KURUKSHETRAUNIVERSITY KURUKSHETRA

('A^{++}' Grade, NAAC Accredited)

Revised Scheme of Examination for MDC (1st, 2nd, 3rd Semester & Minor CC-M2 (2nd Semester) and inclusion of Minor CC-M3 (3rdSemseter) and CC-M6 (6th Semester) for Under-Graduate

(Subject: Biotechnology)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2025-26

DEPARTMENT OF BIOTECHNOLOGY, KURUKSHETRA UNIVERSITY, KURUKSHETRA
Revised Scheme of Examination for Under-Graduate Program
Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2025-26 (in phased manner), Program: Biotechnology

FIRST YEAR: SEMESTER-1									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A&C	**CC-1 MCC-1 4credit**	B23-BTY-101	Introduction of Biotechnology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme C only	**MCC-2 4credit**	B23-BTY-102	Basics of Bio-molecules	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A	**CC-M1 2credit**	B23-BTY-103	Laboratory Techniques & Practices	1	1	10	20	30	3hrs.
			Practical	1	2	5	15	20	4hrs.
Scheme A&C	**MDC-1 3credits**	B23-BTY-104	Biotechnology-I	2	2	15	35	50	3hrs.
			Practical	1	2	5	20	25	4hrs.
Scheme C only	**CC-M1 4credit**	From Available CC-M1 of 4 credits as per NEP							
Scheme A&C	**AEC-1 2credit**	From Available AEC-1of two credits as per NEP							
	SEC-1 3credit	From Available SEC-1 of three credits as per NEP							
	VAC-1 2credit	From Available VAC-1of two credits as per NEP							
FIRST YEAR: SEMESTER-2									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A&C	**CC-2 MCC-3 4credit**	B23-BTY-201	General Microbiology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme C only	**DSEC-1 4credit**	B23-BTY-202	Diagnostic Laboratory techniques	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A only	**CC-M2 2credit**	B23-BTY-203	Basics concepts of Biotechnology	1	1	10	20	30	3hrs.
			Practical	1	2	5	15	20	4hrs.
Scheme A&C	**MDC-2 3credits**	B23-BTY-204	Biotechnology-II	2	2	15	35	50	3hrs.
			Practical	1	2	5	20	25	4hrs.
Scheme C only	**CC-M2 4credit**	From Available CC-M2 of 4 credits as per NEP							
Scheme A&C	**AEC-2 2credit**	From Available AEC-2 of two credits as per NEP							
	SEC-2 3credit	From Available SEC-2 of three credits as per NEP							
	VAC-2 2credit	From Available VAC-2 of two credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 2nd Semester									

DEPARTMENT OF BIOTECHNOLOGY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

SECOND YEAR: SEMESTER-3									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A,B&C	**CC-3 MCC-4 4credit**	B23-BTY-301	Cell Biology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**MCC-5 4credit**	B23-BTY-302	Genetics	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A,B&C	**MDC-3 3credits**	B23-BTY-303	Biotechnology-III	2	2	15	35	50	3hrs.
			Practical	1	2	5	20	25	4hrs.
Scheme A&C	**CC-M3 4credits**	B23-BTY-304	Animal Tissue Culture	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B only	**CC-M3 (V) 4credits**	From Available CC-M3(V) of 4 credits as per NEP							
Scheme A,B&C	**AEC-3 2credit**	From Available AEC-3 of two credits as per NEP							
	SEC-3 3credit	From Available SEC-3 of three credits as per NEP							
Scheme C only	**VAC-3 2credits**	From Available VAC-3 of two credits as per NEP							
Scheme B only	**MCC-3**	**MCC-2 FROM SCHEME C OF FIRST SEMESTER**							
SECOND YEAR: SEMESTER-4									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A,B&C	**CC-4 MCC-6 4credit**	B23-BTY-401	Recombinant DNA Technology-I	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**MCC-7 4credit**	B23-BTY-402	Bioinformatics-I	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**MCC-8 4credit**	B23-BTY-403	Metabolism	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**DSE-1 4 credit Select one option**	B23-BTY-404	IPR, Biosafety and Bioethics	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
		B23-BTY-405	Foundations of Forensic Biotechnology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A,B&C	**CC-M4(V) 4credits**	From Available CC-M4(V) of 4 credits as per NEP							
	AEC-4 2credit	From Available AEC-3 of two credits as per NEP							
Scheme C only	**VAC-4 2credits**	From Available VAC-4 of two credits as per NEP							
Scheme A&B	**VAC-3 2credits**	From Available VAC-3 of two credits as per NEP							
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

