ANNEXURE B

FACULTY OF LIFE SCIENCES

SYLLABUS

of

Bachelor of Science (Bio-Technology) Three Year Degree Programme

Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme

(Semester: III-VI)

(Under Credit Based Continuous Evaluation Grading System)

Session: 2026-27

The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR
(Autonomous)

Upon successful completion of this course, students will be able to:

PSO1: gain and apply knowledge of biotechnology and science concepts to solve problems related to field of environment and biotechnology.

PSO2: design, perform experiments, analyse, and interpret data for investigating complex problems in the field of biotechnology and allied fields.

PSO3: apply ethical principles and commit to professional ethics and responsibilities and norms of the biotechnological practices.

PSO4: design and develop solution to biotechnology problems by applying appropriate tools while keeping in mind safety factor for environment and society.

PSO5: to undertake any responsibility as an individual and as a team in a multidisciplinary environment.

PSO6: contribute to the biotechnology and allied fields in designing, developing, and providing solutions for product/processes/technology development.

PSO7: able to justify societal, health, safety and legal issues and understand the responsibilities in biotechnological engineering practices.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FOUR YEAR DEGREE PROGRAMME

Bachelor of Science (Bio-Technology) Three Year Degree Programme

Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme

Session: 2026-27

Semester-III

Course No.	Course Title	Course Type	Hours per week	Credits L-T-P	Total Credits	L	P	CA	Total Marks
BBTM-3061	Gene Structure and Function	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-3332	Biomathematics and Biostatistics	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-3063	Immunology-I	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-3484	Zoology	MDC	3-0-2	3-0-1	4	50	20	30	100
BBTI-3065	Internship	CCFR	0-0-4	0-0-2	2	-	50	-	50
BBTM-3060	Skill Development in Biotechnology	SEC	3-0-2	3-0-1	4	50	20	30	100
VACE 3221	Environmental Studies (Compulsory)	VAC	2-0-0	2-0-0	2	35	-	15	50
Total Credits					24				

DSC: **Discipline Specific Courses**
MDC: Multidisciplinary Course
CCFR: Co-curricular Field Work and Report Writing
SEC: Skill Enhancement Course
VAC: Value Added Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
SCHEME AND CURRICULUM OF EXAMINATIONS OF FOUR YEAR DEGREE PROGRAMME
Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Session: 2026-27
Semester-IV

Course No.	Course Title	Course Type	Hours per week	Credits L-T-P	Total Credits	L	P	CA	Total Marks
BBTM-4061	Molecular Biology	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-4062	Biochemical and Biophysical Techniques	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-4083	Biochemistry-II	DSC	3-0-2	3-0-1	4	50	20	30	100
BBTM-4084	Chemistry	Minor	3-0-2	3-0-1	4	50	20	30	100
BBTM-4065	Ecology and Evolution	AEC	3-0-2	3-0-1	4	50	20	30	100
VACP-4511	*Personality Development and Gender Sensitization	VAAC	2-0-0	2-0-0	2	35	-	15	50
Total Credits					22				

***Credits of these papers will not be added towards SGPA/CGPA and only grades will be provided**.

DSC: **Discipline Specific Courses**
AEC: Ability Enhancement Courses
VAAC: Value Added Audit Courses

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
SCHEME AND CURRICULUM OF EXAMINATIONS OF FOUR YEAR DEGREE PROGRAMME
Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Session: 2026-27
Semester-V

Course No.	Course Title	Course Type	Credit hours	Credits L-T-P	Total Credits	L	P	CA	Total Marks
BBTM-5061	rDNA Technology-I	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-5062	Animal Biotechnology-I	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-5063	Bioprocess Engineering-I	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-5064	Environmental Biotechnology	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-5085	Chemistry III	MDC	3-0-2	3-0-1	4	50	20	30	100
BBTI-5066	Internship	CCFR	0-0-4	0-0-2	2	-	50	-	50
VACJ-5551	*Job readiness	VAAC	2-0-0	2-0-0	2	35	-	15	50
				Total Credits	28				

***Credits of these papers will not be added towards SGPA/CGPA and only grades will be provided**.

C-Compulsory
MDC: Multidisciplinary Course
CCFR: Co-curricular Field Work and Report Writing
VAAC: Value Added Audit Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FOUR YEAR DEGREE PROGRAMME

Bachelor of Science (Bio-Technology) Three Year Degree Programme

Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme

Session: 2026-27

Semester-VI

Course No.	Course Title	Course Type	Credit hours	Credits L-T-P	Total Credits	L	P	CA	Total Marks
BBTM-6061	Fundamental of Bioinformatics	C	3-0-2	3-0-1	4	50	20	30	100
BBTM-6062	Plant Biotechnology-I	C	4-0-0	4-0-1	5	50	20	30	100
BBTM-6063	rDNA Technology-II	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-6064	Ecology and Evolution	C	4-0-2	4-0-1	5	50	20	30	100
BBTM-6065	Zoology-II	MDC	3-0-2	3-0-1	4	50	20	30	100
BBTM-6060	Skill Development in Bio-Technology-II	SEC	3-0-2	3-0-1	4	50	20	30	100
VACH-6401	Human Rights and Constitutional Duties	VAC	2-0-0	2-0-0	2	35	-	15	50
				Total Credits	29				

C-Compulsory

MDC: Multidisciplinary Courses

SEC: Skill Enhancement Course

VAC: Value Added Course

Semester-III

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3061
Couse Title: Gene Structure and Function
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Describe the molecular organization of DNA and RNA, gene architecture, regulatory elements, mechanisms of DNA replication, and the concepts of genome size and genome complexity in prokaryotic and eukaryotic organisms.

CO2: Analyze the molecular mechanisms of transcription and the structure–function relationship of different RNA molecules, and examine the classification, characteristics, and applications of transposable elements in prokaryotic and eukaryotic genomes

CO3: Evaluate the regulatory mechanisms governing gene expression in prokaryotic and eukaryotic systems, with special emphasis on operon models and molecular control of transcription.

CO4: Assess the molecular basis of oncogenesis, tumour suppressor genes, DNA repair mechanisms, and the scientific significance of the Human Genome Project in advancing genomics, precision medicine, and biotechnology research.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3061
Couse Title: Gene Structure and Function
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks**.**

UNIT-I

Molecular basis of life: DNA and RNA. ultra structure of prokaryotic and Eukaryotic gene and their regulatory elements (promoter, operator, silencer, enhancer, 5' and 3' UTR's), DNA replication; types of replication (conservative, semiconservative and dispersive), Meselson and Stahl experiment of replication, overview of components and mechanism of replication in prokaryotes and eukaryotes, Genome size and Genome complexity: C value and C value paradox, pseudogenes, intergenic sequences, satellite and repetitive, DNA.

UNIT-II

Structure of different types of RNA and their function, transcription process in prokaryotes and eukaryotes (transcription factors, RNA polymerases, formation of initiation, complex, elongation and termination),

Transposable elements (TEs): characteristic of transposable elements, Types of transposable elements: Insertion sequences and transposons- Class I- retrotransposons, LINE and SINE and Class II-DNA Transposons, Autonomous and non-autonomous transposons, Bacterial transposons-composite and non-composite mobile genetic elements, applications of transposable elements.

UNIT-III

Regulation of gene expression in prokaryotes: Lac operon, Repressible model- Negative regulation of lac operon by lactose, Inducible- positive regulation of lac operon: Induction and catabolite activator, mechanism and control of Tryptophan and Histidine operon, levels of gene regulation in eukaryotes

UNIT-IV

Genes playing role in cancer development: protooncogenes, activation of oncogenes, inactivation of tumor suppressor genes (function and mechanism of action of p53) and DNA repair genes, Human Genome Project (HGP): Phases, Principle and goals of Human Genome project, and outcome of HGP

Books recommended:

1. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., Martin, K.C., Yaffe, M.B. and Amon, A. (2021). *Molecular cell biology* (Vol. 1). New York: WH Freeman.

2. Krebs, J. E., Lewin, B., Goldstein, E. S., & Kilpatrick, S. T. (2013). *Lewin's essential genes*. Jones & Bartlett Publishers.

3. Nelson, D.L. & Cox, M.M. (2021). *Lehninger Principles of Biochemistry*. 8th Edition. W.H. Freeman.

4.Freifelder, D. (2013). Microbial Genetics, Narosa Publishing House.

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Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3061
Couse Title: Gene Structure and Function
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Perform the isolation of plant genomic DNA and evaluate its quality and purity using UV–Visible spectrophotometric analysis.

CO2: Operate UV–Visible spectrophotometric techniques to determine the concentration, absorption characteristics, and purity of nucleic acid samples.

CO3: Demonstrate the principles and applications of Native PAGE and SDS-PAGE for the separation and analysis of proteins.

CO4: Analyze genomic sequences using bioinformatics tools to identify open reading frames (ORFs) and exon–intron organization for gene structure annotation and interpretation.

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Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3061
Couse Title: Gene Structure and Function
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Extraction of plant Genomic DNA

2. Determination of absorption spectra of DNA and RNA using UV-Vis Spectrophotometer and determine purity of DNA and RNA sample.

3. To study proteins by Native PAGE

4. To study proteins by SDS PAGE

5. a. To deduce ORF from genomic DNA using different ORF Finder Tools, PlasMappe 3.0.

b. To determine intron exon boundaries using Gene Structure Display Server.

