CH. RANBIR SINGH UNIVERSITY, JIND

Syllabus for

Under-Graduate Programme

(Subject: Biotechnology)

(5th to 6th Semester)

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

CC-5/ MCC-9

Session: 2025-2026

Part A - Introduction

Subject	Biotechnology		
Semester	V		
Name of the course	Immunology		
Course Code	B23-BTY-501		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-5/ MCC- 9		
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. Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens. 2. Understand and describe antigen, antibodies and their interactions. 3. Know about the basic principles of immune cells responses. 4. Learn about the problems emerging in health sector, diseases related to immune system, hybridoma technology and different types of vaccines. 5. Exhibit skills to isolate lymphocytes and serum from Blood and to perform various immunological assays such as ELISA, DID and blood typing.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (Theory); 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 and overview:** Introduction and overview of immunology, cells and organs of immune system. Primary and secondary responses. Innate immunity: anatomic, physiological, phagocytic and inflammatory barriers. Adaptive immunity: Humoral and cell-mediated. Interrelationship between innate and acquired immunity.	10
II	**Antigens:** Concept of antigenicity and immunogenicity, Antigens, epitopes, haptens and adjuvants. **Antibodies:** basic structure of antibodies, antibody classes and their biological activity, antigenic determinants on immunoglobulins, immunoglobulin super family, antigen-antibody interactions: immunoprecipitation, agglutination.	12
III	**Basic principles of immune system:** Structure and function of B-cell receptor, T-cell receptor. Introduction of self-tolerance and MHC-restriction. Structure and role of Major Histocompatibility Complex, Antigen processing and presentation. Complement system and its activation pathways. Cytokines and their role.	12
IV	**Immune system in health and disease:** Hypersensitivity reactions-their types and mechanism, Autoimmune disorders. Passive and active immunization. Hybridoma technology: production of monoclonal antibodies. Vaccines: live attenuated, killed, subunit, conjugate and DNA vaccines.	11
V*	**List of Practicals:** 1. Isolation of Lymphocytes from peripheral blood. 2. Serum preparation and serological reactions-Agglutination and Precipitation 3. To perform Enzyme-linked Immunosorbent assay 4. To perform immunodiffusion by Mancini and Ouchterlony method (single or double) 5. To perform immuno-electrophoresis with a given antigen-antibody system 6. Assays based on agglutination reactions-Blood typing	30

Suggested Evaluation Methods	
Internal Assessment: ➢ Theory-20 Marks • Class Participation: 5 • 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: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Benjamin E. Immunology – A short course 4th Edition, John Wiley, NewYork
2. Kuby J. Immunology,8th Edition, W.H. Freeman & Co., NewYork
3. Roitt, I.M. Essential Immunology, 12thEdition, Oxford Black Well Science,London
4. TizardI.R.Immunology–Anintroduction,9th Edition, Philadelphia Saunders College press.
5. Gupta P.K. Biotechnology and Genomics, Rastogi Publications Meerut
6. Ommerville et al. Alcamo's Fundamentals of Microbiology, Jones and Barteett Publishers.

MCC-10

Session: 2025-2026			
Part A - Introduction			
Subject	**Biotechnology**		
Semester	**V**		
Name of the course	**Microbial Genetics**		
Course Code	**B23-BTY- 502**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**MCC-10**		
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. Know about structure of Prokaryotic Genome and DNA Replication 2. Gain the knowledge of Mutation and DNA repair. 3. Explain about Genetic transformation and Mechanism of genetic exchange 4. Stages in the Lytic Life and Lysogenic Life Cycle of a typical phage 5. Exhibit practical skills in preparation of media and preparation of cell culture. Gain the knowledge of Isolation genetic material from E. *coli* and its analysis.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (Theory), 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	**Prokaryotic Genomes**: Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome). **DNA replication:** Mechanism of DNA replication-conservative, semi-conservative and dispersive types, experimental evidence for semi-conservative replication, enzymes and accessory proteins, proof reading, inhibitors in prokaryotic replication.	10

II	**Mutations**: Spontaneous and induced (physical and chemical mutagens), DNA repair mechanisms, Direct repair- photolyase and Ada, Mismatch repair- *mutSLH*, Recombinational repair- *recA, recFOR, recBCD*, SOS and translation synthesis- *umuCD*, Mutator genes. Molecular mechanisms of mutations: Point mutations, base substitution-transition and transversion (framshift mutations, deletion, addition).	12
III	**Genetic Transformation:** Griffith's Experiment, Genetic change: transformation, transduction, conjugation, plasmids. **Mechanism of genetic exchange**: Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu–virus).	12
IV	**Bacteriophages:** Stages in the Lytic Life Cycle of a typical phage, Properties of a phage infected bacterial culture, Specificity in phage infection, E. coli PhageT4, E.coli Phage T7, E.coli phage lambda, Immunity to infection, Prophage integration, Induction of prophage, Prophage excision, Repressor, Structure of the operator and binding of the repressor and the Cro product, Decision between the lytic and lysogenic Cycles, Transducing phages, E.coli phage phiX174, filamentous DNA phages, Single stranded RNA phages, The lysogenic Cycle.	11
V*	List of Practical: 1. Preparation of Nutrient Agar Media 2. Different Method of Plating and preparation of agar slant. 3. Preparation of pure culture 4. Culture of E.coli in Luria Bertani Media and Study of Bacterial Cell Count by using spectrophotometer 5. Isolation of DNA from E.coli and analysis by agarose gel electrophoresis 6. Isolation of RNA from E.coli 7. Isolation of Plasmid from E.coli and analysis by agarose gel electrophoresis	30
Suggested Evaluation Methods		

Internal Assessment:	**End Term Examination:**
➢ Theory-20 Marks •Class Participation: 5 •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	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Suggested Reading

1. Maloy *et al.*, 1994, Microbial genetics, Jones & Barlett publishers
2. Dale JW 1994, Molecular Genetics of Bacteria, John Wiley & sons
3. Lewin 2002, Gene IX oxford University Press
4. Hayes W, Bacterial & Viral Genetics
5. General microbiology (Vth edi) Stanier, Ingraham, Wheelis & Painter
6. Dubey & Maheshwari , Text book of Microbiology

DSE-2

Session: 2025-2026

Part A - Introduction

Subject	Biotechnology
Semester	V
Name of the course	Fundamentals of Enzymology
Course Code	B23-BTY-503
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2
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. Learn various characteristics of enzymes, classify them and elaborate the role of cofactors in enzyme catalysis. 2. Correlate the structure of enzymes to their functions, mechanism of enzyme catalysis. 3. Exhibit the knowledge of enzyme kinetics of unisubstrate reactions, various kinetics parameters (Km, Vmax etc.) and describe different types of enzyme inhibitions. 4. Discuss techniques of enzyme isolation and purification and analyze the importance of immobilized enzymes and the techniques to prepare them. 5. Knowledge to extract and quantitatively estimate the enzyme activity and protein content of the samples; exhibit skills in studying various characteristics of enzymes like temperature optima, Km, Vmax.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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(Theory), 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	History of Enzymology, General characteristics, nomenclature & classification of enzymes. Significance of numbering system. Introduction to terms: holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site, metallo-enzymes, isoenzymes, monomeric	11

