



Shiromani Gurudwara Parbandhak Committee's

Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)

Matunga, Mumbai – 400 019, Maharashtra

Program: Bachelor of Science

Syllabus

Course: TYBSc

Semester V and VI

(Name of Subject: Biotechnology)

(As per NEP guidelines-DSC model)

With effect from Academic Year 2025 - 2026)



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Program Structure
Semester- V

Course Name	Teaching Hours		Credits Assigned			Marks		
	Theory	Practical	Theory	Practical	Total	Theory	Practical	Total
Major-Paper-I (Cell biology)	45	30	3	1	4	75	25	100
Major-Paper-II (Medical microbiology and instrumentation)	45	30	3	1	4	75	25	100
Major- Paper- III (Genomes and molecular biology)	45	30	3	1	4	75	25	100
Elective Paper 1 (Marine Biotechnology) 2 (Food Biotechnology and Biosafety)	45	30	3	1	4	75	25	100
Vocational Skill Course (VSC) (Biostatistics and Research methodology)	--	60	--	2	2		50	50
OJT- On Job Training	--	--	--	--	4	--	--	100
	180	180	12	6	22	300	150	550

Semester-VI

Course Name	Teaching Hours		Credits Assigned			Marks		
	Theory	Practical	Theory	Practical	Total	Theory	Practical	Total
Major Paper-I (Biochemistry)	45	30	3	1	4	75	25	100
Major Paper-II (Industrial Biotechnology)	45	30	3	1	4	75	25	100
Major Paper- III (Environmental Biotechnology)	45	30	3	1	4	75	25	100
Elective Paper 1 (Plant and Animal Tissue Culture) 2 (Agricultural Biotechnology)	45	30	3	1	4	75	25	100
Minor Paper (Bioinformatics)	15	30	1	1	2	25	25	50
Co-curricular Course (CC)	--	--	--	--	2	--	--	50
Field project (FP)	--	--	--	--	2	--	--	50
	195	150	12	6	22	325	125	550



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Arts

PROGRAMME OUTCOMES (PO)

BACHELOR OF SCIENCE (BSc)

Undergraduate Science Program Outcomes:

PO1	Foundational Understanding: Develop a foundational understanding of core scientific principles and theories across various disciplines of science.
PO2	Analytical Skills: Develop analytical and problem-solving skills to critically analyse scientific problems and apply scientific methodologies.
PO3	Global Perspective: Gain a global perspective by understanding diverse scientific issues and incorporating ethical considerations in scientific practices.
PO4	Research Awareness: Gain awareness of research methodologies and techniques, preparing for future research endeavours.
PO5	Holistic Development: Experience holistic development by embracing values of humanism, empathy, and social responsibility in scientific pursuits.
PO6	Communication Skills: Enhance communication skills to effectively convey scientific concepts to diverse audiences.
PO7	Continuous Learning: Develop a commitment to lifelong learning and staying updated with advancements in science.
PO8	Ethical Practices: Understand and adhere to ethical standards in scientific research and practice.



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Programme: BSc Biotechnology

Programme Specific Outcomes (PSOs) for BSc in Biotechnology

Sr. No.	A student completing BSc in Biotechnology will be able to:
PSO 1	Develop proficiency in basic sciences alongside a comprehensive understanding of biotechnology and chemical science principles, establishing a strong foundation for advanced studies through an interdisciplinary perspective
PSO 2	Demonstrate comprehensive understanding of fundamental concepts in biotechnology, including molecular biology, microbiology, biochemistry, genetics, and cell biology, and apply this knowledge in academic, industrial, and research settings.
PSO 3	Apply knowledge of fundamental biological processes across molecular, cellular, industrial, and environmental contexts.
PSO 4	Acquire proficiency in standard laboratory techniques such as DNA/RNA isolation, gel electrophoresis, PCR, spectrophotometry, chromatography, microbial culturing, and aseptic techniques essential for biotechnological applications.
PSO 5	Analyze, interpret, and reflect on information or data to address problems in the field of biotechnology and acquire scientific and entrepreneurial skills to devise sustainable solutions to current real-world issues.
PSO 6	Integrate concepts from allied sciences including chemistry, physics, mathematics, and computer science with biotechnology to strengthen problem-solving and research capabilities.
PSO 7	Understand the principles of industrial biotechnology, bioprocess engineering, and intellectual property rights, developing skills necessary for employment in biotechnology industries, quality control laboratories, or for pursuing entrepreneurial ventures.
PSO 8	Develop effective communication skills and the ability to work both independently and in teams within the scope of scientific research writing, while demonstrating the capacity to present innovative ideas and research findings effectively.
PSO 9	Demonstrate awareness of ethical, legal, and social aspects of biotechnology research and applications, and commit to responsible and sustainable practices for the betterment of society and the environment.



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-V: Major I

Course Title: Cell Biology

Course Code: GNKUSBTMJ1105

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims to :	
1	Identify and describe the key events taking place in mitosis and interphase of eukaryotic cell cycle
2	Explain the significance of regulation of cell cycle progression and cell cycle checkpoints
3	Gain an insight into principal modes of cell signalling and pathways of apoptosis
4	Develop an understanding of role of oncogenes and tumor suppressor genes in cancer
5	Examine the types, causes, prevention, diagnosis and treatment of cancer

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Outline the phases of the eukaryotic cell cycle and summarize the role of key regulatory components such as CDKs, cyclins, growth factors, etc.	PO 1, 2	PSO 1, 2, 3	R, U
CO 2	Evaluate the consequences of checkpoint failure and deregulation in cell cycle control.	PO 1, 2, 3	PSO 2, 3, 5	E
CO 3	Review the signal transduction mechanisms involving cAMP, PI-derived molecules, and calcium-calmodulin pathways.	PO 1, 2	PSO 2, 3, 6	U, An
CO 4	Assess the role of calcium as a versatile intracellular messenger across different signaling pathways and summarise molecular mechanisms of apoptosis	PO 2, 4	PSO 2, 3, 5	E
CO 5	Explain the factors that contribute to cancer development, discuss cancer prevention and currently available therapeutic treatments.	PO 1, 3, 5, 8	PSO 2, 5, 9	U, Ap

CO 6	Recognize various genetic and molecular changes which take place during transformation into malignant cells.	PO 1, 2, 4, 8	PSO 2, 3, 5	U
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Unit		Cell biology	No. of lectures	CO Mapping
Unit 1		Cell cycle	15	
	1.1	Eukaryotic cell cycle: Phases, Regulation by cell growth and extracellular signals, cell cycle checkpoints.		CO 1, 2
	1.2	Regulators of cell cycle progression: Protein kinases, MPF, Families of CDK and Cyclin, Growth factors and regulation of G1 CDK		CO 1, 2
	1.3	Role of CDK1/Cyclin B in Metaphase of Mitosis		CO 1
Unit 2		Cell signalling	15	
	2.1	Basic elements of cell signaling systems		CO 3
	2.2	GPCR's, cAMP- as secondary messengers, PI derived secondary messenger		CO 3
	2.3	Protein tyrosine phosphorylation, Role of Calcium as intracellular messenger, Ca- Calmodulin		CO 3, 4
	2.4	Apoptosis		CO 4
Unit 3		Cancer	15	
	3.1	Introduction: Types of cancer, properties of cancer cells, causes of cancer, development of cancer, Cancer diagnosis and therapy - historical perspective, Contribution of Indian scientists		CO 5, 6
	3.2	Molecular Genetics of Cancer: Oncogenes and tumor suppressor gene		CO 5, 6
	3.3	Cancer and Virus: Tumor viruses: Hepatitis virus, Papilloma virus, Herpes virus, Retrovirus.		CO 5
	3.4	Prevention, Diagnosis, Treatment of Cancer: 1. Prevention and Early Detection: Molecular Diagnosis 2. New strategies for combating cancer: Immunotherapy, Inhibition of Angiogenesis, Oncogene targeted therapies.		CO 5, 6