DEPARTMENT OF BIOTECHNOLOGY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

THIRD YEAR: SEMESTER-5									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A,B&C	**CC-5 MCC-9 4credit**	B23-BTY-501	Immunology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**MCC-10 4credit**	B23-BTY-502	Microbial Genetics	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**DSE-2 4 credit Select one Option**	B23-BTY-503	Fundamentals of Enzymology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
		B23-BTY-504	Fermented foods	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**DSE-3 4 credit Select one Option**	B23-BTY-505	Foundations of Environment and Ecology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
		B23-BTY-506	Foundations of Nano-Biotechnology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A&C	**CC-M5(V) 4credits**	From Available CC-M5(V) of 4 credits as per NEP							
Scheme A,B&C	**Internship 4 credits**	Internship #4 credits after 4th semester							
THIRD YEAR: SEMESTER-6									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Scheme A,B&C	**CC-6 MCC-11 4credit**	B23-BTY-601	Microbial Technology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**MCC-12 4credit**	B23-BTY-602	Bio-analytical Techniques	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**DSE-4 4 credit Select one Option**	B23-BTY-603	Medical Microbiology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
		B23-BTY-604	Molecular medicine and Gene therapy	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme B &C	**DSE-5 4 credit Select one Option**	B23-BTY-605	Biostatistics	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
		B23-BTY-606	Bio-entrepreneurship	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A only	**CC-M6 4credits**	B23-BTY-607	Fermentation Biotechnology	3	3	20	50	70	3hrs.
			Practical	1	2	10	20	30	4hrs.
Scheme A only	**CC-M7(V) 4credits**	From Available CC-M7(V) of 4 credits as per NEP							
Scheme B only	**CC-M5(V) 4credits**	From Available CC-M5(V) of 4 credits as per NEP							
Scheme C only	**CC-M6(V) 4credits**	From Available CC-M6(V) of 4 credits as per NEP							
Scheme C only	**SEC-4 2credit**	From Available SEC-4 of two credits as per NEP							

DEPARTMENT OF BIOTECHNOLOGY, KURUKSHETRA UNIVERSITY, KURUKSHETRA

FOURTH YEAR

FOURTH YEAR: SEMESTER-7 (FOR HONOURS/ HONOURS WITH RESEARCH IN BIOTECHNOLOGY)									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Honours in biotechnology /Honours with Research in Biotechnology (For Scheme B&C)	**CC-H1 4credit**	B23-BTY-701	Recombinant DNA Technology-II	4	4	30	70	100	3hrs.
	CC-H2 4credit	B23-BTY-702	Pharmaceutical Biotechnology	4	4	30	70	100	3hrs.
	CC-H3 4credit	B23-BTY-703	Molecular Cell Biology	4	4	30	70	100	3hrs.
	DSE-H1 4 credit Select one Option	B23-BTY-704	Molecular diagnostics	4	4	30	70	100	3hrs.
		B23-BTY-705	Biotechnology in Environment Protection	4	4	30	70	100	3hrs.
	PC-H1 4credit	B23-BTY-706	Practical Based on B23-BTY-701TO704/705	4	8	30	70	100	6hrs.
	CC-HM1 4credit	From Available Minor of 4 credits as per NEP							
SEMESTER-8 (FOR HONOURS IN BIOTECHNOLOGY)									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Honours in Biotechnology (For Scheme B&C)	**CC-H4 4credit**	B23-BTY-801	*In vitro* culture techniques -Animal	4	4	30	70	100	3hrs.
	CC-H5 4credit	B23-BTY-802	*In vitro* culture techniques -Plant	4	4	30	70	100	3hrs.
	CC-H6 4credit	B23-BTY-803	Enzyme Technology	4	4	30	70	100	3hrs.
	DSE-H2 4 credit Select one option	B23-BTY-804	Bioinformatics-II	4	4	30	70	100	3hrs.
		B23-BTY-805	Mathematics and calculations in Biotechnology	4	4	30	70	100	3hrs.
	PC-H2 4credit	B23-BTY-806	Practical Based on B23-BTY-801TO804/805	4	8	30	70	100	6hrs.
	CC-HM2 4credit	From Available Minor of 4 credits as per NEP							
OR SEMESTER-8 (FOR HONOURS WITH RESEARCH IN BIOTECHNOLOGY)									
Remarks	**Course**	**Paper(s)**	**Nomenclature of Paper**	**Credits**	**Hours/ Week**	**Internal marks**	**External Marks**	**Total Marks**	**Exam Duration**
Honours with Research in Biotechnology (For Scheme B&C)	**CC-H4 4credit**	B23-BTY-801	*In vitro* culture techniques -Animal	4	4	30	70	100	3hrs.
	CC-H5 4credit	B23-BTY-802	*In vitro* culture techniques -Plant	4	4	30	70	100	3hrs.
	Project/ Dissertation 12credit	B23-BTY-807	Project/Dissertation	8+4	-	-	300	300	-
	CC-HM2 4credit	From Available Minor of 4 credits as per NEP							