(https://gsds.gao-lab.org/)

Books recommended:

1.Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., Martin, K.C., Yaffe, M.B. and Amon, A. (2021). *Molecular cell biology* (Vol. 1). New York: WH Freeman.
2.Bolsover, S.R., Hyams, J.S., S. Shephard, E.A. and White H.A. (1997) From Genes to Cells,John Wiley and Sons.
3.Krebs, J. E., Lewin, B., Goldstein, E. S., & Kilpatrick, S. T. (2013). *Lewin's essential genes*. Jones & Bartlett Publishers.
4.Nelson, D.L. & Cox, M.M. (2021). *Lehninger Principles of Biochemistry*. 8th Edition. W.H. Freeman.
5.Freifelder, D. (2013). Microbial Genetics, Narosa Publishing House.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM -3063
Couse Title: Immunology-I
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the fundamental concepts of innate and adaptive immunity, including immunological memory, specificity, self–non-self recognition, and the terminology associated with the immune system.

CO2: Interpret the organization and functions of lymphoid cells, lymphoid organs, and the lymphatic system, and explain their coordinated roles in the generation and regulation of immune responses.

CO3: Analyze the structural and functional characteristics of antigens, immunoglobulins, and the complement system, and examine their roles in humoral immune responses.

CO4: Evaluate the role of Major Histocompatibility Complex (MHC) molecules and antigen receptors of T and B lymphocytes in antigen recognition, antigen presentation, and adaptive immune responses.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3063
Couse Title: Immunology-I
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setter: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

Types of immunity-innate and adaptive; Features of immune response-memory; Specificity and recognition of self and non-self; Terminology used in the study of immune system.

UNIT-II

Lymphoid cells, heterogeneity of lymphoid cells; T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic.

UNIT-III

Antigen, Epitope (B cell and T Cell epitope), Immunogen, Factors influencing immunogenicity, Immunoglobulins, classes and structure; affinity and avidity; Complement fixing antibodies and complement cascade.

UNIT-IV

MHC class I and class II molecules, structure T and B Cells and function of class I and class II MHC molecules, structure of T-cell antigen receptors.

Books Recommended:

1.Murphy, K., & Weaver, C. (2017). *Janeway's immunobiology*. 9th edition. Garland science.
2.Owen, J., Stranford S.A., Jones P.P., Owen J.A. (2018). *Kuby immunology*. New York: W.H. Freeman, Macmillan Learning.
3.Abbas, A. K., Lichtman, A. H., Pillai, S., Henrickson S. (2025). *Cellular and molecular immunology* (11th ed.). Elsevier.
4.Flajnik, M. (2022). *Paul's fundamental immunology*. Lippincott Williams & Wilkins.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3063
Couse Title: Immunology-I
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Perform safe blood collection, plasma separation, and hematological investigations using standard laboratory procedures and aseptic techniques.

CO2: Determine total and differential blood cell counts and interpret hematological parameters for the assessment of immune and physiological status.

CO3: Isolate peripheral blood mononuclear cells (PBMCs) and evaluate cell viability using standard dye exclusion techniques.

CO4: Demonstrate antigen–antibody interactions by performing different immunological techniques and analyze the experimental outcomes.

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Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3063
Couse Title: Immunology-I
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Collection of blood sample by different method.

2. Separation of Plasma from blood

3. Differential leucocytes count

4. Total Leucocytes count

5. Total RBC count

6. Isolation of mononuclear cells from peripheral blood and to check their viability by dye exclusion method.

7. Ouchterlony Double Immunodiffusion Test.

8. Haemagglutination assay.

9. Haemagglutination Inhibition assay.

Books Recommended:

1.Miller, L. E., & Stevens, C. D. (2023). Clinical immunology and serology.
2.Celis, J.E. (2021). Cell Biology: A laboratory handbook Amsterdam; Boston: Elsevier Academic
3.Hay, F.C. Westwood O.M.R. (2002). Practical Immunology, 4th Ed., Blackwell Science, U.K.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTI 3065
Couse Title: Internship

Upon successful completion of this course, the learners will be able to:

CO1: Apply disciplinary knowledge, technical competencies, and standard professional practices to perform assigned tasks effectively in industrial, research, healthcare, or other professional settings.

CO2: Analyze workplace processes and real-world challenges to identify problems and recommend appropriate scientific or technical solutions.

CO3: Demonstrate professional ethics, effective communication, teamwork, leadership, and responsible workplace behavior while functioning in multidisciplinary professional environments.

CO4: Evaluate professional experiences and learning outcomes by preparing, presenting, and defending a comprehensive internship report that demonstrates reflective learning and professional competence.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTI 3065
Couse Title: Internship

Time: 3 Hours **Max. Marks:50**
L-T-P: 0-0-2

Practical:50

Evaluation of report based on above themes will be evaluated by board of three internal examiners. Award list will be submitted thereafter.

It is a course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution. A key aspect of the internship/apprenticeship is induction into actual work situations. It involves working with local industry, government or private organizations, business organizations, artists, craft persons, and similar entities to provide opportunities for students to actively engage in onsite experiential learning.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3060
Couse Title: Skill Development in Biotechnology
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the principles, production processes, quality standards, and agricultural applications of biofertilizers, including the molecular basis of biological nitrogen fixation.

CO2: Analyze the therapeutic significance of medicinal plants, phytochemicals, and essential oils, together with their extraction methods and industrial applications.

CO3: Evaluate the scientific basis and health-promoting potential of nutraceuticals and functional foods, including nutritional genomics, quality control, and quality assurance practices.

CO4: Assess the applications of biofuels, bioenergy, bioremediation, and bioentrepreneurship in promoting sustainable development and biotechnology-driven innovation.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-III
Session: 2026-27
Course Code: BBTM-3060
Couse Title: Skill Development in Biotechnology
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

Biofertilizers: Introduction and types and importance of biofertilizers, Microorganisms used in biofertilizers production, Biological Nitrogen fixation VIZ: Rhizobium: Process of nodule formation, Role of Nif and Nod gene in, Enzyme nitrogenase and its component, Different methods of application of biofertilizers, Strategies of Mass production and packing, Registration of biofertilizers.

UNIT-II

Herbal Biotechnology: Introduction to medicinal plants and their medicinal value, Phytochemicals, Essential oil: definition, extraction and applications in domestic life, industry and other purposes (Eucalyptus, Lavender, Rosa grass, Tulsi)

UNIT-III

Nutraceuticals and Functional Foods: Introduction to Nutraceuticals as Science, Properties, structure and functions of various Nutraceuticals, Food as remedies, Anti-nutritional Factors present in Foods, Nutraceuticals and Functional, Functional Foods, Nutritional Genomics, Quality Control, Quality Assurance

UNIT-IV

Biofuels, bioenergy, bioremediation and Bioentrepreneurship
Introduction to biofuels and green bioenergy sources, plant and microbe as alternating sources of bioenergy production, biofuels from waste products, bioremediation-types, biodegradation of herbicides, antibiotics, plastic menace and oil spills.

Overview of bioindustries, public/private funding opportunities; Innovation-focused thinking. Preparation of a business plan: socio-economic cost benefit analysis; Statutory and legal aspects. Business and market strategy: pricing, financing, market linkages, branding

Books Recommended:

1. Oladiji, A. T., Ajayi, E. I., Temidayo, A., Oladiji, O., & Olaley, J. (2024). *Nutrition and Diet in Health*.

2. Rakshit, A., Meena, V. S., Fraceto, L. F., Parihar, M., Benavides-Mendonza, A., & Singh, H. B. (Eds.). (2024). *Bio-inoculants in Horticultural Crops: Advances in Bio-inoculant, Volume 3*. Elsevier.

3. Singh, S., Datta, R., Johri, P., & Trivedi, M. (Eds.). (2022). *Phytopharmaceuticals and biotechnology of herbal plants*. CRC Press.

4. Kommu, S., Thirumurugan, R., Madupoju, B. (Eds.) (2024). *Text book of Nutraceuticals and Functional Foods: Theory and Applications*. Notion Press.

5. Gurunathan, B., Sahadevan, R., Zakaria, Z.A. (2021) *Biofuels and Bioenergy: Opportunities and Challenges*. Elsevier.

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Semester-III
Session: 2026-27
Course Code: BBTM-3060
Couse Title: Skill Development in Biotechnology
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Perform the isolation, cultivation, and production of *Rhizobium*-based biofertilizers using standard microbiological techniques.

CO2: Demonstrate the extraction of essential oils from plant materials using appropriate distillation techniques.

CO3: Analyze the phytochemical composition of essential oils by determining their total polyphenolic and flavonoid contents using standard analytical methods.

CO4: Evaluate the antioxidant and antimicrobial potential of essential oils using DPPH and antimicrobial assays, and interpret the experimental findings for their potential biotechnological applications.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
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Semester-III
Session: 2026-27
Course Code: BBTM 3060
Couse Title: Skill Development in Biotechnology
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Isolation of Rhizobium from root nodules
2. Production of commercial biofertilizers using Rhizobium.
3. Extraction of essential oils through oil distillation apparatus.
4. To measure total polyphenolic content of the essential oil.
5. Total flavonoid content of the essential oil.
6. Investigating the antioxidant potential of the oils by DPPH assay.
7. Antimicrobial activity of essential oils.