	enzymes, oligomeric enzymes, multifunctional enzyme and multi-enzyme complexes. Measurement and expression of enzyme activity: Enzyme assay, enzyme units, enzyme turn over number and specific activity.	
II	**Role of cofactors in enzyme catalysis:** NAD/NADP, FMN/FAD, CoA, biocytin, Vit B12, lipoamide, TPP, PLP, tetrahydrofolate and metal ions. Enzyme catalysis: Reaction co-ordinate diagram, transition state, acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Mechanism of action of chymotrypsin, carboxypeptidase and ribonuclease.	12
III	**Introduction to Enzyme Kinetics,** Factors affecting enzyme activity (enzyme concentration, substrate concentration, pH and temperature). Derivation of Michaelis-Menten equation for uni-substrate reaction. K_m and its significance. Lineweaver-Burk plot. Importance of K_{cat}/K_m. Reversible (competitive, non-competitive and uncompetitive inhibitions) and irreversible inhibition. Enzyme regulation: Feedback inhibition, Allosteric enzymes. Covalently modulated enzymes. Zymogen activation.	12
IV	**Enzyme purification:** methods of isolation of Enzyme, purification of enzyme- Ammonium sulphate precipitation, molecular sieving, ion-exchange chromatography, affinity chromatography, Criteria of homogeneity of enzyme. **Immobilized enzymes:** methods of immobilization - Adsorption, ionic binding, covalent coupling, cross-linking, entrapment, microencapsulation. Advantages and disadvantages of immobilization. Applications of immobilized enzymes. Enzyme reactors, Enzymes as biosensors. Extremozymes, Abzymes and Ribozymes Clinical aspects of Enzymology and Future prospects.	10
V*	**List of Practicals:** 1. Estimation of protein by Biuret/Lowry method 2. Assay of acid/alkaline phosphatase activity from germinating mungbean seeds and calculation of activity and specific activity of acid/alkaline phosphatase. 3. Effect of enzyme concentration on the rate of enzyme catalysed rection. 4. Effect of substrate concentration on acid/alkaline phosphatase activity and determination of its Km value. 5. Effect of Temperature on Enzyme activity and determination of optimum temperature. 6. Partial purification of enzyme by change of pH, temperature, addition of organic solvents and ammonium sulphate fractionation technique and to determine the specific activity of the enzyme	30

Suggested Evaluation Methods	End Term Examination:
Internal Assessment: Theory-20 Marks • Class Participation: 5 • 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	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Structure and mechanism in Protein Science, by Alan Fersht (2017). World Scientific.
2. Fundamentals of Enzymology, 3rd edition, by Nicholas C. Price and Lewis Stevens (2009) Oxford U.
3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer, Philip Bonner (2008). East West Publishing.
4. The Chemical Kinetics of Enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press London.
5. An introduction to Practical Biochemistry, 3rd Edition, by David Plummer (2017). Tata Mc-Graw Hill
6. Introductory Practical Biochemistry by S.K. Sawhney& R. Singh (2014). Narosa Publishers
7. Modern Experimental Biochemistry, 3rd edition, by R. Boyer (2002). Addison-Wesley Longman.

DSE-2

Session: 2025-2026

Part A – Introduction

Subject	Biotechnology
Semester	V
Name of the course	Fermented Foods
Course Code	B23-BTY-504
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-2
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 principles and processes of fermentation. 2. Identify the microorganisms involved in fermentation and their roles. 3. Examine the biochemical transformations during fermentation. 4. Analyze the nutritional and sensory attributes of fermented foods. 5. Explore the production techniques of different fermented food products.

Credits	Theory	practical	Total
	3	1	4
Contact Hours/ week	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 theory,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: Definition of fermentation Historical significance and cultural aspects of fermented foods, Importance of fermentation in food preservation and flavor development, Microbiology of Fermentation: Microorganisms involved in fermentation (bacteria, yeasts, molds) Role of microorganisms in fermentation processes Factors influencing microbial growth and activity in fermentation.	10

II	Principles of Fermentation: Biochemical pathways involved in fermentation (e.g., lactic acid fermentation, alcoholic fermentation), Fermentation kinetics and factors affecting fermentation rates, Control of fermentation parameters (temperature, pH, oxygen availability	12
III	Fermented Food Products: Dairy products (e.g., yogurt, cheese, kefir); Fermented vegetables (e.g., sauerkraut, kimchi); Fermented beverages (e.g., beer, wine, kombucha); Fermented grains and legumes (e.g., sourdough bread, tempeh); Fermented meats and fish (e.g., salami, fish sauce)	12
IV	Fermentation Techniques and Equipment: Traditional and modern fermentation techniques; Equipment used in fermentation processes (e.g., fermentation tanks, starter cultures); Scaling up fermentation processes for commercial production; Quality Control and Fermentation Monitoring: Methods for monitoring fermentation progress (e.g., pH measurement, microbial analysis); Quality parameters for evaluating fermented foods (e.g., texture, flavor, shelf life)	11
V	List of Practical: Lab demonstrations of fermentation processes 1. Preparation of yoghurt and buttermilk 2. Preparation of pickles 3. Preparation and maintenance of starter culture 4. Analysis of fermented food products for quality and safety parameters	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
Theory – 20 Marks Class Participation:5 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	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. "Fermented Foods: Principles and Applications" by Jyoti Prakash Tamang
2. Handbook of Fermented Food and Beverage Technology" edited by Y. H. Hui, Lisbeth Meunier-Goddik, et al.
3. The Art of Fermentation: An In-Depth Exploration of Essential Concepts and Processes from Around the World" by Sandor Ellix Katz
4. "Microbiology and Technology of Fermented Foods" by Robert W. Hutkins

DSE-3

Session: 2025-2026			
Part A - Introduction			
Subject	Biotechnology		
Semester	V		
Name of the course	Foundations of Environment and Ecology		
Course Code	B23-BTY- 505		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-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. Students will be able to describe basic concepts of ecology and ecosystem. 2. Students will be able to describe the various biological interactions and relation between abiotic and biotic factors. 3. Students will able to understand biogeochemical cycles and concept of Biodiversity. 4. Students will able to understand the causes of different types of pollution and their management strategies. 5. Learners will able to measure various physio-chemical parameters of water samples		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (Theory), 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	Basic concepts of ecology: Definition, significance. Concepts of habitat and ecological Niche. Ecosystem: Concept, components, properties and functions; Ecological energetics and energy flow-food chain, food web, trophic structure; ecological pyramids, concept of productivity.	10
II	Factors affecting environment: Abiotic factors (light-intensity, quality and duration), temperature, humidity, wind, Rainfall, topography; edaphic factors; Biotic factors.	12

	Introduction to major ecosystems of the world.	
III	Biogeochemical cycles: Concept, reservoir pool, gaseous cycles and sedimentary cycles. Population: Growth and regulation. Concept of biodiversity and conservation of natural resources.	12
IV	Population interactions: Competition, predation, parasitism, commensalisms and mutualism. Environmental pollution: Soil, Water, Air, radiation, landscape, noise Detection of Environmental pollutant. Hazardous wastes Environmental cleanup, Bioremediation, Waste disposal.	11
V*	List of Practical: 1. Chemical analysis of pond and soil ecosystem for pH, 2. Chemical analysis of pond and soil ecosystem for dissolved oxygen, BOD 3. Chemical analysis of pond and soil ecosystem for free CO_2 4. Chemical analysis of pond and soil ecosystem for Nitrates, phosphates and chlorides 5. DNA isolation from soil microbial community 6. Isolation of azotobacter species from soil	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ Theory-20 Marks •Class Participation: 5 •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	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Suggested Reading

1. Fundamentals of Ecology; Odum EP.
2. Wastewater Engineering – Treatment, Disposal and Reuse; Metcalf & Eddy, Tata McGrawhill
3. Environmental Pollution Control Engineering, Rao CS, New Age International Publication.