KURUKSHETRAUNIVERSITY KURUKSHETRA

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Revised Syllabus for MDC (1st, 2nd, 3rd Semester & Minor CC-M2 (2nd Semester) and inclusion of Minor CC-M3 (3rdSemseter) and CC-M6 (6th Semester) for Under-Graduate

(Subject: Biotechnology)

Under Multiple Entry-Exit, Internship and CBCS- LOCF in accordance to NEP-2020 w.e.f. 2025-26

MDC-1

Session: 2025-26			
Part A- Introduction			
Subject	**Biotechnology**		
Semester	**I**		
Name of the Course	**Biotechnology-I**		
Course Code	**B23-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, 2 To study and learn about different evolution theories. 3. To study about function and levels in ecosystem. 4. To study some of the basics of Biotechnology. 5. Learn practical skills on basic Biotechnology practical like microscope, slide preparation, safety measures.		
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.	7
II	**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	8
III	**Ecosystem:** Concept, components, properties and functions; energy flow-food chain, food web, trophic structure; ecological pyramids and concept of productivity. **Biogeochemical cycles:** Concept, reservoir pool, gaseous cycles and sedimentary cycles.	7
IV	**Introduction to biotechnology:** 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.	8

V*	List of Practical: 1. To learn about various safety measures in biotechnology laboratory. 2. To learn about plant tissue culture laboratory setup. 3. To study C, N and O cycle. 4. To study cell division stages under microscope. 5. To study the structure of Prokaryotic cell. 6. To study the structure of Eukaryotic cell.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory-15** • Class Participation:4 • Seminar/presentation/assignment/quiz/classtestetc.:4 • Mid-Term Exam:7 ➢ **Practicum-5** • Class Participation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:5 • Mid-Term Exam: NA	**End Term Examination: 35(Theory); 20 (Practical)-** Evaluation of the practical skill will be done by as per University guidelines.

Part C-Learning Resources

Suggested Readings:

1. Comprehensive Biotechnology, MurrayMoo-Young, 2nd edition (2011), Pergamon Press.
2. Introduction to Biotechnology, WilliamJ.Thieman&MichaelA.Palladino,3rdedition (2012), Benjamin Cummings.
3. Biotechnology Expanding Horizons, BDSingh, 4th edition (2012), KalyaniPublishers.
4. Biotechnology, Applying the Genetic Revolution, David P.Clark &NanetteJ.Pazdernik,1st edition (2009), Academic Cell.
5. Biotechnology: Demystifying the concepts, David Bourgaize, Thomas R. Jewell & Rodolfo G. Buiser,1stedition (1999), Benjamin Cummings.
6. Elements of Biotechnology-Gupta, P.K., Rastogi and Co., Merrut, India, 2nd edition (2010).

The Ethics of Biotechnology (Biotechnology in the 21st Century), Jonathan Morris, Chelsea House Pub (L), 1st edition (2005).

CC-M2

Session: 2025-26			
Part A-Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**Basics concepts of Biotechnology**		
Course Code	**B23-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	**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 Gain fundamental information about various biotechnology fields. 2. Understand enzyme immobilization and their roles. 3. Learn about various immunological components and their functioning in human body. 4. Learn working in biotechnology laboratories. 5. To learn about different biotechnological techniques.		
Credits	Theory	Practical	Total
	1	1	**2**
Contact Hours	1	2	3
Max. Marks: 50 **Internal Assessment Marks:15 (**10Theory+5Practical) **End Term Exam Marks: 35 (**20Theory+15Practical)		**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; Brief account of safety guidelines, risk assessment and ethics in biotechnology; Very brief account of intellectual property rights; future of biotechnology.	3
II	DNA fingerprinting and forensic analysis. Potential laboratory biohazards of genetic engineering. Introduction to molecular markers. Introduction of enzyme technology: nature of enzymes, application of enzymes and immobilized enzymes.	4
III	Scope and applications of animal biotechnology and plant biotechnology. Brief account of immunotechnology: immune system (immune cells, types of immunity and general structure of immunoglobulins), hybridoma technology and monoclonal antibodies. *Invitro* fertilization and embryo transfer technology in brief.	4
IV	Brief account on bioremediation and waste treatment biotechnology, bioleaching. Application of biotechnology in medicine (pharmaceutical industry, vaccines, antibiotics etc.), food industry, biofuels and chemical industry.	4