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. JohnWiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-V: Major I

Course Title: Practicals in Cell Biology

Course Code: GNKUSBTMJ1P105

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims:	
1	To introduce students to fundamental techniques in cellular and molecular biology relevant to laboratory research.
2	To develop hands-on skills in performing biochemical assays and analyzing enzymatic activities.
3	To provide an understanding of the effects of chemical agents on cell division and their implications in therapeutic studies.
4	To prepare students for advanced studies or research by building foundational lab-based problem-solving capabilities.
5	To introduce modern analytical tools such as flow cytometry for cell analysis and characterization.
6	To encourage scientific inquiry and critical thinking through case studies and assignment-based learning.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand and apply basic biochemical and cellular techniques to assess enzyme activities and cellular processes.	PO1, 2, 4	PSO2, 4, 5	U, Ap
CO 2	Demonstrate the ability to conduct experiments related to cell division and analyze the effects of various modulators.	PO2, 4, 7	PSO2, 5, 6	Ap, An
CO 3	Apply in vitro assay techniques to study biological activities such as inflammation and protein denaturation.	PO2, 4	PSO2, 5, 6	U, Ap
CO 4	Understand the principle and working of modern analytical tools	PO1, 4, 6	PSO2, 4, 5	Ap

	such as flow cytometry for cellular analysis.			
CO 5	Develop critical thinking through literature review or case-based assignments on contemporary biomedical issues.	PO3, 5, 7	PSO5, 9	U
CO 6	Demonstrate staining and microscopic techniques to study subcellular organelles and cellular morphology.	PO2, 4, 6	PSO2, 4	E,C

List of Experiments:

1. Determination of membrane integrity using beetroot cells
2. Effect of inhibitor on mitosis
3. Study of cancer cell lines
4. Anti-inflammatory assay using BSA / egg albumin
5. Demonstration of flow cytometer
6. Case study of Cancer- Assignment
7. Isolation of mitochondria
8. Staining of mitochondria by Janus Green method

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-V: Major II

Course Title: Medical microbiology and instrumentation

Course Code: GNKUSBTMJ2105

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To provide foundational knowledge about the nature, structure, and classification of viruses.
2	To explain viral replication mechanisms in various biological systems.
3	To describe the cultivation, purification, and quantification methods for viruses.
4	To explain the principles of discovery, design, and classification of antimicrobial agents.
5	To introduce the working principles and applications of advanced chromatographic techniques.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Describe the general characteristics, structure, and classification systems of viruses.	PO1, 2	PSO1, 2	U
CO 2	Explain viral replication strategies in different host systems.	PO1, 2, 4	PSO2, 3, 5	U
CO 3	Summarize common techniques used for the cultivation, purification, and quantification of viruses.	PO2, 4, 6	PSO4, 6	U, Ap
CO 4	Recognize the significance of viroids and prions in disease development.	PO1, 3, 7	PSO2, 5, 9	R, U
CO 5	Identify the key principles behind the discovery and design of antimicrobial agents.	PO1, 2, 4	PSO2, 5, 7	R, U
CO 6	Explain how different antimicrobial agents exert their effects on microbial cells.	PO2, 4, 6	PSO2, 5, 6	U

CO7	Describe the principles, instrumentation, and applications of chromatographic and radioisotopic techniques used in biological research.	PO2, 4, 6	PSO2, 5, 6	U
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Unit		Medical microbiology and instrumentation	No. of lectures	CO Mapping
Unit 1		Virology	15	
	1.1	Introduction to viruses-Position in biological spectrum; Virus properties		
	1.2	General structure of viruses, Baltimore Classification and Taxonomy(ICTV), Cultivation of viruses		CO 3
	1.3	Reproduction of ds DNA phages, animal and plant virus with examples		CO 2
	1.4	Virus purification and assays, Cytocidal infections and cell damage, Viroids and Prions		CO 3,CO 4
Unit 2		Chemotherapeutics	15	
	2.1	Discovery and Design of antimicrobial agents, Classification of Antibacterial agents, Selective toxicity, MIC, MLC		CO 5
	2.2	Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics :Penicillin, Cephalosporin Glycopeptides: Vancomycin Polypeptides: Bacitracin Injury to Plasma membrane: Polymyxin Inhibition of protein synthesis: Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides-Erythromycin Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole Antimetabolites: Sulphonamides, Trimethoprim		CO 6
	2.3	Drug Resistance: Mechanism, Origin and transmission of drug resistance		CO 6
	2.4	Use and misuse of antimicrobial agents, Antifungal drugs, Antiviral drugs Antimicrobial therapy - Contribution of Indian scientists, Use of Indian traditional medicines as antimicrobial agents		CO 6
Unit 3		Bioanalytical techniques	15	
	3.1	Principle, working and applications of: Affinity chromatography, Ion exchange chromatography, Molecular (size) exclusion chromatography,		CO7

		HPLC, HPTLC		
	3.2	Isotopes in Biology, Nature of radioactivity		CO7
	3.3	Detection Techniques using GM counter, Scintillation counter (liquid and solid), autoradiography, Applications of Tracer techniques in Biology		CO7

References:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
2. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
3. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan, John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.
5. Mim's Medical Microbiology 5th edition
6. Microbiology by Prescott Harley and Klein 5th edition McGraw Hill
7. Medical Microbiology Jawetz E, Brooks. G. E, Melnick. J. L, Butel. J. S, Adelberg E. A 18th edition
8. Medical Microbiology by Patrick Murray 5th edition
9. Foundations in Microbiology by Talaro and Talaro Third edition W.C Brown
10. Understanding Viruses by Teri Shors

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-V: Major II

Course Title: Practicals in Medical microbiology and instrumentation

Course Code: GNKUSBTMJ2P105

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to standard laboratory techniques used in microbiology and bioanalytical chemistry.
2	To develop practical skills for assessing the effectiveness of antimicrobial agents.
3	To provide foundational knowledge of separation and purification techniques for biomolecules.
4	To enhance students' ability to analyze, interpret, and document experimental results.
5	To cultivate ethical practices and safety awareness in handling laboratory materials.
6	To encourage critical thinking and problem-solving in the design and execution of experiments.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Demonstrate proficiency in standard laboratory methods used in antimicrobial testing.	PO2, 4, 6	PSO2, 4, 5	Ap
CO 2	Apply principles of chromatography for separation and analysis of biological or chemical samples.	PO2, 4, 6	PSO1, 4, 6	Ap
CO 3	Analyze experimental data to evaluate the effectiveness of antibiotics or purification processes.	PO2, 5, 7	PSO2, 5, 6	An
CO 4	Interpret scientific results and communicate findings effectively using standard reporting formats.	PO6, 8	PSO8	An, E
CO 5	Follow laboratory safety and ethical guidelines in microbiological and biochemical practices.	PO5, 8	PSO4, 9	U, E
CO 6	Evaluate the interactions of biological agents or chemicals using experimental models.	PO2, 4, 5	PSO3, 5, 6	E

List of Experiments:

1. MIC and MLC of any one antibiotic
2. Antibiotic sensitivity test using agar cup method
3. Antibiotic sensitivity test using paper disc method
4. Antibiotic sensitivity test using ditch method
5. Synergistic action of two drugs
6. Separation of components from a mixture using Affinity chromatography and analysis by PAGE
7. Study of ion exchange chromatography and Size exclusion chromatography