DSE-3

Session: 2025-2026			
Part A - Introduction			
Subject	Biotechnology		
Semester	V		
Name of the course	Foundations of Nano-Biotechnology		
Course Code	B23-BTY-506		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-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. To understand the fundamentals of nanotechnology and its application in biology. 2. To explore the synthesis and characterization of nano materials used in bio-nanotechnology. 3. To examine the interactions between biological systems and nanoparticles. 4. To investigate the applications of bio-nanotechnology in medicine, biosensing, and biotechnology. 5. To discuss ethical, safety, and societal implications of bio-nanotechnology.		
Credits	Theory	Practical	Total
	3	1	4
	3	2	5
Contact Hours / week	Time: 3h (theory),4h(practical)		
Max. Marks: 100 Internal Assessment Marks: 30(20 Theory + 10 Practical) End Term Exam Marks:70 (50 theory + 20 Practicals)			

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 Bio-Nanotechnology - Cellular nanostructures, self-assembly of colloidal nanostructures of biological relevance, bioactive nanoparticles (respiratory surfactants, magnetic nanoparticles), Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles).	10

II	carbon nanotubes, polymeric nanofibers, Implications in neuroscience, tissue engineering and cancer therapy, and Environmental and safety aspects of bio-nanotechnology.	12
III	Introduction to Nanotechnology (Definitions, history and current practice), Multilayer Thin Film: Polyelectrolyte multilayers, coated colloids, smart capsules, LbL self-assembly, Colloids and Colloid Assemblies for Bio-nanotechnology, Nanoengineered biosensors, Fiber Optic Nano-sensors in medical care.	12
IV	Semiconductor and Metal Nanoparticles: Synthesis and Applications, Nanotechnology in Tissue Engineering, Microemulsions and Drug Delivery in Nanotechnology. Overview of current industry applications; nanoscale science and engineering principles	11
V	1. To study nanotube modeller software. 2. To study ninithi software 3. To synthesize nanoparticles by chemical reduction method 4. To synthesize nanoparticles by plant extract. 5. To study AFM 6. To study X Ray diffraction	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
Theory 20 Marks ➢ Class Participation: 5 ➢ Seminar/presentation/assignment/quiz/class test etc.: 5 ➢ Mid-Term Exam: 10 Practicum 10 Marks ➢ Class Participation: ➢ Seminar/Demonstration/viva/Lab records etc.: 10 ➢ Mid-Term Exam: NA	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Recommended Books/e-resources/LMS:

1. Multilayer Thin Films; Decher G, Schlenoff JB, Wiley-VCH Verlag GmbH & Co. KGaA.
2. Bio-nanotechnology : Lessons from Nature; Goodsell DS, Wiley-Liss.
3. Nanotechnology - A Gentle Introduction to the Next Big Idea; Ratner and Ratner, Prentice Hall PTR

CC-6/ MCC-11

Session: 2025-2026			
Part A - Introduction			
Subject	Biotechnology		
Semester	VI		
Name of the course	Microbial Technology		
Course Code	B23-BTY-601		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-6/ MCC- 11		
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. Evaluate the role of micro-organisms in specific biotechnological processes. Have insight about industrially important microbes, recent developments in fermentation processes and various types of fermentations. 2. Attain knowledge about designing of industrial strains and various media optimization strategies, strategies for overproduction of industrial important metabolites structure and functioning of fermenter. 3. Understand the basic principles of microbial commercial fermentations 4. Get introduced to various strategies of product recovery from a fermentation broth. knowledge to solve critical problems 5. Develop practical skill to isolate, improve, analyze and preserve industrially important microbes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (Theory), 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	**Microbial Biotechnology**: Scopes, application and challenges. Biology of industrial micro- organisms: Industrial microorganisms, growth metabolism regulation, substrate assimilation/ product formation. Isolation and preservation of	11

	industrially important microorganisms. Fermentation system; batch and continuous system, fed batch system, multistage system. Solid state fermentation and its applications.	
II	**Overproduction of primary & secondary metabolites**: Use of mutation selection and recombination techniques. Fermentation raw materials: Media for industrial fermentations; criteria used in media formulation. Fermenter /bioreactor design and operation; types of fermenter, stirred tank reactor, bubble column reactor, airlift reactor, packed bed reactor, fluidized bed reactor and trickle bed reactor, agitation and aeration in a reactor, mass transfer. Foam formation and control.	12
III	Industrial production of alcoholic beverages, antibiotics and vaccines (a brief idea). Microbial production of industrial chemicals: ethanol, citric acid, acetic acid, gluconic acid, glycerol, acetone and butanol. Single cell protein (SCP) production, extracellular polysaccharides and enzymes.	12
IV	Microbial inoculants: Food starter cultures; baker's yeast, starter cultures for the dairy industry, meat starter cultures,; microbial inoculants; Microbial transformation of steroids and sterols. Down-stream processing: separation processes for microbial cells and other solids, cell disruption, centrifugation, solvent recovery, drying and crystallization. Recovery schemes for non-volatile metabolites, biomass.	10
V*	**List of Practical:** 1. Demonstration of working of fermenter. 2. Production of Biomass in sub-merged fermentation and surface fermentation. 3. Optimizing growth conditions: physical and chemical. 4. Isolation of industrially important micro-organisms. 5. Isolation of protease/lipase/amylase producing micro-organisms 6. Production of xylanase/Cellulase/ Pectinase by microbes and activity estimation 7. Preservation of isolated microbial cultures.	30

Suggested Evaluation Methods

Internal Assessment: ➢ Theory-20 Marks • Class Participation: 5 • 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: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

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, NewJersey.
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, NewYork.
7. Cruger and Cruger (2002), Biotechnology – A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation, New Delhi.