V*	**List of Practical:** 1. To examine case study of patenting of rice and turmeric. 2. To learn and demonstrate the process of DNA fingerprinting. 3. To learn about possible techniques of enzyme immobilization in laboratory. 4. To discuss various applications of Biotechnology in food and agriculture sector. 5. To demonstrate the process of hybridoma technology. 6. To demonstrate the process of IVF.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory-10** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: NA • Mid-Term Exam: 6 ➢ **Practicum-5** • Class Participation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:5 • Mid-Term Exam: NA	**End Term Examination:** **20 (Theory);** **15 (Practical)-** Evaluation of the practical skill will be done as per university guidelines

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 by J.L. Jain, S. Chand & Co.
3. Essentials of Biochemistry, 5th edition by Satyanarayana and Chakrapani (2019) Elsevier, India

MDC-2

Session:2025-26			
Part A-Introduction			
Subject	**Biotechnology**		
Semester	**II**		
Name of the Course	**Biotechnology-II**		
Course Code	**B23-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	**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 about study of microorganisms. 2. Understand different processes in microorganisms. 3. Learn about different sterilization techniques. 4. Learn about different types of preservation methods. 5. Students get exposed to different microbiological and biotechnological techniques.		
Credits	Theory	Practical	Total
	2	1	**3**
Contact Hours	2	2	4
Max. Marks:75 **Internal Assessment Marks: 20** (15Theory+5Practical) **End Term Exam Marks:55**(35Theory+20Practical)		**Time: Theory-3h; Practical-4h**	
Part B-Contents of the Course			

Instructions for Paper-Setter

Nine questions will be set in all. QuestionNo.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	Bacterial transformation, conjugation, transfection, DNA as genetic material: experimental evidences, Harshey & Chase experiment, Griffth experiment. Genetically modified organisms (some important examples like cattle, pig, fish, plants like tomato, brinjal).	8
II	Sterilization techniques followed in biotechnology lab.- dry and wet sterilization techniques, Preferred method of sterilization for different materials, Lab rules and safety measures to be taken in Biotechnology Laboratory.	7
III	Nutritional categories of micro-organisms, Microbial growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Control of Microorganisms: By physical, chemical and Chemotherapeutic Agents.	8
IV	Cryopreservation: Cryopreservation of plant or animal sample / microorganisms, Difficulties in cryopreservation, Methods for cryopreservation, Selection of material, addition of cryoprotectants, Freezing (rapid freezing, slow freezing, step wise freezing) Storage in liquid nitrogen, Thawing and reculturing of frozen samples.	7
V*	**PRACTICALS** 1. To learn about various sterilization techniques in biotechnology laboratory. 2. To learn about some important sterilizing Instruments in Biotechnology laboratory.	30

	3. To demonstrate the bacterial growth by using suitable resources. 4. To study structure of DNA in detail. 5. To study effectiveness of different agents for microbial growth.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory-15** • Class Participation: 4 • Seminar/presentation/assignment/quiz/class test etc.: 4 • Mid-Term Exam:7 ➢ **Practicum-5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.:5 • Mid-Term Exam: NA	**End Term Examination:** **35 (Theory);** **20 (Practical)-** Evaluation of the practical skill will be done by as per University guidelines.

Part C-Learning Resources

1. Elements of Biotechnology-Gupta, P.K., Rastogi Publications, Merrut, India,2nd edition (2019).
2. Introduction to Plant Biotechnology-Chawla, H.S. CRC Press, 3rd edition(2020).
3. Text Book of Biotechnology-Das, H.K., Wiley India Pvt.Limited,5th edition (2017).
4. Plant Biotechnology-Hammound, J., Mc Garvey, P. and Yusibov,V., SpringerVerag (2012).
5. Plant Biotechnology-Gupta, P.K. Rastogi Publishers,Meerut,India,2nd edition (2016).