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-V: Major III

Course Title: Genomes and molecular biology

Course Code: GNKUSBTMJ3105

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce the fundamental concepts of molecular biology and recombinant DNA technology.
2	To familiarize students with various molecular tools, cloning vectors, and gene manipulation strategies.
3	To develop a conceptual understanding of techniques involved in gene isolation, cloning, and expression.
4	To provide insights into gene sequencing and genome editing tools and their applications.
5	To build a foundation for advanced research in molecular genetics and functional genomics.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Recall the principles and tools used in molecular biology and genetic engineering.	PO1, 7	PSO1, 2	R
CO 2	Understand the structure, types, and functions of cloning and expression vectors.	PO1, 2	PSO1, 2, 3	U
CO 3	Apply recombinant DNA techniques for gene cloning and expression analysis.	PO1, 2, 4	PSO2, 3, 4	Ap
CO 4	Analyze screening and selection techniques for identifying recombinant clones.	PO2, 4	PSO3, 4, 5	An
CO 5	Evaluate sequencing methods and gene editing tools such as CRISPR, TALENs, and RNAi.	PO1, 2, 4, 7	PSO3, 5, 6, 9	E

CO 6	Demonstrate understanding of genetic engineering approaches in plant and animal systems.	PO1, 2, 3	PSO3, 6, 7	U, Ap
CO 7	Assess the methodologies for generating transgenic organisms and their applications in biotechnology.	PO2, 3, 4	PSO5, 6, 7, 9	E

Unit		Genomes and molecular biology	No. of lectures	CO Mapping
Unit 1		Tools in Molecular Biology	15	
	1.1	Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors; expression vectors pET;		CO2
	1.2	Recombinant DNA Technology - Historical perspective, Gene cloning-Strategies of isolation of gene of interest & generation of recombinant DNA molecule		CO1,3
	1.3	Expression of cloned DNA molecules and maximization of expression; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping.		CO4,3
Unit 2		Gene sequencing and editing	15	
	2.1	Selection of recombinant clones – Selection of clones containing recombinant vectors, Selection of the clone containing a specific DNA insert, Hybrid arrest translation (HART), Hybrid release translation (HRT).		CO4
	2.2	Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing		CO5
	2.3	RNAi, ZNF(Zinc finger nucleases), TALENS(Transcription Activator Like Effector Nucleases), CRISPER/Cas system(Clustered Regularly Interspersed Repeats)		CO5
Unit 3		Genetic engineering of plants and animals	15	
	3.1	Genetic engineering of plants: Methodology-Plant transformation with the Ti plasmid of A.tumefaciens, Ti plasmid derived vector system. Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion.		CO6
	3.2	Transgenic mice:methodology - retroviral method, DNA microinjection, ES method. Transgenic animal recombination system; Genetic manipulation with cre-loxP		CO6
	3.3	Applications of transgenic plants and animals		CO7

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology 3rd Edition S.S. Purohit.
5. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: T.Y.B.Sc. Biotechnology Practical

Semester-V: Major III

Course Title: Practicals in Genomes and molecular biology

Course Code: GNKUSBTMJ3P105

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to fundamental molecular biology techniques.
2	To develop practical skills in gene manipulation and bacterial transformation.
3	To enable understanding and application of restriction digestion, ligation, and cloning.
4	To familiarize students with PCR and gene expression analysis techniques.
5	To encourage accurate data analysis and scientific reporting.
6	To promote teamwork, biosafety, and ethical practices in genetic experiments.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Apply basic molecular biology methods for analyzing and manipulating genetic material.	PO1, 2	PSO2, 3	Ap
CO 2	Demonstrate understanding of gene cloning processes and transformation techniques.	PO1, 4	PSO2, 3, 4	U, Ap
CO 3	Utilize DNA amplification and enzymatic techniques to study genetic materials.	PO2, 4	PSO6, 3, 4	Ap
CO 4	Analyze results from molecular biology experiments using standard laboratory procedures.	PO2, 6	PSO4, 5, 6	An
CO 5	Record, organize, and interpret data with attention to scientific accuracy and clarity.	PO6, 4	PSO5, 8	An, E
CO 6	Practice laboratory safety and follow ethical guidelines in handling biological materials.	PO3, 5, 8	PSO4, 9	U, E

List of Experiments:

1. Transformation in *E. coli*
2. Restriction enzyme digestion and ligation
3. Phage titration: Demonstration
4. Gradient plate technique

5. Bacterial gene expression
6. Polymerase chain reaction

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology
Semester-V: Elective I
Course Title: Marine Biotechnology
Course Code: GNKUSBTEL1105
Credits: 3
No of lectures (Hours): 45
Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the fundamentals of marine biotechnology and marine ecosystems.
2	To develop an understanding of marine bioresources with pharmaceutical and industrial applications.
3	To explore the significance of marine microorganisms and enzymes in biotechnology.
4	To raise awareness of the potential and challenges of marine bioprospecting in applied science.
5	To encourage responsible and sustainable utilization of marine biodiversity.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Describe the structure and ecological roles of various marine ecosystems.	PO1, 3	PSO1, 3	U
CO 2	Explain the concept and methods of marine bioprospecting.	PO2, 4	PSO2, 5, 6	U, Ap
CO 3	Identify marine organisms and microorganisms with biotechnological relevance.	PO1, 2	PSO2, 3	R, U
CO 4	Discuss the sources and uses of marine-derived pharmaceutical compounds.	PO1, 4, 7	PSO2, 3, 6	U, An
CO 5	Analyze the role and current applications of marine enzymes in industrial biotechnology.	PO2, 4	PSO3, 6	An, Ap
CO 6	Evaluate the health and commercial potential of marine functional foods and nutraceuticals.	PO2, 5	PSO3, 5, 7	E
CO 7	Assess the use of marine-derived ingredients in cosmetics and personal care.	PO3, 5, 6	PSO5, 7, 9	An, E

Unit		Marine Biotechnology	No. of lectures	CO Mapping
Unit 1		Marine Biotechnology-Introduction & Bio-prospecting	15	
	1.1	Introduction to Marine Biotechnology - The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents		CO1
	1.2	Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms; Methods for Microbial Bioprospecting in Marine Environments		CO1,2
	1.3	Approved marine drugs as pharmaceuticals		CO4
Unit 2		Marine Drugs and Enzymes	15	
	2.1	Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents		CO4,5
	2.2	Approved Marine Drugs as Pharmaceuticals; Marine Natural products and its Challenges		CO4,5
	2.3	Marine Microbial Enzymes Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes		CO3,4,5
Unit 3		Marine Functional foods, Nutraceuticals and Cosmetics	15	
	3.1	Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients, Marine- Derived Ingredients with Biological Properties, Functional Foods Incorporating Marine-Derived Ingredients		CO1,5
	3.2	Marine Bio-actives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids, Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics		CO6,7
	3.3	Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmeceuticals, Target Organs and Cosmetics, Delivery Systems, Treatments Based on Marine Resources, Products		CO6,7

		Based on Marine Resources		
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References:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L-Marine microorganisms-extraction and analysis of bioactive compounds CRC Press Taylor& Francis (2017)
3. R. S. K. Barnes, R. N. Hughes (auth.)-An Introduction to Marine Ecology, Third Edition Wiley-Blackwell (1999)
4. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
6. W. Evans-Trease and Evans Pharmacognosy 15th Edition-Saunders (2010)
7. Industrial Microbiology by Prescott and Dunn's- 4th Edition
8. Industrial Microbiology by L.E.Casida, JR.
9. Industrial Microbiology by A. H. Patel
10. Principles of Fermentation Technology by P. F. Stanbury, A. Whitaker and S. J. Hall

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-V: Elective I

Course Title: Practicals in Marine Biotechnology

Course Code: GNKUSBTEL1P105

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To familiarize students with marine microbial and algal diversity through laboratory practices.
2	To provide hands-on experience in the extraction and analysis of marine-derived bioactive compounds.
3	To introduce fundamental techniques used in marine bioproduct development.
4	To enhance observational, analytical, and reporting skills in marine biotechnology experiments.
5	To instill awareness of sustainable and ethical practices in marine bioresource utilization.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Identify and characterize selected marine bacteria and algae.	PO1, 2	PSO1, 2, 3	R, U
CO 2	Perform assays to evaluate antioxidant activity in marine bioresources.	PO2, 4	PSO3, 5	Ap, An
CO 3	Extract and analyze carotenoids and gelatin from marine organisms.	PO2, 4	PSO3, 6	Ap
CO 4	Demonstrate the ability to cultivate selected marine or coastal organisms (e.g., mushrooms).	PO1, 4	PSO3, 4, 6	Ap, U
CO 5	Understand the design and types of fermenters used in marine biotechnology.	PO1, 6	PSO6, 7	U
CO 6	Record, organize, and interpret lab data with scientific accuracy and ethical considerations.	PO5, 6, 8	PSO5, 8, 9	An, E

List of Experiments:

1. Study of any 3 marine bacteria and algae (Macro and micro)
2. DPPH assay for antioxidant extracted from marine algae
3. Extraction of carotenoids from marine algae/Bacteria/Fungi
4. Extraction and estimation of Gelatin

5. Cultivation of Mushrooms.
6. Different types of fermenters- Assignment

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-V: Elective II

Course Title: Food Biotechnology and Biosafety

Course Code: GNKUSBTEL2105

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce fundamental concepts of food preservation and safety in biotechnology.
2	To familiarize students with conventional and emerging food preservation techniques.
3	To build knowledge on food contamination, regulatory testing, and biosafety measures.
4	To explore microbiological and chemical hazards in food systems.
5	To understand modern analytical and detection tools for food quality assurance.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand the basic principles of food safety, preservation, and biosafety.	PO1, 3	PSO1, 2	U
CO 2	Describe physical and chemical methods used in food preservation.	PO1, 7	PSO2, 3	R, U
CO 3	Evaluate the efficacy of emerging preservation technologies and their applications.	PO2, 4, 8	PSO3, 5, 6	E
CO 4	Analyze the sources of microbial contamination in food and pharmaceuticals.	PO1, 2	PSO2, 5	An
CO 5	Demonstrate understanding of microbial assays and regulatory testing protocols.	PO2, 4	PSO2, 6	U, Ap
CO 6	Identify food-related hazards and describe safety assurance techniques.	PO1, 5	PSO3, 9	U, An

Unit		Food Biotechnology and Biosafety	No. of lectures	CO Mapping
Unit 1		GLP and biosafety in biotechnology	15	
	1.1	Concept of GLP, Practicing GLP		CO1,5
	1.2	Preparation of SOPs, Calibration records; Validation of methods		CO6
	1.3	Concepts on biosafety in Biotechnology, Biological Risk Assessment, Hazardous Characteristics of an agent, Genetically modified agent..		CO6
	1.4	Cell cultures, Hazardous Characteristics of Laboratory Procedures		CO5
	1.5	Potential Hazards Associated with Work Practices, Safety Equipment and Facility Safeguard, Pathogenic risk and management, Regulating rDNA technology, Genetically engineered crops, livestock, Bioethics		CO5
Unit 2		Detection And Testing of Contaminants	15	
	2.1	Microbial Contamination in food and pharma product; Some common microbial contaminants		CO5,6
	2.2	Microbiological Assays for pharmaceutical products		CO5,6
	2.3	Regulatory Microbiological testing in pharmaceuticals.		CO6
	2.4	Regulating food and food ingredients		CO6
Unit 3		Food Safety And Quality Assurance	15	
	3.1	Food Hazards: Microbial: bacterial, fungal, protozoal, viral, emerging food pathogens. Non microbial: adulteration, natural/artificial coloring agents, metals, etc.		CO1,6
	3.2	Food analysis: Sensory, chemical, microbiological, rapid detection methods, CDC programs – pulse Net, Food Net.		CO1,2,6
	3.3	Safe Process Design and Operation: Food Hygiene and sanitation, risk assessment, flow sheets		CO4,5

	3.4	Food Standards and Laws: National, International legislation and agencies governing food and its quality		CO5
	3.5	Food packaging: food and food packaging interaction, shelf life testing, transportation and storage, emerging trends in food packaging		CO4,5,6

References:

1. Pharmaceutical Microbiology-Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. Biosafety in Microbiological and Biomedical Laboratories-5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R. Pasternak, J.J Patten, C.L 3rd edition ASM press
4. Food Microbiology by William C. Frazier and Dennis C. Westhoff – 4th Edition

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-V: Elective II

Course Title: Practicals in Food Biotechnology and Biosafety

Course Code: GNKUSBTEL2P105

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To familiarize students with validation and calibration procedures of laboratory instruments used in food biotechnology.
2	To develop skills in bioassay techniques for food components and nutritional compounds.
3	To enhance awareness of common adulterants and methods of food safety testing.
4	To introduce standard operating procedures (SOPs) for equipment and ensure compliance with good laboratory practices.
5	To cultivate skills in identifying microbial contamination and assessing food preservatives' efficacy.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Demonstrate basic skills in validating and calibrating essential lab instruments for food analysis.	PO1, 2, 6	PSO1, 4	Ap
CO 2	Perform microbiological and biochemical assays related to food quality, such as vitamin estimation.	PO2, 4	PSO2, 3, 4	Ap
CO 3	Identify and detect adulterants in food products using standard testing methods.	PO2, 3, 5	PSO3, 5, 9	An
CO 4	Prepare standard operating procedures (SOPs) for routine lab instruments, ensuring reproducibility and compliance.	PO4, 6, 8	PSO4, 8, 9	C
CO 5	Assess sterility and microbial contamination in food and pharmaceutical samples.	PO1, 2, 5	PSO2, 5, 9	E
CO 6	Evaluate the effectiveness of food preservatives through Minimum	PO2, 4, 7	PSO3, 5, 6	E

	Inhibitory Concentration (MIC) testing.			
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List of Experiments:

1. Validation of micropipette, measuring cylinders, colorimeters
2. Calibration of pH meter and weighing balance
3. Vitamin B12 bioassay
4. Testing for adulterants in food; ex. Tea, Coffee, Chili powder, Milk and Burra sugar.
5. Making SOP for any 2 major laboratory instruments
6. Sterility of injectable.
7. Isolation of food spoilage organisms
8. MIC of salt/sugar/chemical preservatives.

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



**Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology**

Course: T.Y.B.Sc. Biotechnology Practicals
Semester-V: Vocational Skill Course (VSC)
Course Title: Biostatistics and Research methodology
Course Code: GNKUSBTVSC105
Credits: 2
No of lectures (Hours): 60
Marks: 50

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to basic statistical concepts and their application in experimental data analysis.
2	To develop an understanding of hypothesis testing as a tool for scientific decision-making.
3	To familiarize students with fundamental statistical tests and their appropriate use in various scenarios.
4	To encourage accurate and ethical analysis and reporting of experimental outcomes.
5	To promote clear and effective communication of research findings through written reports and visual presentations.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Introduction of fundamental statistical concepts for analyzing and interpreting scientific data.	PO1, 2, 6	PSO1, 4	E
CO 2	Understanding the process of hypothesis testing as a basis for drawing conclusions from experimental results.	PO2, 4	PSO2, 3, 4	E
CO 3	Interpretation of p-values, significance levels, and confidence intervals for informed decision-making.	PO2, 3, 5	PSO3, 5, 9	An, Ap
CO 4	Presentation of research findings in a clear, structured manner through posters and written reports.	PO4, 6, 8	PSO4, 8, 9	C

CO 5	Integration of statistical literacy into broader scientific problem-solving and data-driven inquiry.	PO1, 2, 5	PSO2, 5, 9	Ap, An
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List of Experiments:

1. Gaussian distribution and testing for normality
2. Test of Significance. Steps in Hypothesis testing: Theory of errors-Type I and Type II errors, Null hypothesis, P values-one v/s two tail P values, Confidence intervals
3. z test- Single mean and two mean
4. f test, t test- Single mean, paired and unpaired
5. Chi square test (Test of Goodness of fit and Test of independence of attributes)
6. Research paper presentation / poster presentation.