Books Recommended:

1. Oladiji, Adenike Temidayo, et al. *Nutrition and Diet in Health*. 2024.
2. Waste, F. P. (2025). *Emerging methods for oil extraction from food processing waste*. CRC Press: Boca Raton, FL, USA.
3. Nayik, G. A., & Ansari, M. J. (Eds.). (2023). *Essential oils: extraction, characterization and applications*. Academic Press.
4. Al-Harrasi, A., Al-Rawahi, A., Al Hatmi, S. A., & Bhatia, S. (2025). *Medicinal and Aromatic Plants of Oman: Phytochemistry and Ethno-Pharmacological Aspects, Volume 1*. CRC Press.

Semester-IV

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4061
Couse Title: Molecular Biology
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the molecular organization of DNA, experimental evidence establishing DNA as the genetic material, and the structural organization of genomes and chromosomes in prokaryotes, eukaryotes, organelles, and viruses.

CO2: Analyze the mechanisms of DNA damage and the major DNA repair pathways involved in maintaining genome integrity and cellular stability.

CO3: Evaluate the molecular mechanisms of genetic information flow by interpreting the processes of genetic coding, protein synthesis, post-translational modifications, and translational regulation.

CO4: Assess the principles of genetic linkage, DNA recombination, and mutation, and appraise their significance in genome evolution, genetic diversity, and biotechnological applications.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4061
Couse Title: Molecular Biology
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

DNA as genetic material, structure of DNA, experimental evidence for DNA as genetic material (Griffith's transformation experiment, Avery and Macleod experiment and Hershey and Chase experiment), DNA to chromosome: genomes of bacteria, eukaryotes, organelles and viruses, Linear and Circular chromosomes, single stranded and doubles stranded DNA/RNA viral genome, organization DNA into chromosomes: Heterochromatin and euchromatin, brief idea of chloroplast DNA and mitochondrial DNA.

UNIT-II

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: photoreactivation, bases excision repair, nucleotide excision repair, mismatch repair, SOS repair recombinational repair,

UNIT-III

Genetic code, Protein synthesis and processing: Ribosome, initiation factors aminoacylation of tRNA, aminoacyl tRNA synthetase, formation of initiation complex, elongation and elongation factors, termination and termination factors, and post translational modifications, inhibitors of translation.

UNIT-IV

DNA linkage, DNA recombination: general overview of types of DNA recombination- homologous, non-homologous, site specific and replicative recombination), linkage and recombination of gene in a chromosome crossing-over, cytological basis of crossing over, molecular mechanism of crossing over, Holliday model of recombination. Mutation: Spontaneous versus induced mutations, types of mutations (misssense mutation, non-sense mutation, silent mutation, point mutation, frameshift mutation), mutations rate and frequency, Mutagens: Physical and Chemical, the molecular basis of mutations. Significance and Practical applications of Mutation.

Books Recommended:

1.George M Malacinski (2015) Freifelders Essentials of Molecular Biology, 4Th/Ed, Jones & Bartlett
2.Clark, D. P., Pazdernik, N. J., McGehee, M. R., & Rader, B. A. (2025). *Biotechnology: The Technological Applications of Genetics and Genomics*. Elsevier.
3.Pk Gupta (2018) Molecular biology, 2nd Edition, Rastogi Publications
4.James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard (2017) Molecular Biology of the Gene, 7th Ed, Pearson Education

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4061
Couse Title: Molecular Biology
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Prepare laboratory reagents and stock solutions by following Good Laboratory Practices (GLP) and standard laboratory protocols.

CO2: Isolate genomic DNA from human samples and RNA from plant tissues using standard molecular biology techniques.

CO3: Estimate the concentration and purity of nucleic acids using fluorometric analysis and analyze the experimental data.

CO4: Perform agarose gel preparation and electrophoresis for the separation and visualization of nucleic acids.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4061
Couse Title: Molecular Biology
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Preparation of stock solutions.
2. Isolation of human genomic DNA.
3. RNA isolation from plants.
4. Quantification of DNA by fluorometric (Ethidium bromide) analysis
5. Preparation of Agarose gel for agarose gel electrophoresis

Books Recommended:

1. S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2. J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3.Brown, T. A. (2023). *Genomes 5*. CRC Press.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4062
Couse Title: Biochemical and Biophysical Techniques
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the principles, instrumentation, and applications of centrifugation techniques, including sedimentation theory, centrifuge types, rotor selection, and factors influencing sedimentation.

CO2: Analyze the principles and applications of chromatographic techniques for the separation, purification, and characterization of biomolecules.

CO3: Evaluate the principles, instrumentation, and analytical applications of advanced chromatographic techniques.

CO4: Assess the principles, instrumentation, and applications of spectroscopic techniques for qualitative and quantitative biomolecular analysis.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4062
Couse Title: Biochemical and Biophysical Techniques
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

Centrifugation: Basic principles of sedimentation, theory and applications of preparative and analytical centrifugation, Differential and density gradient centrifugation, Types of centrifugation machines and rotors, Sedimentation co-efficient, Factors affecting sedimentation coefficient, care of rotors.

UNIT-II

Chromatography: Partition Coefficient, Theory and Principle of Paper and column chromatography, Two-dimensional chromatography, gel exclusion chromatography, Principle and applications of paper, thin layer, ion-exchange, and affinity chromatography.

Section-C

Gas Liquid Chromatography, High Performance Liquid chromatography, Fast Protein Liquid chromatography

Section-D

Spectroscopy: Basic Principle, Lambert Beer's law, Absorption spectrum, theory and principles of single and double beam UV/Visible spectroscopy, Basic Principle and instrumentation of NMR and ESR.

Books Recommended:

1.Upadhyay, A., Upadhyay, K. and Nath N. (2022) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2.Sheehan, D. (2009). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd., Chichester, England.
3.Freifelder, D. (1999). Physical Biochemistry - Application of Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman, and Co.
4.Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co.,

New Delhi.
5.Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press, UK
6.Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Publication House, New Delhi.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4062
Couse Title: Biochemical and Biophysical Techniques
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Demonstrate the operation of different centrifugation techniques, including swing-out rotor, angle rotor, and differential centrifugation, for the separation of biological samples.

CO2: Perform the separation of biomolecules using paper chromatography and thin-layer chromatography by following standard laboratory procedures.

CO3: Analyze the separation and purification of proteins using ion-exchange and affinity chromatography based on their physicochemical properties.

CO4: Interpret the experimental results obtained from centrifugation and chromatographic techniques for the qualitative analysis and purification of biomolecules.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4062
Couse Title: Biochemical and Biophysical Techniques
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. To study sedimentation using swing out rotor and angle rotor.
2. To study differential centrifugation
3. To study separation of bio-molecules by paper chromatography.
4. To study separation of bio-molecules by thin layer chromatography.
5. Separation of proteins by ion-exchange column chromatography
6. Separation of proteins by affinity column chromatography

Books Recommended:

1. Upadhyay, A., Upadhyay, K. and Nath N. (2022) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
2. Sheehan, D. (2009). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd., Chichester, England.
3. Friefelder, D. (1999). Physical Biochemistry - Application of Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman and Co.
4. Plummer D (2006) An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Co., New Delhi.
5. Wilson K and Walker J (2010) Principles and Techniques of Practical Biochemistry, Cambridge University Press, UK
6. Sawhney, S.K. and Singh, R. (2001). Introductory Practical Biochemistry. Narosa Pub. House, New Delhi.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4083
Couse Title: Biochemistry-II
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the fundamental principles of metabolism, bioenergetics, thermodynamics, ATP-mediated energy transfer, and electron transport mechanisms underlying cellular metabolic processes.

CO2: Analyze the structural organization and biochemical properties of nucleic acids and biologically important nucleotides, and examine their functional significance in cellular metabolism.

CO3: Evaluate the structure, classification, catalytic mechanisms, and regulation of enzymes, and assess the biochemical significance of vitamins as enzyme cofactors in maintaining normal physiological functions.

CO4: Assess the principles of enzyme kinetics, enzyme inhibition, and hormonal regulation, and appraise their roles in metabolic regulation and human health.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4083
Couse Title: Biochemistry-II
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1

Theory: 50
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

Introduction to metabolism, catabolism, anabolism, Laws of Thermodynamics and living system, Free energy change and direction of metabolism, Characteristics of Metabolic pathways, Regulation of metabolic pathways, Compartmentation, and Interorgan metabolism. ATP: Structure, Free energy change, energy coupling with ATP (Creatinine phosphokinase, NDP kinase, Adenylate kinase), metabolic roles of ATP; Energy rich metabolites, biological oxidation – Reduction reactions. Electron transport chain, calculation of ATP during metabolic processes

UNIT-II

Structure of nucleosides and nucleotides, nucleic acid structure – Watson – Crick Model of DNA, structural features of different types of DNA, Nucleic acid chemistry- UV absorption, effect of temperature, acid and alkali on DNA. Structure and functions of biologically important nucleotides as – source of energy, component of coenzymes, second messengers.