MCC-12	
Session: 2025-2026	
Part A-Introduction	
Subject	**Biotechnology**
Semester	**VI**
Name of the Course	**Bio-analytical Techniques**
Course Code	**B23-BTY-602**
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**MCC-12**
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 various techniques in Biotechnology 2. Gain the knowledge of scope and applications of such techniques 3. Get an insight of scope and applications of bio-analytical techniques 4. Gain knowledge of structure, working, maintenance/calibration and safety measures during handling of biotech lab instruments. Also get insight of maintenance of hygiene/ aseptic conditions. 5. Gain knowledge of various techniques

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

Max. Marks:100 **InternalAssessmentMarks:30**(20Theory+10Practical) **EndTermExamMarks:70**(50Theory+20Practical)	**Time:**3h(Theory),4h(Practical)

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	Bio-separation; filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid- liquid extraction; Purification by chromatographic techniques, reverse osmosis and ultra- filtration; Drying; Crystallization; Storage and packaging. Principles of Sedimentation, centrifugation techniques and their applications, differential centrifugation, density gradient and ultracentrifugation techniques.	12
II	Light Microscopy – Magnification, resolving power, Numerical aperture, Limit of Resolution, Principles and applications of bright field, phase contrast, fluorescence, scanning and transmission electron microscopy. Concept, Factors affecting electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, PAGE, SDS-PAGE, Isoelectrofocusing, 2-Dimentional electrophoresis	12
III	Principles and applications of Paper, Thin layer, Gel-filtration, ion-exchange, Affinity chromatography, Gas liquid chromatography, High pressure liquid chromatography (HPLC); Reversed Phase chromatography. Beer-Lambert law, light absorption and its transmittance, extinction coefficient, a brief account of instrumentation and applications of visible and UV spectroscopic techniques (structure elucidation excluded), NMR and ESR spectroscopy.	11
IV	Types of radiations, radioactive decay, units of radioactivity, detection and measurement of radioactivity (methods based on gas ionization and liquid scintillation counting) and Quenching. Autoradiography: overview, nuclear emulsions used in biological studies, isotopes commonly used in biochemical studies (32P, 35S, 14C and 3H). Biological hazards of radiations and safety measures in handling radioisotopes. Biological applications of radioisotopes.	10
V*	List of Practical: 1. Quantitative estimation of DNA and RNA content in the given sample. 2. Paper Chromatography or Thin Layer Chromatography 3. Gel Filtration, Ion-exchange and Affinity Chromatography 4. Agarose gel electrophoresis 5. PAGE 6. Centrifugation 7. Methods for preparation of nano-bioparticles	30

Suggested Evaluation Methods	
Internal Assessment: ➢ Theory-20 Marks • ClassParticipation:5 • Seminar/presentation/assignment/quiz/classtestetc.:5 • Mid-Term Exam: 10 ➢ Practical-10 Marks • Class Participation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:10 • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Cloning: A Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York,2000
2. Walker J.and Wilson K (2010),PrinciplesandTechniques-PracticalBiochemistry,7th Edition, Cambridge University Press, London.
3. Sawhney, S.K. and Singh R (2005), Introductory Practical Biochemistry, Alpha Science International.
4. Upadhayaye,A;Upadhyaye,KandNathN.(2002),BiophysicalChemistry:Principles & Techniques, Himalaya Publication House, New Delhi.

DSE-4

Session: 2025-2026			
Part A-Introduction			
Subject	**Biotechnology**		
Semester	**VI**		
Name of the Course	**Medical Microbiology**		
Course Code	**B23-BTY-603**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-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. Describe basic principles of medical microbiology, infectious diseases and mechanisms of disease transmission 2. Understand the importance of pathogenic microorganisms in human disease 3. Understand the morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive and gram negative bacteria. 4. Learn about modes of infections, their prevention and cure. 5. Learn about culturing techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	3	2	5
Max. Marks:100 **InternalAssessmentMarks:30**(20Theory+10Practical) **EndTermExamMarks:70**(50Theory+20Practical)		**Time:**3h(theory),4h(practical)	
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	Introduction and history & developments of microbiology, scope of microbiology, general characteristics of prokaryotes and eukaryotes, introduction to bacteriology, mycology, virology and parasitology. Definition, Importance, Principle, Operation and Applications of microscopy. Sterilization and Disinfection: Introduction and its types, principle, procedure and its application, biosafety in microbiology lab.	12
II	Introduction, types of chemotherapeutic agents, mode of action and clinical importance of different chemotherapeutic agents, antibiotic sensitivity tests and its medical importance, multiple drugs resistance and mechanism of drug resistance. Normal microbial flora of the human body, collection and transport of specimens, processing of clinical specimens for microbiological examination.	12
III	Growth kinetics, different types of culture medium, continuous culture and synchronous growth cultures, aerobic & anaerobic cultures, Introduction and its types, various factors affecting the microbial growth Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.	11
IV	Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, B.anthracis, C.tetani, C.botulinum, C.diphtheriae, M.tuberculosis.* Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. meningitidis, S. typhi, H. influenzae, V. cholerae, M. pneumoniae.*	10
V*	List of Practical: 1. Introduction, working and sample preparations for light microscopy. 2. Measurement of growth of microbial culture 3. Different biosafety techniques and precautions to be taken in laboratory. 4. Antibiotic sensitivity tests. 5. Isolation of pure culture from given sample.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ Theory-20 Marks • ClassParticipation:5 • Seminar/presentation/assignment/quiz/classtestetc.:5 • Mid-Term Exam: 10 ➢ Practical-10 Marks • Class Participation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:10 • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
- Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

DSE-4			
Session: 2025-2026			
Part A-Introduction			
Subject	**Biotechnology**		
Semester	**VI**		
Name of the Course	**Molecular medicine and Gene therapy**		
Course Code	**B23-BTY-604**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)	**DSE -4**		
Level of the course (As per Annexure-I	**300-399**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes(CLO): (CLOs1-4of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Acquire a broad understanding of current molecular medicine and gene therapy including current areas of research. 2. Understand how normal cellular processes change, fail or are destroyed by disease development. 3. Understand the role of stem cells and small molecules used in molecular medicine. 4. Understand the role of gene therapy in particular for genetic diseases and role of modern therapeutics. 5. Understand the online/offline/wet lab protocols involved in molecular medicine and gene therapy related to animal/human cells for use of animals/humans etc.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	3	2	5
Max.Marks:100 **InternalAssessmentMarks:30** (20Theory+10 Practical) **EndTermExamMarks:70** (50Theory+20Practical)		**Time:**3h(theory),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 Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.		
Unit	**Topic**	**Contact Hours**
I	**Introduction to Molecular Medicine**: Definition, scope, and historical perspective, Concept of Molecular Medicine? Need, Significance and Limits of Molecular Medicine, Development of Molecular Medicine, Applications of Molecular Medicine for curing human diseases.	10
II	**Molecular Basis of Diseases:** Genetic vs. acquired diseases, Molecular mechanisms underlying common diseases (e.g., cancer and neurodegenerative diseases).Diagnostic Techniques in Molecular Medicine:Polymerase chain reaction (PCR), DNA sequencing, and microarray analysis, Molecular imaging techniques (e.g., PET, MRI).	11
III	**Stems cells and small molecules in Molecular Medicine:** Brief description about stem cells, types of stem cells, Regenerative potential of different stem cell types, Stem cell therapy for neurodegenerative diseases, Cardiac regeneration using stem cells. Small molecules: Importance of small molecules in molecular medicine and drug discovery, role of small molecules in disease treatment.	12
IV	**Gene Therapy: Principles and Applications:** Concept and history of gene therapy. Types of gene therapy: somatic vs. germline, ex vivo vs. in vivo. Vectors for Gene Delivery: Viral vectors (retrovirus, adenovirus, adeno-associated virus). Non-viral vectors (liposomes, nanoparticles). Applications in correcting genetic disorders.Challenges and ethical considerations in gene therapy.	12