MDC-3

Session: 2025-26			
Part A–Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the Course	**Biotechnology–III**		
Course Code	**B23-BTY-303**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**MDC-3**		
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. Understand protection methods for different biotechnological processes and products. 2. Understand applications of IVF 3. Learn diverse applications of Biotechnology. 4. Learn about fermentation technology. 5. Learn practical skills on different aspects and applications in the field of Biotechnology.		
Credits	Theory	Practical	Total
	2	1	**3**
Contact Hours	2	2	4
Max. Marks:75 **Internal Assessment Marks:20** (15Theory+5Practical) **End Term Exam Marks: 55** (35Theory+20Practical)		**Time: Theory-3h; Practical-4h**	
Part B-Contents of the Course			
Instructions for Paper-Setter Nine questions will be set in all. Question No.1comprising 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	Intellectual Property Rights, Biosafety and Ethical Issues: Intellectual property rights (IPR): Patents, trade secrets, copyright, trademarks; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Concerns about GM crops–environmental, biosafety and Ethical issues**.**	7
II	Fermentation Technology: Fermenters, its types, components and applications. stirred-tank, airlift, bubble column and fluidized bed Fermenters Batch, Fed batch and Continuous culture.	8
III	In vitro fertilization and Embryo Transfer Technology: In vitro fertilization in Humans, Embryo transfer in Humans, Super-ovulation and Embryo transfer in Farm animals.	7
IV	Application of biotechnology in medicine (pharmaceutical industry, vaccines, antibiotics etc.), food industry, chemical industry, Animal and plant sectors.	8
V*	List of Practical: 1. To study about some case studies regarding patent. 2. To demonstrate the composition and functioning of a basic fermenter. 3. To discuss about advantages and disadvantages of genetically modified crops. 4. To represent different types of Fermenters diagrammatically. 5. To demonstrate the process of In Vitro fertilization and discuss its applications.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory-15** • Class Participation:4 • Seminar/presentation/assignment/quiz/class test etc.:4 • Mid-Term Exam:7 ➢ **Practicum-5** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.:5 • Mid-Term Exam: NA	**End Term Examination: 35 (Theory);** **20 (Practical)-**Evaluation of the practical skill will be done by as per University guidelines.

Part C-Learning Resources

References

1. Comprehensive Biotechnology, Murray Moo-Young,2nd edition (2011), Pergamon Press.
2. Introduction to Biotechnology, William J. Thieman &MichaelA.Palladino,3rd edition (2012), Benjamin Cummings.
3. Biotechnology Expanding Horizons, BD Singh, 4th edition (2012), Kalyani Publishers.
4. Biotechnology, Applying the Genetic Revolution, David P. Clark &NanetteJ. Pazdernik, 1st edition (2009), Academic Cell.
5. Biotechnology: Demystifying the concepts, David Bourgaize, Thomas R. Jewell& Rodolfo G. Buiser, 1st edition (1999), Benjamin Cummings.
6. Elements of Biotechnology-Gupta, P.K., Rastogi and Co., Merrut, India,2ndedition (2010).

CC-M3

Session: 2025-2026			
Part A - Introduction			
Subject	**Biotechnology**		
Semester	**III**		
Name of the course	**Animal Tissue Culture**		
Course Code	**B23-BTY-304**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M3**		
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. Understand the basics of animal cell culture, types of cell lines, and culture media. 2. Learn techniques like subculturing, cryopreservation, and contamination control. 3. Know about specialized culture methods and their applications in biotechnology. 4. Understand the ethical issues and safety practices in animal cell culture labs. 5. Perform basic cell culture techniques such as media preparation, aseptic handling, subculturing, and cell viability testing.		
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 Question No. 1 and four others selecting one question from each unit. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Animal Cell Culture:-Historical development and milestones in cell culture; Basics of cell biology relevant to culture; Types of cell cultures: Primary, Secondary, and Continuous cell lines; Laboratory setup and biosafety in cell culture; Culture media: Composition, types, and preparation	11