UNIT-III

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Cofactors, Co-enzyme and Prosthetic group, Mechanism of Enzyme Action: Nature of active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes. Effect of temperature and pH on enzyme activity. Covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis. Estimation of enzymes such as α-amylase, acid phosphatase, and catalase to demonstrate enzyme function and their response to temperature and pH.
Vitamins: occurrence, biomedical importance, deficiency of fat – soluble vitamins (A, D, E, K) and water-soluble vitamins (Vitamin B complex and Vitamin C), vitamins as cofactors.

UNIT-IV

Enzyme Kinetics: A brief overview of enzyme energetics, Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of Km and Vmax values. Enzyme inhibition: Reversible and Irreversible inhibition, Competitive and non-competitive inhibition, Regulation of enzyme activity.
Hormones: Secretory glands, biomedical importance and disorders related with steroid hormones (ovarian, testicular, adrenal cortical and corpus luteal) and peptide hormones (hormones of pancreas, hypophysis, parathyroid, GIT), amino acid hormones (thyroidal, adrenal medullary).

Books Recommended:

1. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry*. Macmillan.
2. Berg, J. M., Gatto Jr, G. J., Hines, J., Tymoczko, J. L., & Stryer, L. (2023). *Biochemistry*. Macmillan Higher Education.
3. Abali, E. E., Cline, S. D., Franklin, D. S., & Viselli, S. M. (2025). *Lippincott® illustrated reviews: biochemistry*. Lippincott Williams & Wilkins.
4. J L Jain, Sunjay Jain, Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5. Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4083
Couse Title: Biochemistry-II
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Explain the principles underlying enzyme assays, enzyme kinetics, and biochemical estimation techniques employed in experimental biochemistry.

CO2: Perform biochemical assays for the estimation of enzyme activities, creatinine, DNA, and RNA using standard laboratory protocols and Good Laboratory Practices (GLP).

CO3: Analyze the effects of pH, temperature, substrate concentration, and inhibitors on enzyme activity by interpreting experimental observations and enzyme kinetic parameters.

CO4: Evaluate experimental data to determine enzyme kinetic parameters and biochemical estimations, and draw scientifically valid conclusions based on the experimental findings.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4083
Couse Title: Biochemistry-II
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner: Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Estimation of Alpha-amylase activity from saliva.
2. Quantitative estimation of catalase activity in mung beans
3. Effect of pH and temperature on enzyme activity.
4. Determination of Km for amylase
5. Competitive and non-competitive inhibition
6. To estimate creatinine level in a given sample
7. Estimation of DNA by diphenylamine method
8. Estimation of RNA by orcinol method

Books Recommended:

1.Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry*. Macmillan.
2.Berg, J. M., Gatto Jr, G. J., Hines, J., Tymoczko, J. L., & Stryer, L. (2023). *Biochemistry*. Macmillan Higher Education.
3.Abali, E. E., Cline, S. D., Franklin, D. S., & Viselli, S. M. (2025). *Lippincott® illustrated reviews: biochemistry*. Lippincott Williams & Wilkins.
4.J L Jain, Sunjay Jain, Nitin Jain (2016) Fundamentals of Biochemistry, 7th Ed, S Chand
5.Satyanarayana (2020) Biochemistry, 5th Ed, Elsevier.
6.Plummer D (2006) An introduction to Practical Biochemistry. Tata McGraw Hill Publishing Co., New Delhi.
7.Sawhney S.K. and Singh, R. (2001). Introductory Practical Biochemistry, Narosa Publication House, New Delhi.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4065
Course Title: Ecology and Evolution
(Theory)

COURSE OUTCOME:

After successful completion of this course, the learners will be able to:

CO1: Explain the fundamental concepts of ecology, environmental components, habitat, niche, trophic interactions, nutrient cycling, and species interactions.
CO2: Analyze ecological succession, ecosystem structure and function, energy flow, biogeochemical cycles, and biodiversity conservation strategies for sustainable ecosystem management.
CO3: Interpret the principles of organic evolution, origin of life, natural selection, and speciation using classical and modern evolutionary theories.
CO4: Apply the principles of population genetics, molecular evolution, phylogenetic reconstruction, and biogeography to explain genetic variation, evolutionary relationships, and species diversification.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4065
Course Title: Ecology and Evolution
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1

Theory: 50
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions: trophic levels and their interactions; nutrient cycles; primary and secondary levels. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized Species. Interactions: Types of interactions (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc.), interspecific competition (physiological adaptations to abiotic environment); prey- predator interactions (Lotka-Volterra equation etc.), prey predator interactions (mimicry, crypsis, etc.).

Unit-II

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. **Ecosystem Ecology**: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of ecosystems: terrestrial (forest, grassland) and aquatic (freshwater, marine, estuarine). *in situ* conservation (endemism, biodiversity hotspots, protected areas); *ex-situ* conservation; conservation genetics (genetic diversity, inbreeding depression).

Unit-III

Organic evolution: Evidences of evolution (palaeontological, comparative anatomy, embryological, biogeographical and molecular evidences); natural selection and types of selection (stabilizing, directional, disruptive), industrial melanism and polymorphism.

Origin of life: Origin of micro-molecules, macromolecules, viruses, prokaryotes and eukaryotes speciation: isolation and its types.

Unit-IV

Population and Quantitative genetics: Origins of genetic variation; Mendelian genetics; Hardy-Weinberg equilibrium; drift; selection population genetics polygenic traits.

Molecular evolution Neutral theory; molecular clocks; rates of evolution; phylogenetic reconstruction; molecular systematics. Species concepts and speciation; adaptive radiation; convergence; biogeography.

Books Recommended:

1. Drickamer, L. C., Vessey, S. H., & Jakob, E. (2002). *Animal behavior: Mechanisms, ecology, evolution* (5th ed.). McGraw-Hill.
2. Jansma, R. (2016). *Global philosophical and ecological concepts*. Motilal Banarsidass Publishers.
3. Rastogi, V. B. (2022). *Organic evolution: Evolutionary Biology*. MedTech Science Press.
4. Sigmund, K. (2017). *Games of life: Explorations in ecology, evolution, and behavior*. Dover Publications.
5. Odum, E. P., and Barrett, G. W. (2005). *Fundamentals of ecology* (5th ed.). Cengage Learning India Private Limited
6. Smith, T. M., & Smith, R. L. (2015). *Elements of ecology*, Global Edition. Pearson Education.
7. Maynard Smith, J. (1993). *The theory of evolution*. Cambridge University Press.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4065
Course Title: Ecology and Evolution
(Practical)

COURSE OUTCOME:

After completion of this practical course, the learners will be to:

CO1: Identify ecological sampling methods, homologous and analogous structures, mimicry, and fossils related to ecology and evolution.

CO2: Explain the principles of quadrat analysis and water quality assessment using dissolved oxygen (DO) and total dissolved solids (TDS).

CO3: Perform ecological sampling and water quality analysis using standard laboratory techniques.

CO4: Analyze experimental observations and evolutionary evidence to interpret ecological patterns, adaptations, and evolutionary relationships.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-IV
Session: 2026-27
Course Code: BBTM-4065
Course Title: Ecology and Evolution
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:
1. To determine the minimum size of the quadrat by species area-curve method.
2. To measure amount of dissolved oxygen in pond water.
3. To determine the total dissolved solids (TDS) in water
4. Comparison of homologous and analogous structures
5. Demonstration of kinds of mimicry in various group of animals,
6. Study of fossils

Books Recommended:

1. Drickamer, L. C., Vessey, S. H., & Jakob, E. (2002). *Animal behavior: Mechanisms, ecology, evolution* (5th ed.). McGraw-Hill.
2. Kardong, K.V. (2018). *Vertebrates: Comparative anatomy, function, evolution* (8th ed.). McGraw-Hill Education.
3. Rastogi, V. B. (2022). *Organic evolution* (Evolutionary Biology). MedTech Science Press.

B.Sc. Bio-Technology Semester-V

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5061
Couse Title: r-DNA Technology-I
(Theory)

Upon successful completion of this course, the learners will be able to:

CO1: Explain the properties, mechanisms of action, and applications of DNA-modifying enzymes employed in recombinant DNA technology and molecular cloning.

CO2: Analyze the characteristics, selection strategies, and applications of cloning vectors used for gene cloning and recombinant DNA technology in *Escherichia coli*.

CO3: Evaluate the principles and applications of nucleic acid hybridization, blotting techniques, and gene transfer methods used in molecular biology and genetic engineering.

CO4: Assess the principles, methodologies, and detection strategies of radioactive and non-radioactive nucleic acid labelling for molecular diagnostics and biotechnology research.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5061
Couse Title: r-DNA Technology-I
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 4-0-1 **Practical:20**
Theory: 50
CA:30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 12 marks.

Unit-I

DNA Modifying enzymes: Ligases for blunt and sticky end ligation, DNA Polymerases, Klenow fragment, Phosphatases, Polynucleotide kinase, Terminal deoxynucleotidyl transferase, Restriction enzymes, reverse transcriptase. RNase-H, DNase-I, Nuclease S-I

Unit-II

Cloning Vectors for *E coli*: features of plasmids and development of plasmids as vector (α complementation), lytic and lysogenic cycle in Lambda: bacteriophages as vector, Genetic selection (Hfl, Spi) and histochemical selection, M13 as cloning vector, Cosmids

Unit-III

Southern and Northern blotting, Hybridization, Merits and demerits of nitrocellulose and nylon membranes (N and N+). Methods of Transformation: $CaCl_2$, electroporation, transfection, microprojectile.

Unit-IV

Labelling of DNA and RNA- Radioactive labeling (Nick Translation, Random Priming, End Labelling), Non-Radioactive labelling (Direct and Indirect non isotopic labeling), Detection systems of labeled probes

Books Recommended:

1.Primrose, S. B., & Twyman, R. M. (2014). *Principles of gene manipulation and genomics*. Wiley-Blackwell

2.Watson, J. D., Myers, R. M., Caudy, A. A., & Witkowski, J. A. (2017). *Recombinant DNA: Genes and genomes—A short course*. W. H. Freeman.

3.Brown, T. A. (2025). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.

4. Sharma, A. D. (2017). *rDNA technology* (2nd ed.). Himalaya Publishing House.

5.Reece, R. J. (2008). *Analysis of genes and genomes*. Wiley-Blackwell.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5061
Couse Title: r-DNA Technology-I
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Explain the principles underlying bacterial culture, genomic DNA isolation, restriction digestion, agarose gel electrophoresis, and Southern blotting.
CO2: Perform bacterial culture, genomic DNA isolation, spectrophotometric quantification, and agarose gel electrophoresis using standard molecular biology protocols.
CO3: Analyze DNA quality, restriction enzyme digestion patterns, and electrophoretic profiles to assess the integrity and characteristics of nucleic acid samples.
CO4: Evaluate the results of restriction digestion and Southern blotting for the detection and characterization of specific DNA sequences in molecular biology investigations.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5061
Couse Title: r-DNA Technology-I
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:
1. Isolation of genomic DNA from bacteria.
2. Spectrophotometric quantification of DNA and determination of purity.
3.Restriction enzyme digestion of the isolated DNA with 6, 5 and 4 cutters.
4.Southern Blotting.

Books Recommended:

1.S.B. Primrose and R.M. Twyman; Principles of Gene Manipulation. 2006.
2.J. Sambrook and Michael R. Green; Molecular Cloning: A Laboratory Manual, (Fourth Edition), CSHL, 2012.
3.Brown, T. A. (2023). *Genomes 5*. CRC Press.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5062
Couse Title: Animal Biotechnology-I
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the principles, laboratory design, aseptic techniques, cryopreservation methods, and characteristics of normal and transformed cells in animal tissue culture.

CO2: Analyze the sources, types, prevention, and control of contamination, laboratory biosafety practices, and cleanroom facilities required for safe and effective animal tissue culture.

CO3: Evaluate the composition, physicochemical properties, and applications of culture media and reagents, including serum-supplemented, serum-free, and conditioned media, for the cultivation of animal cells.

CO4: Assess the methodologies for primary and established cell culture, cell isolation, cultivation, growth kinetics, and cell proliferation analysis for applications in animal tissue culture research.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5062
Couse Title: Animal Biotechnology-I
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 4-0-1 **Theory: 50**
Practical:20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

UNIT-I

Historical background, Advantages and Disadvantages of animal tissue culture, Design and layout of ATC Lab, Equipments used in ATC Lab, Aseptic Techniques in ATC- Sterilization of culture media, glassware and tissue culture laboratory. Growth and viability of cells in culture, cryopreservation and retrieval of cells from frozen storage, transportation of cells. Characteristics of normal and transformed cells.

UNIT-II

Contamination- sources, Types, monitoring and eradication of contamination, Cross Contamination. Safety considerations in ATC laboratory, Clean Environment – P1, P2, P3 facility and their applications.

UNIT-III

Culture Media and Reagents-Types of cell culture media, physiochemical properties, balanced salt solution, constituents of serum, serum free media (SFM), design of SFM, Advantages and disadvantages of serum supplemented and serum free media, conditioned media

UNIT-IV

Primary culture and Established cell line Culture (Finite and continuous cell lines), Isolation of cells-Enzyme digestion, perfusion and mechanical disaggregation. Culture of attached cells and cells in suspension, phases of cell growth and determination of cell growth data (calculation of in vitro age, multiplication rate, population doubling time, cell counting, phases of cell cycle)

Books Recommended:

1.Freshney, R. I. and Davis A.C. (2021). *Culture of animal cells: A manual of basic technique and specialized applications* (8th ed.). John Wiley & Sons.

2.Davis, J. M. (Ed.). (2011). *Animal cell culture: Essential methods*. John Wiley & Sons.

3.Celis, J. E. (Ed.), Carter, N., Simons, K., Small, J. V., Hunter, T., & Shotton, D. (Eds.). (2006). *Cell biology: A laboratory handbook*. Elsevier Academic Press.

4.Butler, M. (2005). *Animal cell culture and technology*. Taylor & Francis.

5.Basic Cell Culture: A Practical Approach, 2nd ed. Edited by John Davis Oxford University Press, Oxford and New York. 2002 Davis, J. M. (2004). Basic cell culture: a practical approach. In *Basic cell culture: a practical approach*.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5062
Couse Title: Animal Biotechnology-I
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Explain the sources of contamination and the decontamination measures essential for maintaining aseptic conditions in an animal tissue culture laboratory.

CO2: Prepare balanced salt solutions, culture media, and serum by following standard protocols.

CO3: Perform the isolation and culture of lymphocytes from peripheral blood using aseptic techniques and appropriate cell culture procedures.

CO4: Analyze the quality of prepared media, serum, and cultured cells by interpreting laboratory observations and assessing their suitability for animal tissue culture applications.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5062
Couse Title: Animal Biotechnology-I
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:
1.Sources of contamination and decontamination measures.
2. Preparation of Hanks Balanced salt solution.
3. Preparation of Minimal Essential Growth medium.
4. Separation of Serum from blood.
5.Isolation and Culture of Lymphocytes from Peripheral Blood

Book Recommended:

1. Freshney, R. I. and Davis A.C. (2021). *Culture of animal cells: A manual of basic technique and specialized applications* (8th ed.). John Wiley & Sons.
2. Davis, J. M. (Ed.). (2011). *Animal cell culture: Essential methods*. John Wiley & Sons.
3. Celis, J. E. (Ed.), Carter, N., Simons, K., Small, J. V., Hunter, T., & Shotton, D. (Eds.). (2006). *Cell biology: A laboratory handbook*. Elsevier Academic Press.
4. Butler, M. (2005). *Animal cell culture and technology*. Taylor & Francis.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5063
Couse Title: Bioprocess Engineering-I
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the fundamental principles of biochemical engineering, including heat and mass transfer, diffusion phenomena, oxygen transfer mechanisms, and microbial culture systems used in bioprocesses.
CO2: Analyze microbial growth kinetics and evaluate the influence of kinetic parameters, substrate utilization, product formation, and biomass productivity on bioprocess performance.
CO3: Evaluate the regulatory mechanisms governing microbial metabolism and product formation, including feedback regulation and the effects of environmental factors on bioprocess efficiency.
CO4: Assess the principles, methods, and process design of sterilization systems employed in bioprocessing for ensuring aseptic operation and product quality.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5063
Couse Title: Bioprocess Engineering-I
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 4-0-1 **Theory: 50**
Practical: 20
CA: 15

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. Fourier's Laws of heat transfer, Molecular diffusion, Diffusion theory, role of diffusion in bioprocessing, Oxygen transfer methodology in bioreactors and factors affecting oxygen transfer, Types of microbial culture: Batch, Fed batch and continuous culture.

Unit-II

Microbial Growth Kinetics: Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, metabolic and biomass productivities.

Unit-III

Internal and external feed back systems, effector molecules and its kinetics, Effect of temperature, pH and inducer on product synthesis.

Unit-IV

Sterilization: Introduction, air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Books Recommended:

1.Stanbury, P. F., Whitaker, A., & Hall, S. J. (2026). *Principles of fermentation technology* (3rd ed.). Elsevier Science.

2.Moo-Young, M. (2019). *Comprehensive biotechnology*. Elsevier.

3.Moo-Young, M., Anderson, W. A., & Chakrabarty, A. M. (Eds.). (2014). *Environmental biotechnology: principles and applications*. Springer Science & Business Media.

4. Bailey, J. E., & Ollis, D. F. (2018). *Biochemical engineering fundamentals*. McGraw-Hill.

5. Pirt, S. J. (1975). *Principles of microbe and cell cultivation* (pp. 274-pp).

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5063
Couse Title: Bioprocess Engineering-I
(Practical)

COURSE OUTCOMES:

Upon successful completion of this practical course, the learners will be able to:

CO1: Explain the principles of microbial growth, fermentation processes, and sterilization techniques employed in bioprocess engineering.

CO2: Perform microbial cultivation, determine growth kinetics, and evaluate specific growth rate and generation time using standard fermentation techniques.

CO3: Analyze the influence of process parameters, including temperature, pH, and aeration, on microbial growth and bioprocess performance.

CO4: Evaluate enzyme production and activity in bioreactor or shaking flask systems and interpret the experimental outcomes for process optimization.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5063
Couse Title: Bioprocess Engineering-I
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:

Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:

1. To study the growth curve of microorganism.
2. To determine the specific growth rate and generation time of a bacterium during submerged fermentation.
3. Demonstration of sterilization of fermenter and other accessories.
4. To study the effect of temperature, pH and aeration on growth of microbes.
5. Production and assay of an enzyme in a Bioreactor/shaking flask.