V*	**List of practical:** 1. Use online tools or software to simulate Polymerase Chain Reaction (PCR) experiments. 2. Design primers, set PCR conditions, and analyze the results virtually. 3. Perform PCR amplification of a known DNA fragment using genomic DNA as a template. 4. Verify the success of amplification by agarose gel electrophoresis. 5. Transfect cultured cells with a plasmid containing a reporter gene 6. Utilize online bioinformatics tools to analyze DNA or protein sequences. 7. Perform sequence alignment, homology searches, and phylogenetic analysis. 8. Access databases such as NCBI GEO or EMBL-EBI for gene expression data. 9. Use online platforms that simulate molecular cloning techniques. 10. Practice designing cloning experiments, selecting restriction enzymes, and analyzing plasmid maps.	30

Suggested Evaluation Methods

Internal Assessment: ➢ Theory-20 Marks • Class Participation:5 • Seminar/presentation/assignment/quiz/classtestetc.:5 • Mid-TermExam:10 ➢ Practicum-10 Marks • Class Participation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:10 • Mid-Term Exam: NA	**End Term Examination:** Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Jameson, J. L., & Fauci, A. S. (2006). *Principles of Molecular Medicine.* Humana Press.
2. Giacca, M. (2010). *Gene Therapy.* Springer.
3. Trent, R. J. (2005). *Molecular Medicine: An Introductory Text.* Academic Press.
4. Wolfe, T. M., & Lipinski, D. J. (2017). *Gene Therapy: Principles and Applications.* Wiley.
5. Singh, B., Gautam, S.K., Mukesh, M. (2019). *Advances in Animal Biotechnology.* Springer International Publishing
6. Arora, R., & Gupta, P. (2013). *Molecular Medicine: Genomics to Personalized Healthcare.* Elsevier.
7. Lanza, R., Atala, A., & Thomson, J. A. (2009). *Essentials of Stem Cell Biology and Gene Therapy.* Academic Press.
8. Press, O. W. (2002). *Gene Therapy: A Handbook for Physicians.* CRC Press.
9. Cook, R. E. (2008). *Molecular Medicine: An Introduction.* Wiley-Liss.
10. O'Carroll, C. D. (2016). *Gene Therapy: Therapeutic Mechanisms and Strategies.* Academic Press.

DSE-5

Session: 2025-2026			
Part A - Introduction			
Subject	Biotechnology		
Semester	VI		
Name of the course	Biostatistics		
Course Code	B23-BTY-605		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-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. To understand basic principles of probability and statistics. 2. To apply statistical methods for analyzing biological data. 3. To interpret and communicate statistical results effectively. 4. To critically evaluate statistical methods used in biological research. 5. To design experiments and studies using appropriate statistical techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (theory), 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	Statistics, its meaning and objectives. Population samples, frequency tables and their graphs, measures of central tendency (mean, mode, median) and their dispersion.	10
II	Concepts of moments, Skewness and kurtosis, Intuitive definition of random variables, probability mass function and probability density function, expectation and variance. Standard distribution ; binomial , Poisson and normal distribution with their important properties and significance.	12
III	Fitting of main distributions and testing of goodness –of – the –fit with special reference to $\chi 2$- test, t –test, Z-test. Fitting of trends; linear and quadratic with least square method	12
IV	Lines of regression, coefficient of correlation, coefficient of variation and their significance. Analysis of variance; one way and two way classification. Learn applications of statistics in the field of biology	11
V	**List of Practicals :** 1: Measurement and Sampling 2: Frequency Distributions 3: Summary Statistics 4: Probability 5: Introduction to Estimation 6: Introduction to Hypothesis Testing 7: Paired Samples 8: Independent Samples	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
Theory 20 Marks ➢ Class Participation: 5 ➢ Seminar/presentation/assignment/quiz/class test etc.: 5 ➢ Mid-Term Exam: 10 Practicum 10 Marks ➢ Class Participation: ➢ Seminar/ Demonstration/ viva/ Lab records etc.: 10 ➢ Mid-Term Exam: NA	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Recommended Books/ e-resources/ LMS:

1. Biostatistics; Arora PN, Malhotra PK, Himalaya Publishing House.
2. Introduction to Biostatistics; Sokal S & Rohit S, Toppan Publication.

DSE-5

Session: 2025-2026			
Part A - Introduction			
Subject	**Biotechnology**		
Semester	**VI**		
Name of the course	**Bio-entrepreneurship**		
Course Code	**B23-BTY- 606**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**DSE-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 the knowledge of structure, management and role of innovations in an organization 2. Discuss the government schemes for commercialization of biotechnology 3. Describe various elements of operational research and management, Compare and analyse the characteristics of biotech enterprises 4. Various parameters of quality control and government regulations. 5. Analyse personality and ability as an entrepreneur by different type of assessment tests. Plan and analyse the requirement and status of Biotech industry		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours/ week	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 (Theory), 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	Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology Organizational structure & Management. Capital Management. Product innovation and management. Government schemes for commercialization of technology (Eg. Biotech Consortium)	10
II	Basics of production management: Methods of manufacturing-Project/Jobbing, Batch. Production, Flow/Continuous production, process production-Characteristics of each method. Plant location-Importance, Factors affecting location, factory Building, Plant layout-Installation of Facilities.	12
III	Operational Research: Linear Programming, PERT and CPM; Production Planning and Control-Scheduling- Gantt Charts-Documentation-Production Work Order. Kaizen (Continuous improvement in product & management) Biotech enterprises: Small, Medium and Large.	12
IV	Quality control in Biotech industries. Govt. regulations for biotech products Public policy, regulatory and ethical challenges facing the biotechnology Entrepreneurship. Business development for medical products	11

V*	List of Practical: 1. To analyze your entrepreneurial personality and creativity 2. To analyze your entrepreneurial potential by performing online Bill Wager's self assessment test. 3. To analyze your personality type by performing online Jung & Myer Brigg's assessment test. 4. To analyze personality type by performing online DISC self assessment test. 5. To make a business plan. 6. To study Biotech Enterprises	30

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ Theory-20 Marks •Class Participation: 5 •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	Theory: 50 Marks (Written exam); Practical: 20 Marks (Demonstration/Viva-voce/Lab records etc.)

Part C- Learning Resources

Suggested Reading

1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM Patterns of Entrepreneurship.
3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand &Sons. Innovation and Entrepreneurship in Biotechnology: Concepts, Theories &Cases;
4. Hyne D and Kapeleris J. Entrepreneurship in Biotechnology: Managing for growth from start-up; Martin Gross Mann.
5. Best Practices in Biotechnology Education; Friedman Y, Logos Press.

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

Undergraduate Programs

Course: SEC-2

Session:2025-26			
PartA-Introduction			
Subject	**Biotechnology**		
Semester	**II**		
NameoftheCourse	**GeneticEngineering**		
CourseCode	**BTY-SEC-215**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VA C)	**SEC-2**		
Levelofthecourse(Asper Annexure-I	**200-299**		
Pre-requisite for the course (if any)	**NA**		
CourseLearningOutcomes(CLO):	Aftercompletingthiscourse,thelearnerwillbeableto: 1. Understandaboutdifferentterminologyrelatedto genetic engineering and tools used for it. 2. Understandaboutisolation,sequencingand synthesis of genes. 3. Knowthetechniquesfortransferandexpressionof cloned gene 4. Applytheknowledgeofgeneticengineeringin biological research.		
	5*.DeveloptheskillstoisolateDNAfromplantsand bacteria, plasmid DNA;Demonstratethe making and transforming competent cells.		
Credits	Theory	Practical	Total
	2	1	3
ContactHours	2	2	4

Max. Marks:75 **InternalAssessmentMarks:20**(15Theory+5Practical) **EndTermExamMarks: 55**(35Theory+20Practical)	**Time: Theory- 3h;** **Practical-4h**

PartB-ContentsoftheCourse

InstructionsforPaper- Setter: Thequestionpaper willconsist ofNINE questionsout ofwhich the candidate would be required to attempt FIVE questions. The first question will be compulsory and will have short answer questions uniformly spread over entire syllabus. The remaining EIGHT questions will be set taking TWO questions fromeach ofthe four units. Each question will carry equal marks. The candidate would be required to attempt ONE question from each unit in addition to compulsory question.

Unit	Topics	Contact Hours
I	**Cloning and amplification of DNA:** Introduction, choice of the organism, use of restriction endonucleases for the productionofDNAfragments.Vehicles forcloning -plasmids, phagevectorsandcosmids. RNAisolation, preparationanduse of cDNAs. Application of recombinant DNAtechnology.	8
II	**Isolation, sequencing and synthesis of genes:** Isolation of genes, sequencing of genes, synthesis of genes, Cloning of specific eukaryotic genes and their expression in bacteria. Genes involved in regulation, regulatory gene, promoter gene, operator gene and structural genes.	8
III	**Gene transfer methods:** Gene transfer methods for plants-Agrobacterium mediated gene transfer, physical and chemical methods. Gene transfer methods for animals-Biochemical, physical and virus-mediated gene transfer methods.	7
IV	**ApplicationsofGeneticEngineering:** Geneticengineeringin animals: Production and applications of transgenic mice, roleof ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering.	7
V*	1. IsolationofchromosomalDNAfromplant/animalcells 2. QualitativeandquantitativeanalysisofDNAusing spectrophotometer. 3. PlasmidDNAisolation 4. RestrictiondigestionofDNA 5. Makingcompetent cells 6. Transformationofcompetentcells.	30

SuggestedEvaluationMethods

Internal Assessment:	End Term Examination:
➢ **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	**35 (Theory);** **20 (Practical) -** Evaluation of the practical skill will be done by an external examiner.

Part C-Learning Resources

1. Gene Cloning and DNA Analysis - An Introduction, 7 th edition, by T. A. Brown (2016), Blackwell Publishing.
2. Molecular Biotechnology - Principles & applications of Recombinant DNA, 5th ed., Bernard R. Glick, Cheryl L. Patten (2017), ASM Press.
3. Principles of Gene Manipulation, 7th ed., Sandy B. Primrose, Richard Twyman (2006), Blackwell Scientific Publication.
4. Analysis of Genes and Genomes, 2004 by Richard J Reece, John Wiley & Sons, Ltd.
5. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
6. Rajmohan Joshi (Ed.) 2006. Biosafety and Bioethics, Isha Books, Delhi.

*Applicable for courses having practical component.

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

Undergraduate Programs

Course: SEC-3

Session:2025-26	
PartA-Introduction	
Subject	**Biotechnology**
Semester	**III**
NameoftheCourse	**DairyProcessing**
CourseCode	**BTY-SEC-315**
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**SEC-3**
Levelofthecourse(Asper Annexure-I	**300-399**
Pre-requisite for the course (if any)	NA
CourseLearningOutcomes(CLO): CLOs 1-4 of theory and 5th of practical)	Aftercompletingthiscourse,thelearner willbeableto: 1. To have knowledge of collection and standardization of milk, also study mechanical separation methods. 2. To have knowledge of traditional Indian dairy products 3. To suggestthe dairyindustrypersonnelregarding 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
ContactHours	2	2	4

Max. Marks:75 **InternalAssessmentMarks:20**(15Theory+5Practical) **EndTermExamMarks: 55**(35Theory+20Practical)	**Time:Theory-3h;** **Practical-4h**
PartB-ContentsoftheCourse	

InstructionsforPaper- Setter

Ninequestionswillbesetinall.QuestionNo.1comprisingofobjective/shortanswertype questions from the entire syllabus, will be compulsory.The remaining eightquestions will be set taking two questions fromeach 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	ContactHours
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 milkfat to make different milk products, Mechanical Separation: Sedimentation, Filtration, Centrifugal separation, Bactofugation; Homogenization; Pasteurization.	8
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.	8
III	CleaningandSanitation: Cleaningagents, CIP&COPii) 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.	7
IV	Basic principles and methods of dairy processing and preservation. Emerging Technologies in dairyprocessing. Packaging machines: Pouch filling machine pre-pack and aseptic filling bulk handling system; Mixing andagitation: Theory and purpose of mixing, Ultrafiltrationof 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.	7

V*	**PRACTICALS** 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. Preparation of sterilized reconstituted skim milk and propagation of starter cultures. 7. Preservation of starter cultures by freeze-drying techniques. 8. Preparation of Indian dairy products like paneer, khoa, butter milk and lassi etc.	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 an external examiner.

Part C-Learning Resources

1. Ahmed, T. 1985. Dairy Plant System Engineering. Kitab Mahal, K.L. Agencies Pvt. ltd., New Delhi.
2. Tamime, A Y. and Robinson, R. K. (1999). Yoghurt Science and Technology, 2nd ed. Woodhead Publ. Ltd. and CRC Press LLC, USA.
3. Ahmed, T. 1990. Dairy Plant System Engineering and Management. Kitab Mahal, K.L. Agencies Pvt. ltd., New Delhi.
4. Anantakrishnan, C.P. and Simha, N. N. 1987. Technology and Engineering of Dairy Plant Operations. Laxmi Publ., Delhi.
5. Food Engineering and Dairy Technology. V. A. Kessler Publ., Freising, Germany.1981.

CHAUDHARYRANBIRSINGHUNIVERSITY,JIND

UndergraduatePrograms

Course: VOC-2

Session2025-26			
PartA– Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
Nameofthecourse	**PlantTissue Culture**		
CourseCode	**BTY-VOC-115**		
Course Type: (CC/MCC/MDC/CC-M/ DSEC/VOC/DSE/PC/A EC/VAC)	**VOC-2**		
Levelofthecourse(As per Annexure-I	**100-199**		
Pre-requisiteforthe course(ifany)	**NA**		
Course Learning Outcomes(CLO):	Aftercompletingthis coursethe students willlearn: 1. Abouthistoryofplanttissueculture,totipotencyandsomatic embryogenesis, lab equipment, safety, and sterilization techniques. 2. Topreparеplanttissueculturemedia,establishandmaintain suspension and callus cultures, and understand their applications in secondary metabolite production and genetic engineering. 3. Micropropagation techniques, including axillary bud proliferation, nodal culture, and shoot tip culture. They'll also understand the design, construction, and environmental controlofpolyhousesandgreenhousesforplanttissueculture applications. 4. The importance of hardening micropropagated plants, understandvarioushardeningmethods,andgraspthеprocess of acclimatization. They'll also explore applications like haploid production, seedless plant propagation, cryopreservation, and genetic engineering in plant tissue culture. 5. Students will gain practical experience in setting up a plant tissue culture lab, preparing media, establishing suspension andcalluscultures,workingwithinvitrocultures,visitinga greenhouse, and hardening micropropagated plants.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

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

PartB-Contentsofthe Course

InstructionsforPaper- 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 settakingtwoquestionsfrom eachunit.Thecandidateswillberequiredtoattempt Q.No.1& fourothersselectingone questionfromeachunit.Allquestionscarryequalmarks.