II	Techniques and Maintenance of Cell Cultures:- Aseptic techniques and sterilization; Subculturing, cryopreservation, and thawing of cells; Cell viability, growth kinetics, and characterization; Contamination: Sources, detection, and prevention; Serum and serum-free culture systems. .	12
III	Specialized Cell Culture Techniques:- Stem cell culture (ESCs, iPSCs, MSCs); 3D culture and organoid technology (introductory); Co-culture and suspension culture techniques; Scaling up cell culture: Bioreactors and perfusion systems; Cytotoxicity and cell-based assays.	12
IV	Applications and Ethical Aspects; Applications in vaccine production, toxicology, recombinant protein expression; Animal biotechnology: Embryo culture, cloning, and gene editing; Cell culture in cancer research and regenerative medicine; Ethical concerns and regulatory aspects in animal cell culture.	10
V*	**List of Practical: Any five** 1. Introduction to animal tissue culture laboratory and aseptic practices. 2. Preparation of different types of cell culture media. 3. Preparation of gelatin or poly-L-lysine coated culture plates. 4. Establishment of primary culture from tissue explants. 5. Sub-culturing and maintenance of animal cell lines. 6. Observation and identification of bacterial and fungal contamination. 7. Cryopreservation and thawing of cultured cells. 8. Microscopic observation of cell morphology. 9. Cytotoxicity testing using colorimetric assays (e.g., MTT). 10. Simulated cell culture experiments using teaching kits or video demonstration.	**30**
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory-20** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5		**End Term Examination: 50 (Theory); 20 (Practical)-** Evaluation of the

• Mid-Term Exam: 10 ➢ **Practicum - 10** • Class Participation: • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	practical skill will be done by as per University guidelines.

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Textbook of Animal Biotechnology by S.K. Gautam, B. Singh, M.S. Chauhan, S.K. Singla
   Publisher: TERI Publishers, New Delhi
2. Advances in Animal Biotechnology by B. Singh, S.K. Gautam, M. Mukesh, G. Mal
   Publisher: Springer Nature
3. Animal Cell Culture: A Practical Approach by John R.W. Masters
   Publisher: Oxford University Press
4. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by R. Ian Freshney
   Publisher: Wiley-Blackwell

CC-M6

Session: 2025-2026			
Part A - Introduction			
Subject	**Biotechnology**		
Semester	**VI**		
Name of the course	**Fermentation Biotechnology**		
Course Code	**B23-BTY-607**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M6**		
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 development of fermentation. Have knowledge of isolation and preservation of industrially important microbes and various types of fermentations. 2. Attain knowledge about formulation of industrial media, design and types of fermenters. 3. Get introduced to various strategies of product recovery from a fermentation broth. 4. Understand the basic principles of microbial commercial fermentations. 5. Develop practical skill to isolate, improve, analyze and preserve industrially important microbes.		
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: 3h, 4h (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 Question No. 1 and four others selecting one question from each unit. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to fermentation technology: History, development and commercial applications. Ideal characteristics for industrially important microorganisms, methods of isolation, screening and preservation. Types of Fermentation systems; batch, fed-batch and continuous system.	11
II	Media selection and formulation for industrial fermentations. Liquid and solid substrates used in fermentations. Foam formation, drawbacks and control. General design of a Fermenter/bioreactor. Types of fermenters commonly used; stirred tank reactor, airlift reactor, tower fermenter and bubble	12

	column reactor.	
III	Process development of industrial fermentation: upstream and down-stream processing. Product purification: separation of microbial cells and other solids, cell disruption, filtration, centrifugation, phase extraction, chromatography, drying and crystallization.	12
IV	Commercial importance of fermentation: production of alcoholic beverages in industry; beer, wine and whisky, dairy products; cheese, yoghurt, buttermilk. Single cell protein (SCP): production and significance. Brief idea of extracellular enzymes and their industrial significance.	10
V*	**List of Practical:** 1. Demonstration of working of fermenter. 2. Isolation of industrially important micro-organisms. 3. Production of Biomass in sub-merged fermentation and surface fermentation. 4. Preservation of isolated microbial cultures. **5.** Development of fermentation process for various products like wine, buttermilk or extracellular enzyme.	**30**

Suggested Evaluation Methods

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

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Stanbury P.F. et al. (1997), Principles of Fermentation Technology, Pergmon Press Oxford.
2. Ward O.P., (1998), Fermentation Biotechnology – Principles, Process and Products. Prentice Hall Publishing, New Jersey.
3. Microbial Biotechnology: Basic Research and Applications (2020). Edit. Singh *et al*. Pub. Springer
4. Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Science Publishers
5. Arnold I. Demain and Julian E. Davies (1999), Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press, Washington D.C.
6. Glazer and Nikaido (1998) Microbial Biotechnology by WH Freeman & Company, New York.
7. Cruger and Cruger (2002), Biotechnology – A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi.