** 1. Estimation of nitrogen by micro- Kjeldahl method. 2. Estimation of blood glucose by colorimetrically. 3. Estimation of ascorbic acid by titrimetric method. 4. Preparation of starch from potato and determination of achromatic point by salivary amylase 5. Isolation of total lipids by Folch method and determineacid value. 6. Isolation of casein from milk and determination of isoelectric pH.	30

Suggested Evaluation Methods

Internal Assessment: **Theory-20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Mid-Term Exam: 10 Marks **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory**: 50 Marks **Practical**: 20 Marks Evaluation of the practical skill will bedone by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers.
2. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing, NY.
4. Outlines of Biochemistry by E. E. Conn, P. K. Stumpf, G. Bruenimg and Ray H. Doi (1987). John Wiley & Sons, NY
5. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S.Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.

DSE -1

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
Name of the Course	**IPR, Biosafety & Bioethics**		
Course Code	**24 L5.0-BTY-404**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE -1**		
Level of the course (As per Annexure-I	**400 – 499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Gain Knowledge about Intellectual Property Rights to protect biological inventions. 2. Understand process of filing a patent, about different treaties, rights and duties of Patent owner. 3. Gain Knowledge of working principles in a laboratory taking all safety measures, handling of pathogenic cultures, disposal of infectious waste, care of the equipment requiring safety audit. 4. Get an insight into Biosafety guidelines and Analyze and Manage the Risks involved with GMOs. 5. Understand the Process involved in Patenting, Patent Search and the protocols for ethical permissions and procedures for use of animals in research, gene therapy etc.		
	Theory	Practical	Total
Credits	3	1	4
	3	2	5
Contact Hours			
Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	
Part B- Contents of the Course			
Instructions for Paper- Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt			

Q.No.1 &four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Introduction to intellectual property rights**: Introduction to Intellectual Property, Patents, Trademarks, Copyright, Trade secrets, Industrial Design and Rights, Traditional Knowledge, Geographical Indications -importance of IPR – patentable and non patentable – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).	10
II	**Grant of patent, patenting authorities and treaties**: Types of patent applications: Ordinary, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner. Agreements and Treaties: PCT, GATT, TRIPS Agreements; Budapest Treaty; UPOV & Berne convention etc.	11
III	**Biosafety:** Introduction of biosafety issues; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms. Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc., Environmental release of GMOs; Risk Analysis; Risk Assessment and management, Overview of International biosafety agreements.	12
IV	**Bioethics:** Ethical issues related to use of Animals in Research and Testing, Alternatives for Animals in Research and testing; Animal Cloning, Human Cloning and their Ethical Aspects; Gene therapy - ethical and social issues; Organ transplantation- ethical and legal implications; Testing of Drugs on Human Volunteers and its ethical concerns; Ethics, Pros and Cons of IP protection and its impact on biodiversity rich developing countries.	12
V*	**List of practical:** 1. Case study of Intellectual property rights in Biotechnology, Biopiracy and Bioprospecting 2. To perform different Patent Search methods, Patent Databases & Libraries, online tools, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping 3. Case studies of different types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition 4. Study of Biotechnology and Patent laws: patenting living beings, Patents for Chemicals, Pharmaceuticals 5. To operate Biosafety cabinets and understand GLP- Good Laboratory biosafety Practices.	30

4. Protocols of ethical concerns related to gene therapy, ethics in patient care, human volunteers for Clinical research, Informed consent performa etc. 5. Parameters and Procedures in Animal Cloning, Human cloning, Risks and hopes	

Evaluation Methods

Internal Assessment: **Theory -20 Marks** Class Participation: 5 Marks Seminar presentation/assignment/quiz/class test etc.:5 Mid Term Exam: 10 **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Mid-Term Exam: NA	**End Term Examination:** **Theory**: 30 Mark **Practical**: 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Introduction to Plant Biotechnology, H S Chawla
2. M K Sateesh, Bioethics and Biosafety, Kindle Edition
3. Shomini Parashar, Deepa Goel IPR, Biosafety and Bioethics Pearson India 2013
4. Private Power, Public Law: The Globalization of Intellectual Property Rights by Susan K. Sell Cambridge University Press, 2003
5. Essentials of Intellectual Property: Law, Economics, and Strategy by Alexander I. Poltorak; Paul J. Lerner Wiley, 2011 (2nd edition)
6. Diane O. Fleming, Debra L. Hunt Biological Safety: Principles and Practices, 4th Edition. ASM 2006.
7. Singh, L and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).