Units	Topics	Contact Hours
Unit 1	Introduction to Plant Tissue Culture: Definition, scope, and significanceofplanttissueculture,Historicaldevelopmentofplant tissue culture, Basic principles and concepts of totipotency and somatic embryogenesis. Laboratory Organization and Safety: Essential equipment and materials for a plant tissue culture laboratory, Safety measures and precautionsinthelaboratory,Sterilizationtechniquesforlaboratory equipmentandmaterials	12
Unit 2	Plant Tissue Culture Media: Composition of plant tissue culture media(MS,MurashigeandSkoog),Preparationofvarioustypesof plant tissue culture media, Autoclaving and sterilization of media. SuspensionandCallusCultures:Establishmentandmaintenanceof suspension and callus cultures, Applications of suspension and calluscultures(secondarymetaboliteproduction,genetic engineering)	12
Unit 3	Micropropagation:Principlesandtechniquesofmicropropagation, Axillary bud proliferation, nodal culture, and shoot tip culture, In vitro rooting and acclimatization. PolyhouseandGreenhouseTechnology:Designandconstructionof polyhouses and greenhouses, Environmental control systems in polyhouses and greenhouses, Applications of polyhouses and greenhouses in plant tissue culture.	10
Unit 4	HardeningofMicropropagatedPlants:Importanceofhardening, Methods of hardening, Acclimatization to field conditions. Applications of Plant Tissue Culture: Production of haploids and doubledhaploids,Propagationofseedlessplants,Cryopreservation of plant germplasm, Genetic engineering of plants	11
Practical	Practicum: 1. Introduction to plant tissueculturelaboratoryset-up. 2. Preparationandsterilizationofplanttissueculturemedia (e.g. MS media). 3. Establishmentofsuspensionandcallusculturesfrom different plant materials. 4. Invitroculturesfromdifferentplantmaterials(e.g.,nodal segments, shoot tips). 5. Visitingalocalpolyhouse/greenhousefacility. 6. Hardeningofmicropropagatedplantsusingdifferent methods (e.g., misting chambers, cold frames).	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. Plant Tissue Culture: Techniques and Applications by Gamborg, Miller, and Ojima
2. Plant Tissue Culture: Theory and Practice by Bhojwani and Razdan
3. Plant Cell and Tissue Culture by Pais
4. Micropropagation: Theory and Practice by George and Rao
5. Plant Tissue Culture: A Laboratory Manual by Paul and Vasil
6. Plant Tissue Culture: A Practical Approach edited by Davey and Putter
7. Plant Biotechnology by S.K. Jain
8. Plant Tissue Culture and Biotechnology by S.C. Maheshwari and V.K. Bhatia
9. Handbook of Plant Cell and Tissue Culture edited by P.V. Ammal
10. In Vitro Culture of Plants by Murashige and Skoog

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

Undergraduate Programs

Course: VAC-3

Session:2025-26			
PartA-Introduction			
Subject	**Biotechnology**		
Semester	**IV**		
NameoftheCourse	**Fermented Foods**		
CourseCode	**BTY-VAC-315**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**VAC-3**		
Levelofthecourse(Asper Annexure-I	**300-399**		
Pre-requisite for the course (if any)	NA		
CourseLearningOutcomes(CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the principles of fermentation and microbial roles in fermented foods. 2. Identify various traditional and industrially fermented food products. 3. Analyse the nutritional, health, and economic significance of fermented foods. 4. Learn the methods of food preservation, safety, and quality control in fermented foods. 5. Develop awareness about entrepreneurship opportunities in the fermented food industry.		
Credits	Theory	Practical	Total
	2	0	2
ContactHours	2	0	2
Max. Marks:50 **InternalAssessmentMarks:15**(Theory) **EndTermExamMarks:35**(Theory)		**Time:3h(theory)**	
PartB-ContentsoftheCourse			
InstructionsforPaper- 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 settakingtwoquestionsfrom			

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

Unit	Topics	Contact Hours
I	Introduction to fermentation: history, types (lactic acid, alcoholic, acetic acid), key microbes involved (*Lactobacillus*, *Saccharomyces*, *Acetobacter*); Basic principles of microbial metabolism in fermentation.	8
II	Traditional Indian fermented foods: idli, dosa, curd, dhokla, kanji, gundruk, etc. Global fermented foods: sauerkraut, kimchi, tempeh, miso, kombucha, kefir, and yogurt.	8
III	Nutritional enhancement and health benefits of fermented foods: probiotics, prebiotics, gut microbiota interaction, bioactive compounds, safety and shelf-life.	7
IV	Industrial production of fermented foods (bread, cheese, beer, wine, vinegar, soy sauce); Fermentation technology; quality control and packaging; entrepreneurship potential in fermented foods.	7

Suggested Evaluation Methods

Internal Assessment: Theory	**End Term Examination: Theory**
➢ Class Participation: 4 marks ➢ Seminar/presentation/assignment/quiz/class test etc.: 4 marks ➢ Mid-Term Exam: 7 marks	Written Examination: 35 marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Steinkraus, K. H. (1996). *Handbook of Indigenous Fermented Foods*. Marcel Dekker.
2. Tamang, J.P. (2010). *Fermented Foods and Beverages of the World*. CRC Press.
3. Hutkins, R.W. (2006). *Microbiology and Technology of Fermented Foods*. Blackwell Publishing.
4. Campbell-Platt, G. (1994). *Fermented Foods of the World – A Dictionary and Guide*. Butterworths.
5. Ray, R.C. &Montet, D. (2014). *Fermented Foods, Part I: Biochemistry and Microbiology*. CRC Press.

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND

Undergraduate Programs

Course: VOC-3

Session:2025-26			
PartA-Introduction			
Subject	**Biotechnology**		
Semester	**V**		
NameoftheCourse	**FoodProcessing**		
CourseCode	**BTY-VOC-215**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-3**		
Levelofthecourse(Asper Annexure-I	**200-299**		
Pre-requisite for the course (if any)	NA		
CourseLearningOutcomes(CLO): (CLOs 1-4 of theory and 5th of practical)	Aftercompletingthiscourse,thelearnerwillbeableto: 1. Explain how different foods are deteriorated and how they can be processed/preserved. 2. Apply various processing/preservation techniques to different foods. 3. Analyze the effect of various preservation techniques on processed foods 4. Develop novel techniques/methods of food preservation and to evaluate their effect on food properties 5. Gets hands on training of tools and technique of foodprocessing.		
Credits	Theory	Practical	Total
	3	1	4
ContactHours	3	2	5
Max. Marks:100 **InternalAssessmentMarks:30**(20Theory+10Practical) **EndTermExamMarks:70**(50Theory+20 Practical)		**Time:3h(theory), 4h(practical)**	
PartB-ContentsoftheCourse			

InstructionsforPaper- 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 settakingtwoquestionsfrom eachunit.Thecandidateswillberequiredtoattempt Q.No.1& fourothersselectingone questionfromeachunit.Allquestionscarryequalmarks.

Unit	Topics	ContactHours
I	**Introduction:** Status of food processing - India *vs*developed world; Principles of food preservation; Causes of food deterioration; Water activity and its relation withfood spoilage **Processing and preservation by heat:** Heat resistance of microorganisms; Protective effect of food constituents; Blanching; Pasteurization; Sterilization and UHT processing; Effect on foods	12
II	**Processing and preservation by low temperature:** Refrigeration vs Freezing; Refrigeration system; Freezing curve; Factors affecting freezing rate; Freezing methods and equipment: Effects on foods. **Processing and preservation by dehydration:**Drying curve; Drying methods and equipment; Changes in food due to drying; Intermediate moisture foods(IMF).Packagingofdriedfoods,Deteriorationof driedfoods,Factorsaffectingdryingrate.	12
III	**Novel and emerging technologies for food preservation:** High pressure processing; Pulsed electric field; Hurdle technology; Ozone application; Ohmicheating;Microwaveheating;Technologiesfor sous-vide ready meals; Membrane technology- RO, NF, UF, MF and Electrodialysis; Membrane materials, Configuration and modules.	10
IV	**Processing of foods:** Concept and science of post-harvest technology, Fruits and vegetables processing and preservation, meat and poultry processing. **Concentration:** Methods; Equipment; Changes in Food during concentration **Irradiation in food preservation:** Source; Dose; Direct and indirect effects responsible for death/inactivation of microorganisms; Effect on foods.	11
V*	**ListofPractical:** 1. Determinationofwater activity. 2. Canningoffruitsandvegetables(Beverages). 3. Dehydrationoffruitsandvegetables 4. Preparationoftomatoproducts(Sauces,Soup,ketchup,) 5. Determination of chemical preservatives infruitsand vegetables products 6. Determination of microbial counts: Total viable,Psychrotrophic, Thermophilic.	30

	7. Aerobic & Anaerobic spore farmers, Coliform counts, Yeast and mold count.	

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. AK Haghi, Food Science: Research and Technology. Academic Press (2011).
2. D Singh, Food Processing and Preservation. Shree Publisher (2015).
3. DW Sun (2020) Thermal food processing new technology and quality issues, CRC Press.
4. F Chemat, Green Food Processing Techniques: Preservation Transformation and Extraction, Academic Press (2019).
5. G Saravakos and AK Kostaropoulos, Handbook of Food Process Equipment. Springer (2016).
6. GV Barbosa-canovas and Gould GW, Innovation in Food Processing. CRC Press (2017).
7. HS Ramaswamy and M Marcotte, Food Processing Principle and Application. Taylorand Francis (2006).
8. HW Xiao et al., Recent developments and trends in thermal blanching - A comprehensive review. Information Processing in Agriculture. Volume 4, 101-127 (2017).
9. J Boye, Green Technology in Food Production, CRC Press (2012).
10. J. Ahmed, Novel Food Processing, CRC Press (2018).
11. JS Smith and YH Hui, Food Processing. Wiley (2014).
12. K Kai, Innovative Food Processing Technologies. WP Publisher (2016).
13. M Regier, The Microwave Processing of Foods. Academic Press, (2017).
14. MC Knirsch (2010) Ohmic heating–a review. Trends in Food Science & Technology,21, 436-441.
15. NN Potter, Food Science. CBS Publishers (2007).
16. P Fellows, Food Processing Technology Principles and Practice. CRC Press (2005).
17. P Putnik, JM Lorenzo, FJ Barba et al., Novel food processing and extraction technologies of high-added value compounds from plant materials. Foods, 7(7), 106(2018).

CHAUDHARYRANBIRSINGHUNIVERSITY,JIND

UndergraduatePrograms

Course: VOC-4

Session:2025-26			
PartA-Introduction			
Subject	**Biotechnology**		
Semester	**VI**		
NameoftheCourse	**DNA Fingerprinting**		
CourseCode	**BTY-VOC-315**		
Course Type: (CC/MCC/MDC/CC-M /DSEC/VOC/DSE/PC/AEC/VAC)	**VOC-4**		
Levelofthecourse(Asper Annexure-I	**300-399**		
Pre-requisite for the course (if any)	NA		
CourseLearningOutcomes(CLO): (CLOs 1-4 of theory and 5th of practical)	After completing this course, the learner will be able to: 1. Understand the principles and history of DNA fingerprinting and its molecular basis. 2. Perform DNA extraction, PCR amplification, and gel electrophoresis techniques. 3. Interpret DNA fingerprinting profiles for identity verification and genetic analysis. 4. Apply DNA fingerprinting in various fields such as forensic science, paternity testing, biodiversity conservation and agriculture. 5. Gain hands-on training in DNA isolation, PCR setup, electrophoresis, and analysis of DNA profiles.		
Credits	Theory	Practical	Total
	3	1	4
ContactHours	3	2	5
Max. Marks:100 **InternalAssessmentMarks:30**(20Theory+10Practical) **EndTermExamMarks:70**(50Theory+20 Practical)		**Time:3h(theory), 4h(practical)**	
PartB-ContentsoftheCourse			

InstructionsforPaper- 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 settakingtwoquestionsfrom eachunit.Thecandidateswillberequiredtoattempt Q.No.1& fourothersselectingone questionfromeachunit.Allquestionscarryequalmarks.

Unit	Topics	ContactHours
I	Introduction and History of DNA Fingerprinting; Genetic markers – RFLP, VNTRs, STRs, SNPs; DNA structure, gene, and genome organization; Ethical and legal issues.	12
II	Methods of DNA extraction from biological samples: Quality and quantity assessment; PCR principles and applications; Primer designing and optimization.	12
III	Gel electrophoresis – principles and types; Visualization of DNA using stains; Southern blotting; STR profiling techniques; Capillary electrophoresis.	10
IV	Applications of DNA fingerprinting: Forensics, paternity testing, wildlife forensics, agriculture, and microbial identification; Case studies and interpretation of results.	11
V*	**List of Practical:** • DNA extraction from plant/animal/human samples • PCR amplification of target genes • Agarose gel electrophoresis of PCR products • Use of gel documentation system • Analysis of STR markers • Simulated case study for paternity or forensic identification	30

SuggestedEvaluationMethods

InternalAssessment:	End Term Examination:
➢ **Theory-20** • ClassParticipation:5 • Seminar/presentation/assignment/quiz/classtestetc.:5 • Mid-TermExam: 10 ➢ **Practicum-10** • ClassParticipation: • Seminar/Demonstration/Viva-voce/Labrecordsetc.:10 • Mid-TermExam: NA	**50 (Theory);** **20 (Practical) -** Evaluation of the practicalskillwillbe done by an external examiner.

PartC-LearningResources

RecommendedBooks/e-resources/LMS:

1. Primrose, S.B. &Twyman, R.M. Principles of Gene Manipulation and Genomics. Blackwell Publishing.
2. Kumar, H.D. A Textbook on Biotechnology. Affiliated East West Press.
3. Watson, J.D. et al. Molecular Biology of the Gene. Pearson Education.
4. Brown, T.A. Genomes. Garland Science.
5. Shrivastava, M. Forensic DNA Typing: Principles, Applications and Ethics. Springer.
6. Butler, J.M. Fundamentals of Forensic DNA Typing. Elsevier.
7. Online databases: NCBI, Ensembl, Forensic Science journals.