Total Marks: 50

- **Experiment Marks: 40 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-VI: Major I

Course Title: Biochemistry

Course Code: GNKUSBTMJ1106

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To describe the pathways and regulatory mechanisms involved in carbohydrate metabolism across bacteria, plants, and animals.
2	To explain the biosynthesis and functional roles of peptidoglycan and extracellular polysaccharides in prokaryotes.
3	To illustrate the biosynthetic processes and control of glycogen, starch, and sucrose metabolism in different biological systems.
4	To differentiate the origin, structure, and biochemical roles of hormones secreted by major endocrine glands.
5	To integrate concepts of metabolism and endocrinology to formulate mechanisms of hormonal regulation under normal and pathological conditions.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Define fundamental concepts and terminologies related to metabolism and hormonal regulation	PO1, 7	PSO1, 2	R
CO 2	Explain the biochemical basis of metabolic pathways and endocrine functions.	PO1, 2	PSO2, 3	U
CO 3	Analyze the role of key biomolecules in maintaining physiological homeostasis.	PO2, 5, 8	PSO3, 5, 9	An
CO 4	Illustrate the interconnections between metabolic reactions and their regulatory mechanisms.	PO1, 2, 4	PSO2, 3, 4	U/An
CO 5	Compare the regulatory mechanisms of energy metabolism in animals, plants, and microbes.	PO2, 3, 7	PSO3, 6, 9	An/E

CO 6	Apply the acquired knowledge to interpret metabolic changes under hormonal influence.	PO2, 4, 6	PSO3, 5, 8	Ap
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Unit		Biochemistry	No. of lectures	CO Mapping
Unit 1		Carbohydrate Metabolism	15	
	1.1	Carbohydrate biosynthesis and regulation: Peptidoglycan and extracellular polysaccharides in bacteria,		CO1,5
	1.2	Biosynthesis and regulation of glycogen in animals, galactose		CO5
	1.3	Biosynthesis and regulation of Starch and sucrose in Plants		CO5
Unit 2		Lipid Metabolism	15	
	2.1	Biosynthesis and regulation of fatty acids,		CO3,5
	2.2	Biosynthesis and regulation of cholesterol		CO3,5
	2.3	Biosynthesis and regulation of triacylglycerol and membrane phospholipids		CO3,5
Unit 3		Endocrinology	15	
	3.1	Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus Anterior Pituitary gland -GH, stimulating hormones; Posterior Pituitary gland oxytocin and vasopressin Pancreas –insulin and glucagon		CO2,3,4
	3.2	Thyroid gland- Thyroxine, calcitonin Parathyroid gland - PTH Adrenal medulla - epinephrine and norepinephrine Adrenal cortex- Glucocorticoids		CO3,4
	3.3	Female Gonads –estrogen and progesterone Male gonads –testosterone Placenta –hCG		CO3,4

References:

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
2. Biochemistry, 4th edition (2010), Voet and Voet, John Wiley and sons, USA
3. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
4. Biochemistry, 4th edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd 5. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Major I

Course Title: Practicals in Biochemistry

Course Code: GNKUSBTMJ1P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To train students in standard qualitative and quantitative biochemical assays.
2	To impart the ability to determine various physical and chemical properties of substances.
3	To enable learners to integrate theoretical concepts with experimental practices.
4	To cultivate understanding of hormone detection methods and their diagnostic relevance.
5	To enhance competence in applying colorimetric and volumetric techniques for biomolecule estimation.
6	To foster proficiency in handling and analyzing diverse types of samples.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Perform standard biochemical tests to estimate biomolecules such as glucose, starch, and glycogen.	PO1, 2	PSO1, 3, 4	Ap
CO 2	Apply instrumental methods such as colorimetry, spectrophotometry, conductometry, and pH metry for accurate biochemical analysis of clinical and non-clinical samples.	PO2, 4	PSO4, 6	Ap
CO 3	Detects the presence of specific hormones, using qualitative methods relevant to clinical diagnostics.	PO2, 5, 6	PSO3, 5, 8	U/Ap
CO 4	Execute procedures for the extraction and hydrolysis of plant polysaccharides and relate the findings to plant carbohydrate metabolism	PO1, 2, 4	PSO2, 3, 4	Ap/An

CO 5	Evaluate the efficiency and limitations of biochemical assays and correlate laboratory data with possible clinical outcomes or health conditions.	PO2, 3, 8	PSO3, 5, 9	E
CO 6	Summarize the procedures, observations, and inferences of various biochemical experiments	PO1, 6	PSO2, 8	

List of Experiments:

1. Determination of blood glucose levels for detection of diabetes mellitus
2. Determination of serum cholesterol (total, HDL and LDL ratio)
3. TLC of lipids
4. Isolation of starch from potato and its estimation by anthrone method
5. Estimation of Glucose by Benedict's method - Volumetric analysis
6. Assignment on endocrinology

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology
Semester-VI: Major II
Course Title: Industrial Biotechnology
Course Code: GNKUSBTMJ2106
Credits: 3
No of lectures (Hours): 45
Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce learners to the microbiological and technological aspects of dairy processing and product preservation.
2	To explore the historical development and contributions of Indian scientists in fermentation technology.
3	To understand the composition and preparation of fermentation media and sterilization techniques.
4	To explore various types of fermenters and their suitability for different fermentation processes.
5	To gain insights into scaling up bioprocesses from lab to industrial level.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Recall and describe the normal microbial flora of milk and factors affecting its bacteriological quality.	PO1, 2	PSO1, 2	R/U
CO 2	Apply the principles of pasteurization and preservation in improving milk safety and extending shelf life	PO2, 4	PSO3, 4	Ap
CO 3	Compare and contrast the industrial processes involved in the production of antibiotics, organic acids, enzymes, amino acids, and vitamins.	PO1, 2, 3	PSO2, 5, 7	An
CO 4	Analyze the design and functional aspects of various industrial fermenters	PO2, 4	PSO3, 6, 7	An

CO 5	Illustrate the transition of a fermentation process from laboratory scale to industrial scale, highlighting challenges and key considerations.	PO2, 4, 7	PSO5, 6, 7	U/Ap
CO 6	Summarize the historical contributions of Indian scientists in the field of fermentation technology and relate it to current industrial applications.	PO1, 3, 5	PSO1, 8, 9	U
CO 7	Evaluate the effectiveness of different fermentation media components and sterilization methods in optimizing microbial production.	PO2, 4, 8	PSO3, 5, 9	E

Unit		Industrial Biotechnology	No. of lectures	CO Mapping
Unit 1		Dairy Technology	15	
	1.1	Milk: Normal flora, changes in raw milk, Enumeration, Factors affecting bacteriological quality, Dairy technology, Preservation methods, Pasteurization		CO1
	1.2	Fermented product: Starter Cultures, Production process and spoilage of: Cheese: Swiss and Cheddar Yogurt, Buttermilk		CO1
Unit 2		Fermentor Design And Types	15	
	2.1	Fermentation technology - Historical development, Contribution of Indian scientists Design of a fermenter: Basic Design; Parts of a Typical Industrial Fermenter. Fermentation Media: Components; Design and Optimization.		CO1,6
	2.2	Sterilization: Sterilization of Fermenter and Fermentation Media.		CO1,4
	2.3	Types of Fermenters: Air Lift, Bubble, Column, Deep jet and Membrane bioreactor. Different aspects of commercialization (from lab to commercial)		CO4
Unit 3		Fermentation Process	15	
	3.1	Antibiotic Fermentations: Streptomycin, Tetracyclines and Griseofulvin		CO4,5,7
	3.2	Organic acids: Acetic Acid, Citric Acid		CO4,5,7
	3.3	Enzymes: Amylase, Proteases		CO4,5,7
	3.4	Amino acids: L-Glutamic Acid, Lysine		CO4,5,7
	3.5	Vitamins: Vitamin B ₁₂ , Vitamin C		CO4,5,7

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele MerceL Dekker Inc New York, 2nd edition
2. Microbial Technology Pepler, H.J and Perlman, D 2nd Academic PressPracticals 3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittkar
6. Pharmaceutical Microbiology by Russel and H
7. Industrial Microbiology by L.E.Casida, JR.
8. Industrial Microbiology by A. H. Patel

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Major II

Course Title: Practicals in Industrial Biotechnology

Course Code: GNKUSBTMJ2P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To develop practical skills for analyzing the quality and composition of dairy products.
2	To expose learners to instrumentation and demonstrate bioreactor operations.
3	To strengthen the link between theoretical concepts and real-world industrial applications.
4	To understand standard protocols used in estimation of biomolecules and microbial analysis.
5	To familiarize learners with experimental approaches in assessing product quality and safety.
6	To estimate important biomolecules like proteins, acids, and vitamins in food products.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Demonstrate proficiency in microbiological methods for assessing quality and contamination in biological products.	PO1, 2, 6	PSO2, 4, 5	Ap
CO 2	Identify and isolate microorganisms from industrial and food-related sources using appropriate techniques.	PO2, 4	PSO3, 5	Ap/An
CO 3	Apply standard laboratory techniques for the estimation of biochemical constituents in food and industrial samples.	PO2, 4, 6	PSO3, 4	Ap
CO 4	Measure and monitor critical parameters such as pH, acidity, and enzyme activity using standard protocols	PO2, 4	PSO3, 4	Ap

CO 5	Construct standard curves and calibrate instruments for quantitative biochemical analysis.	PO2, 6	PSO3, 4	Ap/E
CO 6	Differentiate between various microbial enumeration techniques and assess their applications in quality control	PO2, 4, 8	PSO3, 5, 9	An/E

List of Experiments:

1. Estimation of Milk protein-Pyne's method
2. Microbial analysis of Milk by MBRT and RRT
3. Phosphatase test in Milk
4. DMC of milk sample
5. Isolation of Normal flora from Milk and curd
6. Encapsulation of yeast and estimation of invertase activity
7. Estimation of Acidity of Vinegar.
8. Estimation vitamin C by DCPIP method.
9. Working of bioreactor - Demonstration

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology
Semester-VI: Major III
Course Title: Environmental Biotechnology
Course Code: GNKUSBTMJ3106
Credits: 3
No of lectures (Hours): 45
Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the fundamental concepts of renewable energy sources and their biotechnological applications.
2	To develop a foundational understanding of industrial wastewater treatment using aerobic and anaerobic biological processes.
3	To explain the mechanisms and applications of bioremediation and solid waste management techniques.
4	To provide insight into the principles and types of biofertilizers and biopesticides used in sustainable agriculture.
5	To demonstrate understanding of solid waste treatment techniques and evaluate their environmental impacts.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Describe the concept of bioremediation and compare various microbial strategies for environmental remediation.	PO1, 3, 5	PSO1, 3, 9	U/An
CO 2	Describe the structure and functioning of biogas plants and analyze the factors affecting biogas production and its utility as an energy source.	PO2, 3, 4	PSO2, 3, 6	U/An
CO 3	Compare different fermentation technologies used for large-scale biofuel and biogas production.	PO2, 4, 7	PSO3, 5, 6	An/E
CO 4	Illustrate the role of biofertilizers and plant growth-promoting microbes in enhancing soil fertility and agricultural productivity.	PO1, 3, 5	PSO2, 3, 9	U/Ap

CO 5	Explain the biodegradation of xenobiotics and analyze microbial and chemical factors influencing their degradation in the environment.	PO1, 2, 8	PSO3, 5, 9	U/An
CO 6	Demonstrate understanding of solid waste treatment techniques and evaluate their environmental impacts.	PO2, 3, 5, 8	PSO3, 6, 9	U/E
CO 7	Differentiate types of biopesticides and explain their mechanisms of action, benefits, and applications in crop protection.	PO1, 2, 3	PSO2, 3, 9	U/An

Unit		Environmental Biotechnology	No. of lectures	CO Mapping
Unit 1		Bioremediation	15	
	1.1	Concept of Bioremediation.		CO1
	1.2	Bioremediation Strategies: Indigenous micro-organisms, Stimulation of indigenous microbial growth, Bio-augmentation, Genetically manipulated organisms.		CO1
	1.3	Bioremediation techniques in situ: Bioremediation on land, Land farming, Bioventing, Biosparging, Bioaugmentation / stimulation.		CO1
	1.4	Bioremediation techniques ex situ: Composting, Biopile process, Bioreactors and novel technologies.		CO1
	1.5	Phytoremediation : mechanism and types, Phycoremediation		CO1
Unit 2		Industrial Effluent Treatment	15	
	2.1	Biological processes for industrial effluent treatment, aerobic biological treatment-activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR		CO3
	2.2	Anaerobic biological treatment-contact digesters, packed bed reactors, anaerobic baffled digesters, UASB		CO2,3
	2.3	Solid waste treatment, Biosensors in environmental pollution detection		CO5
		Biodegradation of xenobiotic-persistent compounds, chemical properties influencing biodegradability, microorganisms in		CO6

		biodegradation		
Unit 3		Biofertilizers and Biopesticides	15	
	3.1	Biofertilizer: Nitrogen-fixing Rhizobacteria -Symbiotic Nitrogen Fixers, Non-symbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate-Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance		CO4
	3.2	Plant Growth Promotion by Fungi: Mycorrhizae, Arbuscular Mycorrhizae, Ectomycorrhizae		CO4
	3.3	Microbial Inoculants: Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations		CO7
	3.4	Biopesticides: types, <i>Bacillus thuringiensis</i> , <i>Trichoderma</i> , insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application)		CO7

References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig.C.R, Stitzel.R.E 5th edition
3. Clinical Pharmacology Bennet, P. N. Brown, M.J, Sharma, P 11th Edition Elsevier
4. Biochemistry Metzler, D.E. Elsevier

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Major III

Course Title: Practicals in Environmental Biotechnology

Course Code: GNKUSBTMJ3P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the basic principles and techniques used in the analysis of environmental samples.
2	To familiarize learners with physical, chemical, and microbiological parameters used to assess water and effluent quality.
3	To provide hands-on experience in applying standard methods to monitor and interpret environmental quality.
4	To enable understanding of environmental standards and protocols for pollution monitoring.
5	To promote good laboratory practices and biosafety awareness while handling environmental samples.
6	To develop competency in performing quantitative estimations of pollutants such as heavy metals and organic loads.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Measure key physico-chemical parameters (pH, temperature, color, turbidity) of industrial effluents to assess water quality.	PO1, 2, 6	PSO1, 3, 4	Ap, An
CO 2	Quantify heavy metals (e.g., chromium) in wastewater samples and interpret their environmental significance.	PO2, 4, 6, 7	PSO3, 4, 5	AP, E
CO 3	Determine the Biological Oxygen Demand (BOD) of sewage samples to assess organic pollution levels.	PO1, 2, 4	PSO3, 5, 6	An, E
CO 4	Analyze Chemical Oxygen Demand (COD) in industrial effluents to determine chemical pollutant load.	PO2, 4, 6, 8	PSO3, 5, 6	Ap, E
CO 5	Apply analytical techniques to assess the efficiency of wastewater treatment processes.	PO2, 3, 4, 6	PSO3, 5, 6	Ap, E

CO 6	Demonstrate safe handling of environmental samples and laboratory chemicals following biosafety protocols.	PO5, 6, 8	PSO4, 8, 9	Ap, U
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List of Experiments:

1. Determination of TDS, TSS and TS from an effluent sample.
2. Study of physico-chemical (pH, temp, color, turbidity) parameters of any one industrial effluent sample
3. Estimation of chromium from effluent sample.
4. Microbial analysis of water by MPN method
5. Study the effect of heavy metals on the growth of bacteria.
6. Determination of BOD of domestic sewage sample
7. Determination of COD of industrial effluent.
8. Isolation of Rhizobium and Azotobacter

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-VI: Minor

Course Title: Bioinformatics

Course Code: GNKUSBTMI1106

Credits: 1

No of lectures (Hours): 15

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To understand the concept and significance of scoring matrices used in biological sequence alignment.
2	To apply basic tools and techniques for comparing biological sequences using dot plots and algorithm-based methods.
3	To interpret results from multiple sequence alignment and phylogenetic tree construction to understand evolutionary relationships.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand the concept and significance of scoring matrices used in biological sequence alignment.	PO1, 2, 4, 7	PSO1, 2, 4, 6	U, Ap
CO 2	Apply basic tools and techniques for comparing biological sequences using dot plots and algorithm-based methods.	PO1, 2, 4, 8	PSO2, 3, 4, 9	U, An
CO 3	Interpret results from multiple sequence alignment and phylogenetic tree construction to understand evolutionary relationships.	PO1, 4, 5, 6	PSO2, 4, 5, 8	U, Ap

Unit		Bioinformatics	No. of lectures	CO Mapping
Unit 1		Bioinformatics	15	
	1.1	Databases: types- public domain database, sequence database, structural database, motif database, genome database, proteome database, annotated		CO 1, 2

		sequence database		
	1.2	Scoring matrices for global and local alignment		CO 1
	1.3	Substitution matrix- PAM, BLOSSOM		CO 3
	1.4	DOT PLOTS and Dynamic programming		CO 2
	1.5	Multiple Sequence Alignment and phylogenetic trees		CO 3

References:

1. Rastogi, S. C., Rastogi, S. C., Mendriratta, N., & Rastogi, P. (2006). Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors Pvt. Limited
2. Mount David W., Bioinformatics: Sequence and Genome Analysis. (2005) 2nd edition, Cold Spring Harbor Laboratory Press.
3. Teresa Attwood, Parry Smith, David J. Introduction to Bioinformatics. (2007), Pearson Education (Singapore) Pvt. Ltd.

Marks: 25 Marks (20 Marks External + 05 Marks Internal)

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Minor

Course Title: Practicals in Bioinformatics

Course Code: GNKUSBTMI1P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce learners to the essential tools and concepts in sequence analysis, including pairwise and multiple sequence alignment, for understanding genetic relationships and molecular evolution.
2	To develop practical proficiency in using bioinformatics platforms such as BLAST and primer designing tools, enabling application in research, diagnostics, and biotechnology.
3	To foster analytical and interpretative skills through hands-on experience with computational techniques for biological data analysis and visualization.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Understand and apply methods for aligning biological sequences to identify similarities and evolutionary patterns.	PO1, 2, 4, 5	PSO2, 4, 5, 9	Ap, An
CO 2	Demonstrate the ability to design suitable primers for molecular biology experiments.	PO1, 4, 6, 7	PSO2, 4, 6	Ap, U
CO 3	Use online tools to search and analyze nucleotide sequences for gene identification and annotation.	PO2, 4, 6	PSO2, 4, 5	An, E

List of Experiments:

1. Multiple Sequence Alignment and Phylogeny.
2. Scoring matrices
3. Primer Designing
4. Pairwise alignment
5. Querying in Specialized databases
6. Types of BLAST

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology

Semester-VI: Elective I

Course Title: Plant and Animal Tissue Culture

Course Code: GNKUSBTEL1106

Credits: 3

No of lectures (Hours): 45

Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to basic concepts and techniques of plant and animal tissue culture.
2	To develop an understanding of aseptic techniques and contamination control in culture laboratories.
3	To encourage application of tissue culture methods in areas such as germplasm conservation, biotransformation, and genetic improvement.
4	To promote careful observation, data recording, and critical analysis of tissue culture experiments
5	To introduce molecular tools like DNA markers and their applications in plant and animal biotechnology.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Introduction of core principles and methodologies in plant and animal tissue culture for biological research and biotechnological applications.	PO1, 2, 6	PSO1, 3, 4	E
CO 2	Understanding of culture techniques including primary, secondary, monolayer, suspension, and organ-specific cultures.	PO2, 4, 6, 7	PSO3, 4, 5	U,E
CO 3	Exposure to advanced plant culture techniques such as callus induction, protoplast isolation, hairy root culture, and somatic embryogenesis.	PO1, 2, 4	PSO3, 5, 6	E,U

CO 4	Application of plant tissue culture in secondary metabolite production, biotransformation, and germplasm conservation.	PO2, 4, 6, 8	PSO3, 5, 6	Ap
CO 5	Understanding of DNA barcoding techniques, marker systems, procedural steps, and current advancements in species identification.	PO2, 3, 4, 6	PSO3, 5, 6	E
CO 6	Introduction to molecular marker technologies, their applications in plant genetics, and the principles of QTL mapping.	PO5, 6, 8	PSO4, 8, 9	E

Unit		Plant and Animal Tissue Culture	No. of lectures	CO Mapping
Unit 1		Basic concepts in ATC and PTC	15	
	1.1	ATC laboratory design, Instruments and equipment used in ATC, Types of cultures in ATC - Primary culture, Secondary culture, Concept of monolayer culture and suspension culture		CO1
	1.2	ATC - Maintenance of aseptic conditions, Contamination; type and detection methods		CO1
	1.3	PTC laboratory organization, Equipment and instruments used in PTC, Precautions to maintain aseptic conditions in PTC lab		CO1
	1.4	Callus culture, organ culture and protoplast isolation techniques in PTC		CO1,2
Unit 2		Plant Tissue Culture	15	
	2.1	Plant suspension cultures, Biotransformation, hairy root culture, elicitors		CO5,6
	2.2	Somatic embryogenesis, Germplasm conservation		CO5
	2.3	Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP), QTL mapping		CO6
	2.4	Barcoding – Barcoding markers (matK, rbcL, ITS), steps, recent advances, benefits, limitations		CO6
Unit 3		Animal Tissue Culture	15	
	3.1	Cell lines: Cell line designation, selection of cell lines, routine maintenance, evolution of cell lines		CO5
	3.2	Cytotoxicity, transformation, genetic instability, chromosomal aberrations, variation in DNA content		CO1
	3.3	Monoclonal antibody production, Cryopreservation		CO1

References:

1. Razdan M.K, Introduction to Plant Tissue culture. (2019) 3 rd edition, Oxford & IBH

Publ, New Delhi

2. Kalyan Kumar De, Plant Tissue culture (2010), New central Book Agency Calcutta
3. H.S. Chawla. Plant biotechnology. 3rd ed. India: Oxford & IBH Publishing Co., 2010
4. R. Ian Freshney. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 6th ed. Wiley & Sons, Inc., USA, 2010.
5. Sudha Gangal, Principles and Practice of Animal Tissue Culture, 2nd ed. University Press, India,2010.

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Elective I

Course Title: Practicals in Plant and Animal Tissue Culture

Course Code: GNKUSBTEL1P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the use and handling of basic glassware and instruments in plant and animal tissue culture laboratories.
2	To develop skills in isolating protoplasts and understanding their role in genetic and cellular studies.
3	To provide hands-on training in animal tissue culture techniques including monolayer formation and trypsinization.
4	To build competency in assessing cell viability and cytotoxic effects using bioassays such as the MTT assay.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Demonstrate proper handling and maintenance of glassware and equipment used in tissue culture laboratories.	PO1, 2, 6	PSO1, 3, 4	Ap
CO 2	Carry out anther culture for haploid plant production and understand its role in plant breeding.	PO2, 4, 6, 7	PSO3, 4, 5	Ap
CO 3	Assess cell viability and perform basic cytotoxicity testing using the MTT assay.	PO1, 2, 4	PSO3, 5, 6	An
CO 4	Interpret experimental data and maintain accurate lab records and reports	PO1, 2, 6	PSO1, 3, 4	An
CO 5	Practice aseptic techniques to minimize contamination and ensure reliable experimental outcomes.	PO2, 4, 6, 7	PSO3, 4, 5	Ap,U,An

List of Experiments:

1. Glassware and instruments used in ATC and PTC
2. Isolation of protoplast
3. Anther culture
4. Callus/Seed Culture induction
5. Monolayer formation
6. Trypsinization of animal tissue & viability count
7. Toxicology - MTT assay
8. To assay radical scavenging activity of a tissue hydrolysate using DPPH

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**



Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous)
Department of Biotechnology

Course: T.Y.B.Sc. Biotechnology
Semester-VI: Elective 2
Course Title: Agricultural Biotechnology
Course Code: GNKUSBTEL2106
Credits: 3
No of lectures (Hours): 45
Marks: 75

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the scope, significance, and evolution of agricultural biotechnology in India and globally.
2	To familiarize students with biotechnological tools used in diagnostics, including variety testing and pathogen detection.
3	To explore plant responses to abiotic stresses and understand the physiological and molecular mechanisms involved.
4	To study biotic stress and the molecular interactions between plants and pathogens.
5	To build awareness of plant defense strategies including systemic resistance and pathogen-derived resistance.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Explain the fundamentals of agricultural biotechnology and its relevance to national and global food security.	PO1, 2, 6	PSO1, 3, 4	Ap
CO 2	Compare classical and modern agricultural biotechnology approaches and their practical applications.	PO2, 4, 6, 7	PSO3, 4, 5	Ap
CO 3	Describe and evaluate modern farming techniques such as urban agriculture, hydroponics, and aeroponics.	PO1, 2, 4	PSO3, 5, 6	An
CO 4	Apply biotechnological methods for diagnostic applications like variety purity and pathogen detection.	PO1, 2, 6	PSO1, 3, 4	An

CO 5	Identify components and functions of greenhouse systems, including design parameters and environmental control.	PO2, 4, 6, 7	PSO3, 4, 5	Ap,U,An
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Unit		Agricultural Biotechnology	No. of lectures	CO Mapping
Unit 1		Agricultural Biotechnology	15	
	1.1	Introduction, Scope, Importance, Role of agricultural biotechnology in India and world, Classical vs modern Agricultural biotechnology		CO1
	1.2	Concepts and applications of e-agriculture and use of ICT in Agriculture.		CO1
	1.3	Urban agriculture, Vertical Farming, Hydroponics, Aeroponics		CO1
	1.4	Biotechnology for Diagnostic Application: Variety purity testing, Pathogen diagnosis		CO1
Unit 2		Greenhouse Technology and Protected Cultivation	15	
	2.1	Types of green house, importance, functions and features of green house, Design criteria and calculation		CO2,3
	2.2	Functions and features of a green house. Heating, cooling and ventilation system, Computer controlled environment		CO4
	2.3	Construction material, covering material and its characteristics, growing media, green house irrigation system. nutrient management		CO2,3
	2.4	Scope and future of greenhouse technology		CO2
Unit 3		Plant stress biology	15	
	3.1	Abiotic stress –Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photooxidative stress, stress perception and stress signaling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging		CO4,5
	3.2	Biotic stress - plant interaction with bacterial, viral and fungal pathogens, plant responses to pathogen– biochemical and molecular basis of host-plant resistance , toxins of fungi and bacteria , systemic and induced resistance –pathogen derived resistance, signallin		CO4

References:

1. N.S. Subbarao, *Advances in Agricultural Microbiology*. (2017), Oxford and IBH Publication Co, New Delhi
2. P. Parvatha Reddy (auth.)-*Sustainable Crop Protection under Protected Cultivation* Springer Singapore (2016)
3. S. Prasad and U. Kumar, *Greenhouse Management of Horticultural Crops*. (2005), Kalyani Publishers
4. Altieri, Miguel A. Farrell, John G-*Agroecology- The Science Of Sustainable Agriculture*, Second Edition-CRC Press (2018)

Total Marks: 75 Marks

- **Internal Examination (15 Marks):** 10 Marks exam (MCQ and short answer question) with 20% completed syllabus. (10 Marks will be converted to 5 Marks). Duration of exam: 20 minutes. 5 Marks for either Quiz/Assignments/Presentation/Viva and 5 Marks for Overall Performance (Class Participation, Attendance)
- **End Semester theory examination (60 Marks):** Weightage of each unit will be proportional to the number of lecture hours as mentioned in the syllabus. Duration of exam: 2 hours
- Combined passing of 40% with minimum 20% in Internal Component.

Course: TY B.Sc. Biotechnology Practical

Semester-VI: Elective 2

Course Title: Practicals in Agricultural Biotechnology

Course Code: GNKUSBTEL2P106

Credits: 01

No of Practical (Hours): 30

Marks: 25

Course Objectives:

Sr. No.	Course objectives
The course aims at:	
1	To introduce students to the scope, significance, and evolution of agricultural biotechnology in India and globally.
2	To familiarize students with biotechnological tools used in diagnostics, including variety testing and pathogen detection.
3	To explore plant responses to abiotic stresses and understand the physiological and molecular mechanisms involved.
4	To study biotic stress and the molecular interactions between plants and pathogens.
5	To build awareness of plant defense strategies including systemic resistance and pathogen-derived resistance.

Course Outcomes (COs):

Sr. No.	On completing the course, the student will be able to:	POs addressed	PSOs addressed	Cognitive Levels addressed
CO 1	Demonstrate the ability to assess the effects of herbicides or biopesticides on plant growth using pot culture techniques.	PO1, 2, 6	PSO1, 3, 4	Ap
CO 2	Gain exposure to greenhouse technologies through a field visit and recognize key components and their functions.	PO2, 4, 6, 7	PSO3, 4, 5	Ap
CO 3	Conduct rapid screening tests using PEG, mannitol, and NaCl to evaluate drought and salinity tolerance in plants.	PO1, 2, 4	PSO3, 5, 6	An
CO 4	Estimate antioxidant levels and enzyme activities such as ascorbate, catalase, and peroxidase in stressed plants.	PO1, 2, 6	PSO1, 3, 4	An

CO 5	Compile and submit a structured field visit report demonstrating observation and analytical skills.	PO2, 4, 6, 7	PSO3, 4, 5	Ap,U,An
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List of Experiments:

1. Demonstration of effect of herbicide / Biopesticide (any one) on plant growth using pot culture
2. RAPD analysis demonstration experiment
3. Isolation of Phosphate solubilising bacteria
4. Study of effect of abiotic stress on plants
5. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol & salinity NaCl)
6. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase, and Peroxidase
7. Visit to green house facility and submission of field visit report

Total Marks: 25 Marks

- **Experiment Marks: 15 Marks**
- **Journal & Viva Marks: 5 + 5 Marks**