Important Web Links: https://www.w3.org/IPR/
https://www.wipo.int/portal/index.html.en
https://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org
https://www.cbd.int/biosafety/background.shtml

DSE -1

Session: 2024-25	
Part A – Introduction	
Subject	**Biotechnology**
Semester	**IV**
Name of the Course	**Foundations of Forensic Biotechnology**
Course Code	**24 L5.0-BTY-405**
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE -1**
Level of the course (As per Annexure-I	**400 – 499**
Pre-requisite for the course (if any)	NA
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the basic concept, meaning, significanceand development of Forensic science. 2. To elucidate research methodologies and techniques used in the formation of research design on a specific problem. 3. To understand the Concept of gene and sequence variation. 4. To learn the techniques used in DNA Profiling. 5. Gain the knowledge of methodologies/ techniques (Microscopy, Chromatography, Spectroscopy, Electrophoresis, PCR and other biological & biochemical analysis tools) and learn about the methods and significance of collecting biological and serological samples.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Internal Assessment Marks: 30** (20 Theory + 10 Practical) **End Term Exam Marks: 70** (50 Theory + 20 Practical)	**Time:** **Theory: 3h** **Practical: 4h**

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	**Introduction to Forensic Science:** What is Forensic Science? Need, Scope, Concepts, Significance and Limits of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Applications and branches of forensic science, Organizational set-up of a Forensic Science Laboratory of Centre and State, NCRB and NICFS.	10
II	**Tools and techniques in Forensic Science:** General principles of Biological/ Bio-chemical Analysis, pH and buffers, Physiological solution, cell and tissue culture, Cell fractionation, biological variations etc. Centrifugation Techniques, Basic principles of microscopy, spectroscopy, chromatography. Electrophoresis, Enzyme- Linked Immunosorbent Assay (ELISA), Radio Immuno- Assay (RIA).	11
III	**DNA in Forensics:** Introduction to DNA, Concept of gene, Nature and structure of human genome and its diversity, Concept of DNA Polymorphism - VNTRs, STRs, Mini STRs, SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Generation and assessment of DNA profiles, Statistical interpretation of DNA profiles, evaluation and presentation of DNA evidence. DNA Profiling of Other Species, Kinship testing and lineage markers, DNA databanks and their utility invarious criminal investigations.	12
IV	**Recent Trends in Forensic Science:** Environmental Forensics: Definition, Legal processes involving environmental forensic science. Geo-forensics: Global Positioning System: Basic principles and applications. Biometrics in Personal Identification: Introduction, Concepts of Biometric Authentication, Role in person Identification, Techniques and Technologies (Fingerprint Technology, Face Recognition, IRIS, Retina Geometry, Hand Geometry, Speaker Recognition, Signature Verification and other forensic related techniques). Bioterrorism: Definition, Concepts of Biosecurity and microbial forensics, Weapons of mass destruction (WMD), mass-casualty weapons (MCW), NBC and CBRNE, Dirty Bombs.	12

V*	**List of practical:** 1. Isolation and instrumental analysis of different toxic substances and drugs. 2. Microscopy of various physical and biologicalevidence 3. TLC and spot test of alkaloids of drugs of abuse and toxic substances. 4. Thin layer chromatography of explosive substances 5. UV-Visible Spectroscopic analysis of Drugs 6. To estimate the quantity of protein by UV-absorptionmethod 7. To estimate the activity of amylase enzyme in serum/urine, saliva 8. Examination of blood, saliva, semen, urine and its stains: Chemical and crystal tests 9. Identification of spermatozoa by differential stainingmethod 10. Determination of blood group types. 11. Isolation of DNA from blood – purification 12. Amplification of DNA using PCR 13. Quantitative estimation of DNA, RNA & proteins 14. Electrophoresis of DNA, RNA & proteins 15. Restriction Digestion of DNA	30

Evaluation Methods

Internal Assessment: **Theory-20 Marks** Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 10 Marks **Practicum -10 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:10 Marks Mid-Term Exam: NA	**End Term Examination:** **Theory: 50** **Practical: 20** Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Academic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
3. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
4. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
5. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc,

USA.2007. 6. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press.New York, 2003.
7. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press New York, 2003.
8. G.R. Chatwal; Analytical Spectroscopy 2nd Edn, Himalaya Publishing House New Delhi.2002. 9. Aitken and Stoney: The Use of Statistics in Forensic Science, Ellis Horwood, New York, 1991.
9. Brown, T; Gene cloning and DNA analysis: An Introduction, 5th ed. Blackwell publishing, London, 2006.
10. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
11. Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.
12. Primorac, D. & Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.
13. Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed., CRC press,New York, 2001.
14. Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

SEC-2

Session: 2024-25	
Part A – Introduction	
Subject	**Biotechnology**
Semester	**II**
Name of the Course	**Bioanalytical Techniques**
Course Code	
Course Type: (CC/MCC/MDC/CC-M DSEC/VOC/DSE/PC/AEC/VAC)	**SEC**
Level of the course (As per Annexure-I	**100-199**
Pre-requisite for the course (if any)	NA
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	**After completing this course, the learner will be able to:** 1. Understand the basic chemistry and properties of water physiological buffers. 2. Demonstrate the knowledge of the general principles, components and applications of centrifuges. 3. Learn the principles and applications of chromatographic techniques in isolation, quantification and characterization of biomolecules. 4. Know the general principles, components and applications of spectrophotometer. 5. *Develop the skills to verify and apply the basic principles of spectroscopy; separation of amino acids by thin layer/ paper chromatography.

	Theory	Practical	Total
Credits	2	1	3
	2	2	4
Contact Hours	2	**Time:** **Theory: 3h** **Practical: 4h**	

Max. Marks: 75
Internal Assessment Marks: 20 (15 Theory+ 5 Practical)
End Term Exam Marks: 55 (35 Theory+ 20 Practical)

Part B- Contents of the Course

Instructions for Paper- Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting

question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Water and Buffers: Structure, hydrogen bonding, solvent properties, and ionization, Weak acids and bases, ionization of weak acids, titration of weak acid by a strong base, pH, buffers, Henderson-Hasselbalch equation and physiological buffers. Measurement of pH: Principles and composition of reference electrodes, glass electrode and combined electrode.	10
II	Centrifugation: Basic principle of centrifugation techniques, sedimentation rate, Svedberg unit / sedimentation coefficient. Preparative ultracentrifuge, Differential centrifugation, density gradient centrifugation, rate zonal, isopycnic, equilibrium centrifugation. Analytical ultracentrifuge method.	10
III	Chromatographic techniques- General principles and applications of adsorption, ion-exchange, molecular-sieve, thin layer & paper chromatography.	8
IV	UV-Visible Spectroscopic techniques: Beer-Lambert law, light absorption and its transmittance, extinction coefficient, a brief account of instrumentation and applications of UV-visible spectroscopic techniques (structure elucidation excluded).	7
V*	List of Practical: 1. Determination of pKa of acetic acid and glycine. 2. Verification of Beer- Lambert's Law. 3. Estimation of Amino acid by Ninhydrin method. 4. Estimation of Protein by Biuret method. 5. Separation of amino acids/ sugars by thin layer chromatography/paper chromatography.	15

Evaluation Methods

Internal Assessment:	End Term Examination:
Theory-15 Marks Class Participation: 5 Marks Seminar/presentation/assignment/quiz/class test etc.:5 Marks Mid-Term Exam: 5 Marks **Practicum- 5 Marks** Class Participation: Seminar/Demonstration/Viva-voce/Lab records etc.:5 Marks Mid-Term Exam: NA	**Theory**: 35 Marks **Practical**: 20 Marks Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Principles & Techniques of Biochemistry & Molecular Biology, 7th edition, by Keith Wilson and John Walker (2018)
2. Biophysical Chemistry: Principles and Techniques, by A. Upadhyay, K. Upadhyay and N. Nath. (2016). Himalaya Publishing House, Delhi.
3. Introductory Practical Biochemistry by S.K. Sawhney and Randhir Singh (2014). Narosa Publishing House, New Delhi.
4. An introduction to Practical Biochemistry, 3rd Edition, by David Plummer (2017). Tata Mc Graw Hill
5. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002) Addison-Wesley Longman.
6. Biochemical Methods, 3rd edition, by Sadasivam & Manickam (2018) New Age International (P) Ltd.
7. A Lab. Manual in Biochemistry by J. Jayaraman (1996) New Age International (P) Ltd

SEC-3

Session: 2024-25			
Part A – Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the Course	**Dairy Processing**		
Course Code			
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**		
Level of the course (As per Annexure-I	**300-399**		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO): (CLOs 1-4 of theory and 5th of practical)	**After completing this course, the learner will be able to:** 1. To have knowledge of collection and standaization of milk, also study mechanical separation methods. 2. To have knowledge of traditional Indian dairy products 3. To suggest the dairy industry personnel regarding the formulation of cleaning agents and sanitizers which would help in efficient cleaning and sanitization of dairy equipment. 4. To suggest the principles and methods of dairy processing and preservation 5. *Know methodologies/ techniques used in quality check and preparation of different dairy products.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 **Internal Assessment Marks: 20** (15 Theory+ 5 Practical) **End Term Exam Marks: 55** (35 Theory+ 20 Practical)		**Time:** **Theory: 3h** **Practical: 4h**	
Part B- Contents of the Course			
Instructions for Paper- Setter Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting			

One question from each unit. All questions carry equal marks.

Unit	Topics	Contact Hours
I	Collection and Transportation of milk: Organization of milk collection routes, practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitor, reception, chilling, classification and storage; Standardization of milk: Addition or removal of milk fat to make different milk products, Mechanical Separation: Sedimentation, Filtration, Centrifugal separation, Bactofugation; Homogenization; Pasteurization	10
II	Classification of traditional Indian dairy products: Preparation of pasteurized milk; standardized milk; flavoured milk; burfi, khoa, kalakand, milk cake, paneer, kheer, srikhand, ghee, butter oil etc. Manufacture of different varieties of Cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage, Pizza cheese etc.; Frozen dairy products. Refrigeration and Air Conditioning: The basic refrigeration cycles and concepts required for the various kinds of milk.	9
III	Cleaning and Sanitation: Cleaning agents, CIP & COP ii) Working & maintenance of can washer, crate washer and bottle washer iii) Sanitary milk pump & fittings, types of pumps iv) Boiler; Refrigeration. vi) Dairy Plant layout: Selection of site, layout of liquid and composite milk plant	8
IV	Basic principles and methods of dairy processing and preservation. Emerging Technologies in dairy processing. Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system; Mixing and agitation: Theory and purpose of mixing, Ultrafiltration of milk; Process technology for manufacture of evaporated milk, condensed milk, dried milk, malted milk, infant and baby foods, ice-cream, cheese, butter, fermented milk and indigenous dairy products	8
V*	List of Practical: 1. Familiarization with equipment for reception of milk in plant, platform test. 2. Cream separation: parts of a separator and the process. 3. Preparation of special milk: toned and double toned milk. 4. Detection of adulterants and preservatives in milk. 5. Testing purity of starter cultures by Gram's staining, catalase test; creatine test 6. Testing starter activity by dye reduction tests, Horrell Elliker, White Head & Cox test. 20 34(751) 7. Preparation of sterilized reconstituted skim milk and propagation of starter cultures. 8. Preservation of starter cultures by freeze-drying techniques. 9. Preparation of Indian dairy products like paneer, khoa, butter milk and lassi etc.	12