Book Recommended:

1.Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory (Pearson Benjamin Cummings). Cappuccino, J.G. and Sherman, N. (2014). Microbiology: A Laboratory Manual 10th Edition, Harlow, Addition-Wesley.
2.Plummer D.T. (2006). An introduction to practical biochemistry (Tata McGraw Hill Publishers Co. Ltd., New Delhi).
3.Bansal, D.D. (1985). Practical biochemistry (Standard Publication Chandigarh).

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5064
Couse Title: Environmental Biotechnology
(Theory)

COURSE OUTCOMES:

Upon successful completion of this course, the learners will be able to:

CO1: Explain the causes and impacts of environmental pollution and the principles of biotechnological approaches employed for pollution monitoring, wastewater treatment, solid waste management, and environmental protection.

CO2: Analyze the sources, production technologies, and applications of biomass and biofuels, and examine their potential for sustainable energy generation and environmental sustainability.

CO3: Evaluate the molecular mechanisms of biological nitrogen fixation and the role of biofertilizers in enhancing agricultural productivity and promoting sustainable farming practices.

CO4: Assess the applications of bioremediation technologies and microbial processes for the remediation of environmental pollutants and the development of sustainable environmental management strategies.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5064
Couse Title: Environmental Biotechnology
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 4-0-1 **Theory: 50**
Practical:20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

Environmental Pollution and Management: Types of pollution, sources, methods for the measurement of pollution and their control through Biotechnology; waste water treatments (physical, chemical and Biological). Microbiology of waste water treatments, aerobic and anaerobic process. Thin film techniques for waste water treatment using aquatic plants. Role of nanotechnology in environmental pollution control. Solid Waste Management with Vermicomposting, overall benefits, economics and marketing.

Unit-II

Biomass Production and Biofuels: Introduction, plant biomass, sources of biomass forest biomass, crop residues (cereals, leguminous crops, sugar cane etc.) aquatic biomass, wastes as a source of energy, composition of plant biomass (cellulose, hemicellulose and lignins), biomass conversion, biological and non- biological processes, useful products biomass (ethyl alcohol, methanol, methane), Application and future prospects, Recent trends in biofuel research.

Unit-III

Biological Nitrogen Fixation and Biofertilizer: The range of nitrogen fixing organisms, biochemistry of nitrogenase, genetics of nitrogen fixation, regulation of nif gene expression, symbiotic nitrogen fixation, genetic analysis of Rhizobium bacteria, regulation of nod gene expression, transfer of nif genes from Klebsiella pneumoniae to other organisms, application and future prospects. green manuring, the blue green algae, algalization, Azolla, present status and improvements.

Unit-IV

Bioremediation: Types of bioremediation, use of fungi, algae and bacteria in biosorption, ecological considerations, biodegradation of oil spills, surfactants, TNT wastes, dye stuff wastes, insecticides, herbicides, antibiotics. plastic menace, biodegradable plastics, volatile toxic gases and biofiltration.

Books Recommended:

1. Manahan, S. E. (2022). *Environmental chemistry*. CRC press.
2. Anderson, D., & Conning, D. M. (1993). *Experimental toxicology*. Royal Society of Chemistry.

3. Abbasi, S.A., and Ramasami, E. (1999). Biotechnological Methods of Pollution Control. Universities Press, Hyderabad.
4. Alexander, M. (1999). Biodegradation and Bioremediation. Academic Press, San Diego.
5. Young, L. Y., & Cerniglia, C. E. (Eds.). (1995). *Microbial transformation and degradation of toxic organic chemicals* (pp. xii+-654).
6. Omenn, G. S. (2013). *Environmental biotechnology: reducing risks from environmental chemicals through biotechnology*. Springer Science & Business Media.
7. Rittmann, D.E., McCarty, P.L. (2001). Environmental Biotechnology: Principles and Applications. McGraw Hill, New York

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5064
Couse Title: Environmental Biotechnology
(Practical)

Upon successful completion of this practical course, the learners will be able to:

CO1: Explain the principles and significance of environmental quality assessment, biofertilizer production, vermicomposting, and bioremediation in sustainable environmental management.

CO2: Perform physicochemical and microbiological analyses of environmental samples, including drinking water quality assessment, determination of BOD and COD, and isolation and cultivation of environmentally significant microorganisms.

CO3: Analyze the efficiency of cellulolytic microorganisms, *Rhizobium*, vermicomposting, and fungal strains in waste degradation, biofertilizer production, and dye bioremediation.

CO4: Evaluate experimental findings to assess the effectiveness of biotechnological approaches for pollution control, waste management, and environmental sustainability.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTM-5064
Couse Title: Environmental Biotechnology
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:

Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:

1.Determination of drinking water quality
2.Determination of BOD and COD Sewerage samples
3.Isolation of Cellulolytic waste degrading microorganism
4.Isolation of Rhizobium from root nodule and mass cultivation
5.Study the technique of vermicomposting
6.Bioremediation of dyes using different fungal strain from soil

Book Recommended:

1. Manahan, S. E. (1997), Environmental Science and Technology, Lewis Publishers, New York
2. Anderson, D., & Conning, D. M. (1993). *Experimental toxicology*. Royal Society of Chemistry.
3. Abbasi, S.A., and Ramasami, E. (1999). Biotechnological Methods of Pollution Control. Universities Press, Hyderabad.
4. Alexander, M. (1999). Biodegradation and Bioremediation. Acadamic Press, San Diego.
5. Young, L. Y., & Cerniglia, C. E. (Eds.). (1995). *Microbial transformation and degradation of toxic organic chemicals* (pp. xii+-654).

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTI-5066
Course Title: Internship

After passing this course the student will be able to:

CO1: Apply theoretical knowledge in real-life professional and community settings through experiential learning.
CO2: Develop practical skills, communication abilities, and professional ethics while working with industries and organizations.
CO3: Understand workplace culture, teamwork, and problem-solving approaches in different professional environments.
CO4: Prepare and present internship/community outreach reports effectively based on their field experiences.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-V
Session: 2026-27
Course Code: BBTI-5066
Course Title: Internship

Time: 3 Hours **Max. Marks:50**
L-T-P: 0-0-2

Evaluation of report based on above themes will be evaluated by board of three internal examiners. Students will be evaluated as satisfactory or unsatisfactory. Award list will be submitted

Course Outcomes:

1. It is a course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity.
2. A key aspect of the internship/ apprenticeship is induction into actual work situations.
3. It involves working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in onsite experiential learning

B.Sc. Bio-Technology Semester-VI

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6061
Couse Title: Fundamental of Bioinformatics
(Theory)

COURSE OUTCOME:

After successful completion of this course, the learners will be able to:

CO1: Explain the fundamental concepts of computers, computer organization, hardware, software, storage devices, and input/output devices and their relevance in bioinformatics.

CO2: Apply the principles of bioinformatics, including pairwise sequence alignment algorithms, scoring matrices (PAM and BLOSUM), and multiple sequence alignment methods for biological sequence analysis.

CO3: Analyze biological sequence data using BLAST and interpret sequence alignment results for comparative analysis of nucleotide and protein sequences.

CO4: Utilize major biological databases and bioinformatics resources, for retrieval, annotation, and interpretation of biological information.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6061
Couse Title: Fundamental of Bioinformatics
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 15

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

Computers: General introduction to computers, organization of computers, Computer hardware and software. Data Storage Devices: Primary and secondary Storage devices. Input/Output Device: Key tape/diskette devices, light pen mouse and joystick. Printed Output: Serial, line, page, printers; plotters, visual output; voice response units

Unit-II

Introduction to bioinformatics: History, Milestones and Applications, Local and Global alignments, Gap Penalities, Pairwise sequence alignments (Needleman-Wunsch, Smith- Watermann Algorithms), Significance of Sequence Alignment.

Unit-III

Scoring Matrices: PAM, BLOSUM
Multiple Sequence Alignment: Progressive Alignment, Iterative Alignment Methods
Database Searching: BLAST and its types

Unit-IV

Primary and Secondary databases, Online resources of Bioinformatics: Introduction about: NCBI, EBI, DDBJ, Expasy, PUBMED, PDB, UNIPROT, Pfam, Prosite.

Books Recommended:

1. Norton, P. (2002). *Introduction to Computing Fundamentals*. McGraw-Hill Education, New Delhi.
2. Pradeep, K., & Priti, S. (2004). Computer Fundamentals. BPB Publications.
3. Xiong, J. (2006). *Essential bioinformatics*. Cambridge University Press.
4. Baxevanis A.D. and Ouellette B.F.F. (2011). Bioinformatics a Practical Guide to the Analysis of Genes and Proteins.(3rd Edition) Wiley-Interscience

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6061
Couse Title: Fundamental of Bioinformatics
(Practical)

COURSE OUTCOME:

After successful completion of this course, the learners will be able to:

CO1: Explain the applications of MS Office tools, biological databases, and standard biological sequence formats used in bioinformatics.

CO2: Retrieve biological information from online databases, including NCBI, EMBL, UniProt, and PubMed, using appropriate search strategies.

CO3: Perform biological sequence analysis using BLAST, Clustal Omega, and standard sequence formats (FASTA and GenBank).

CO4: Analyze protein sequences to identify conserved domains and functional motifs using PFAM and PROSITE.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6061
Couse Title: Fundamental of Bioinformatics
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:

Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:

1. MS-Office: word, Excel, Power-point
2. Introduction about Various Databases: NCBI, EMBL, UNIPROT, PUBMED
3. GenBank Format, FASTA format etc.
4. Basic Local Alignment Search tools (BLAST)
5. Multiple Sequence Alignment using Clustal Omega
6. Prediction of Protein functional domain using PFAM/PROSITE

Books Recommended:

1. Norton, P. (2002). *Introduction to Computing Fundamentals*. McGraw-Hill Education, New Delhi.
2. Pradeep, K., & Priti, S. (2004). Computer Fundamentals. BPB Publications.
3. Xiong, J. (2006). *Essential bioinformatics*. Cambridge University Press.
4. Baxevanis A.D. and Ouellette B.F.F. (2011). Bioinformatics a Practical Guide to the Analysis of Genes and Proteins. (3rd Edition) Wiley-Interscience

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6062
Course Title: Plant Biotechnology-I
(Theory)

COURSE OUTCOMES:

After successful completion of this course, the learners will be able to:

CO1: Describe the fundamental concepts of plant tissue culture, cellular totipotency, tissue competency, laboratory organization, and sterilization techniques.

CO2: Explain the composition of culture media and the roles of plant growth regulators in the growth and development of plant tissues under in vitro conditions.

CO3: Apply the principles of organogenesis, somatic embryogenesis, micropropagation, and acclimatization for in vitro plant regeneration and multiplication.

CO4: Analyze the applications of haploid and triploid production, embryo, ovule and ovary culture, and somaclonal variation in plant improvement and crop biotechnology.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6062
Course Title: Plant Biotechnology-I
(Theory)

Time: 3 Hours **Max. Marks: 100**
Theory: 50
Practical:20
CA: 30

L-T-P: 3-0-0

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 12 marks.

Unit-I

Cellular totipotency; differentiation, dedifferentiation and redifferentiation of cells; tissue competency; plant-explant-plant concept.
Plant tissue culture lab: Layout and organization, infrastructure, equipments and instruments.
Sterilization methods for lab, glassware, tools, culture media and plant materials.

Unit-II

Culture Media: Nutritional requirements for plant tissue culture; types of media and role of different components; preparation of culture media.
Physiological functions and biosynthesis of major plant growth regulators such as auxins, cytokinins, gibberellins and abscisic acid.

Unit-III

Modes of regeneration: Organogenesis and somatic embryogenesis; types and applications of somatic embryogenesis. Micropropagation methods (axillary bud, shoot-tip and meristem culture); stages of micropropagation, factors affecting micropropagation and technical problems; acclimatization of tissue culture raised plants; applications of micropropagation; a brief account of synthetic seeds.

Unit IV

Haploid and triploid plant production through tissue culture and their applications; ovary and ovule culture; embryo culture and rescuing hybrid embryos; somaclonal variations, selection of variant cell lines and its applications.

Books Recommended:

1.Bhojwani, S. S., & Dantu, P. K. (2013). *Plant tissue culture: an introductory text* (Vol. 318). India: Springer.

2.Razdan, M. K. (2019). *Introduction to Plant Tissue Culture* (3rd ed.). Oxford & IBH Publishing Co. Pvt. Ltd.
3.Davey, M. R., & Anthony, P. (2010). *Plant cell culture: essential methods*. John Wiley & Sons.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6062
Course Title: Plant Biotechnology-I
(Practical)

COURSE OUTCOMES:

After successful completion of this practical course, the learners will be able to:

CO1: Identify the laboratory infrastructure, essential instruments, culture vessels, and sterilization methods used in plant tissue culture.

CO2: Explain the principles of laboratory organization, aseptic techniques, culture media preparation, and sterilization procedures employed in plant tissue culture.

CO3: Perform the preparation of stock solutions, Murashige and Skoog (MS) medium, sterilization of culture materials, and aseptic inoculation of explants for in vitro culture establishment.

CO4: Analyze the suitability of explants, culture media, and sterilization procedures for the successful establishment of contamination-free plant tissue cultures.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6062
Course Title: Plant Biotechnology-I
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:

1. To study functions and operations of various instruments required for plant tissue culture (pH meter, autoclave, laminar air-flow, incubators, oven, distillation unit etc.).
2. Laboratory design set up for a PTC Laboratory.
3. Cleaning of glassware, plasticware and contaminated cultures.
4. Different types of enclosure used in plant tissue culture. Preparation of cotton plugs.
5. Preparation of stock solutions of Murashige and Skoog (1962) medium.
6. Preparation of Murashige and Skoog's medium from stock solutions.
7. Different sterilization process (Instruments, glassware and thermolabile and thermostable components)
8. Selection, preparation, sterilization and inoculation of explants.

Books recommended:

1.Bhojwani, S. S., & Dantu, P. K. (2013). *Plant tissue culture: an introductory text* (Vol. 318). India: Springer.
2.Razdan, M. K. (2019). *Introduction to Plant Tissue Culture* (3rd ed.). Oxford & IBH Publishing Co. Pvt. Ltd.
3.Davey, M. R., & Anthony, P. (2010). *Plant cell culture: essential methods*. John Wiley & Sons.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6063
Course Title: rDNA Technology-II
(Theory)

COURSE OUTCOMES:

After successful completion of this course, the learners will be able to:

CO1: Describe the structure, characteristics, and applications of cloning and expression vectors used in recombinant DNA technology.

CO2: Explain the principles and methodologies of genomic cloning, cDNA cloning, PCR, microarray technology, and DNA sequencing.

CO3: Apply the concepts of recombinant DNA technology to the selection of appropriate cloning strategies, vectors, and molecular techniques for gene manipulation and analysis.

CO4: Analyze gene modification approaches for their applications in biotechnology and genetic engineering.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6063
Course Title: rDNA Technology-II
(Theory)

Time: 3 Hours **Max. Marks: 100**
Theory: 50
Practical: 20
CA: 30

L-T-P: 4-0-1

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 12 marks.

UNIT-I

Phagemids, Fosmids, Cloning vectors for Eukaryotes (TAC, YAC, BAC, Ti plasmids), Expression Vectors pET280, pGEX, role of promoter, cassettes and gene fusion, important components of shuttle vectors.

UNIT-II

Overview of cloning, genomic cloning in (Lambda) vector, cDNA cloning: Linker, Adapters, Different strategies for cDNA cloning- self priming and adaptor linker methods.

UNIT-III

Principles and applications of PCR, Fundamental concepts and applications of microarray. DNA Sequencing: Sanger-Coulson method (chain terminating nucleotides), Maxam Gilbert method (chemical degradation of DNA),

UNIT-IV

Changing genes: site directed mutagenesis, cassette mutagenesis, single primer method, PCR methods of site directed mutagenesis, phage display: selection of mutant peptides

Books Recommended:

1. Primrose, S. B., & Twyman, R. M. (2014). *Principles of gene manipulation and genomics*. Wiley-Blackwell
2. Watson, J. D., Myers, R. M., Caudy, A. A., & Witkowski, J. A. (2017). *Recombinant DNA: Genes and genomes—A short course*. W. H. Freeman.
3. Brown, T. A. (2025). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
4. Sharma, A. D. (2017). *rDNA technology* (2nd ed.). Himalaya Publishing House.
5. Reece, R. J. (2008). *Analysis of genes and genomes*. Wiley-Blackwell.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6063

Course Title: r-DNA Technology-II

(Practical)

COURSE OUTCOMES:

After successful completion of this practical course, the learners will be able to:

CO1: Identify the principles and laboratory requirements for plasmid isolation, ligation, transformation, and PCR techniques.

CO2: Explain the principles underlying plasmid isolation, preparation of competent cells, transformation, and polymerase chain reaction (PCR).

CO3: Perform plasmid DNA isolation, ligation, competent cell preparation, bacterial transformation, and PCR using standard molecular biology protocols.

CO4: Analyze the outcomes of transformation and PCR experiments to verify successful gene transfer and amplification.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6063
Course Title: r-DNA Technology-II
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiments:

1. Isolation of plasmid DNA
2.To perform ligation reaction
3. Preparation of competent cells
4. Transformation of competent cells by $CaCl_2$ method.
5. Confirmation of the transformants for the presence of plasmid.
6. PCR

Books Recommended:

1. Primrose, S. B., & Twyman, R. M. (2014). *Principles of gene manipulation and genomics*. Wiley-Blackwell
2. Watson, J. D., Myers, R. M., Caudy, A. A., & Witkowski, J. A. (2017). *Recombinant DNA: Genes and genomes—A short course*. W. H. Freeman.
3. Brown, T. A. (2025). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
4. Sharma, A. D. (2017). *rDNA technology* (2nd ed.). Himalaya Publishing House.
5. Reece, R. J. (2008). *Analysis of genes and genomes*. Wiley-Blackwell.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6064
Course Title: Ecology and Evolution
(Theory)

COURSE OUTCOME:

After successful completion of this course, the learners will be able to:

CO1: Explain the fundamental concepts of ecology, environmental components, habitat, niche, trophic interactions, nutrient cycling, and species interactions.
CO2: Analyze ecological succession, ecosystem structure and function, energy flow, biogeochemical cycles, and biodiversity conservation strategies for sustainable ecosystem management.
CO3: Interpret the principles of organic evolution, origin of life, natural selection, and speciation using classical and modern evolutionary theories.
CO4: Apply the principles of population genetics, molecular evolution, phylogenetic reconstruction, and biogeography to explain genetic variation, evolutionary relationships, and species diversification.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6064
Course Title: Ecology and Evolution
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 4-0-1

Theory: 50
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions: trophic levels and their interactions; nutrient cycles; primary and secondary levels. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized Species. Interactions: Types of interactions (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc.), interspecific competition (physiological adaptations to abiotic environment); prey- predator interactions (Lotka-Volterra equation etc.), prey predator interactions (mimicry, crypsis, etc.).

Unit-II

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. **Ecosystem Ecology**: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of ecosystems: terrestrial (forest, grassland) and aquatic (freshwater, marine, estuarine). *in situ* conservation (endemism, biodiversity hotspots, protected areas); *ex-situ* conservation; conservation genetics (genetic diversity, inbreeding depression).

Unit-III

Organic evolution: Evidences of evolution (palaeontological, comparative anatomy, embryological, biogeographical and molecular evidences); natural selection and types of selection (stabilizing, directional, disruptive), industrial melanism and polymorphism.

Origin of life: Origin of micro-molecules, macromolecules, viruses, prokaryotes and eukaryotes speciation: isolation and its types.

Unit-IV

Population and Quantitative genetics: Origins of genetic variation; Mendelian genetics; Hardy-Weinberg equilibrium; drift; selection population genetics polygenic traits.

Molecular evolution Neutral theory; molecular clocks; rates of evolution; phylogenetic reconstruction; molecular systematics. Species concepts and speciation; adaptive radiation; convergence; biogeography.

Books Recommended:

1. Drickamer, L. C., Vessey, S. H., & Jakob, E. (2002). *Animal behavior: Mechanisms, ecology, evolution* (5th ed.). McGraw-Hill.
2. Jansma, R. (2016). *Global philosophical and ecological concepts*. Motilal Banarsidass Publishers.
3. Rastogi, V. B. (2022). *Organic evolution: Evolutionary Biology*. MedTech Science Press.
4. Sigmund, K. (2017). *Games of life: Explorations in ecology, evolution, and behavior*. Dover Publications.
5. Odum, E. P., and Barrett, G. W. (2005). *Fundamentals of ecology* (5th ed.). Cengage Learning India Private Limited
6. Smith, T. M., & Smith, R. L. (2015). *Elements of ecology*, Global Edition. Pearson Education.
7. Maynard Smith, J. (1993). *The theory of evolution*. Cambridge University Press.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6064
Course Title: Ecology and Evolution
(Practical)

COURSE OUTCOME:

After completion of this practical course, the learners will be to:

CO1: Identify ecological sampling methods, homologous and analogous structures, mimicry, and fossils related to ecology and evolution.

CO2: Explain the principles of quadrat analysis and water quality assessment using dissolved oxygen (DO) and total dissolved solids (TDS).

CO3: Perform ecological sampling and water quality analysis using standard laboratory techniques.

CO4: Analyze experimental observations and evolutionary evidence to interpret ecological patterns, adaptations, and evolutionary relationships.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6064
Course Title: Ecology and Evolution
(Practical)

Time: 3 Hours **Practical Marks: 20**

Instructions for the practical Examiner:
Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:
1. To determine the minimum size of the quadrat by species area-curve method.
2. To measure amount of dissolved oxygen in pond water.
3. To determine the total dissolved solids (TDS) in water
4. Comparison of homologous and analogous structures
5. Demonstration of kinds of mimicry in various group of animals,
6. Study of fossils

Books Recommended:

1. Drickamer, L. C., Vessey, S. H., & Jakob, E. (2002). *Animal behavior: Mechanisms, ecology, evolution* (5th ed.). McGraw-Hill.
2. Kardong, K.V. (2018). *Vertebrates: Comparative anatomy, function, evolution* (8th ed.). McGraw-Hill Education.
3. Rastogi, V. B. (2022). *Organic evolution* (Evolutionary Biology). MedTech Science Press.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6060
Course Title: Skill Development in Bio-Technology-II
(Theory)

After successful completion of this course, learners will be able to:

CO1: Explain the principles of phlebotomy, hematological investigations, and diagnostic techniques used in clinical laboratory practice.

CO2: Apply appropriate laboratory and diagnostic procedures for the analysis of hematological parameters and the diagnosis of human diseases.

CO3: Analyze the role of tumor markers, molecular diagnostic techniques, and PCR-based methods in the detection and diagnosis of infectious diseases and cancer.

CO4: Evaluate biomedical waste management practices and biorisk management strategies for infection prevention, laboratory safety, and regulatory compliance.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6060
Course Title: Skill Development in Bio-Technology-II
(Theory)

Time: 3 Hours **Max. Marks: 100**
L-T-P: 3-0-1 **Theory: 50**
Practical: 20
CA: 30

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions in all, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carries 10 marks.

Unit-I

Phlebotomy: Collection of blood samples, preparation and use of different anticoagulants, estimation of CBC, TLC, DLC, bleeding count, clotting time, Platelet count, Reticulocyte count, Morphology of red cells, ESR, PCV

Unit-II

Diagnostic tests: Principles of X-ray, MRI, ultrasonography, CT scan, PET Scan, ECG, ECHO, Biopsy, colonoscopy, Gastroscopy, Eye test, Hearing test

Unit-III

Cancer, Tumor & Cancer Markers: Carcinogens, Oncogene, Clinical applications of tumor markers, Overview of vector borne diseases: Dengue, Chikungunya, PCR based diagnosis of Bacterial, viral & fungal diseases (covid-19, Swine flu, Tuberculosis, Candidiasis)

Unit-IV

Bio-medical Waste and Biorisk Management: Sources and transmission of biomedical infections, investigation, prevention and control of biomedical infections, principles of biorisk management**,** risk assessment and risk mitigation**,** decontamination methods (physical and chemical), sterilization and disinfection, segregation and disposal of non-infectious waste**,** infectious sharp waste**, and** infectious non-sharp waste**,** handling and disposal of ethidium bromide (EtBr) waste**,** biological spill management, and biomedical waste management guidelines.

Books Recommended:

1. McPherson, R. A., & Pincus, M. R. (2021). *Henry's clinical diagnosis and management by laboratory methods E-book*. Elsevier Health Sciences.
2. Kumar, V., Abbas, A. K., & Aster, J. C. (2024). Robbins & Cotran Pathologic Basis of Disease. 11th, editor.

3. World Health Organization. (2025). *Water, sanitation, hygiene, environmental cleaning and waste management in health care facilities: 2023 data update and special focus on primary health care*. World Health Organization.
4. Turgeon, M. L. (2005). *Clinical hematology: theory and procedures*. Lippincott Williams & Wilkins.
5. Tille, P. M. (2013). *Bailey & Scott's Diagnostic Microbiology-E-Book: Bailey & Scott's Diagnostic Microbiology-E-Book*. Elsevier Health Sciences.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6060
Course Title: Skill Development in Bio-Technology-II
(Practical)

COURSE OUTCOMES:

After successful completion of this practical course, learners will be able to:

CO1: Explain the principles of blood collection, peripheral blood smear preparation, and hematological investigations used in clinical diagnostics.
CO2: Perform hematological procedures using standard laboratory techniques.
CO3: Analyze clinical diagnostic reports for disease interpretation.
CO4: Evaluate biomedical waste segregation and disposal practices in accordance with Biomedical Waste Management Guidelines to ensure laboratory safety and infection control.

Bachelor of Science (Bio-Technology) Three Year Degree Programme
Bachelor of Science (Honours) Bio-Technology Four Year Degree Programme
Semester-VI
Session: 2026-27
Course Code: BBTM-6060
Course Title: Skill Development in Bio-Technology-II
(Practical)

Time: 3 Hours

Practical Marks: 20

Instructions for the practical Examiner:

Question paper is to be set on the spot jointly by the internal and external examiners. Two copies of the same may be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar.

Experiment:

1. Collection of Blood Sample and Preparation of Peripheral Blood Smear.
2. Determination of bleeding time and clotting time
3. Determination of ESR and Packed Cell Volume (PCV).
4. Interpretation of Diagnostic Reports (CBC, X-ray, ECG, CT/MRI Images).
5. Segregation and Disposal of Biomedical Waste according to Biomedical Waste Management Guidelines.

Books Recommended:

1. Turgeon, M. L. (2005). *Clinical hematology: theory and procedures*. Lippincott Williams & Wilkins.
2. McPherson, R. A., & Pincus, M. R. (2021). *Henry's clinical diagnosis and management by laboratory methods E-book*. Elsevier Health Sciences.
3. Tille, P. M. (2013). *Bailey & Scott's Diagnostic Microbiology-E-Book: Bailey & Scott's Diagnostic Microbiology-E-Book*. Elsevier Health Sciences.
4. Cappuccino, J. G., & Welsh, C. T. (2020). Microbiology: A Laboratory Manual. Edn. 12th.
5. Naeem, M. (2026). *Clinical Scores: A Quick Reference Guide*. Cambridge Scholars Publishing.