KUVEMPU UNIVERSITY
BIOTECHNOLOGY

Bachelor of science (B.Sc.) Semester scheme
Curriculum structure for upgraded programme – 2024-25
In accordance with SEP

Sl. No	Course/ Paper Code	Title of Paper	Subject Category	Teaching hours	Semester end exams	Internal assessment	Total marks	Credits	Examination duration
Semester - 1									
1	BT – MC -I	**Biomolecules and metabolism**	MC – T	04	80	20	100	03	3Hrs
	Practical -1		MC – P	04	40	10	50	02	3Hrs
Total				**08**	**120**	**30**	**150**	**05**	**--**
Semester - 2									
2	BT –MC - II	**Cell and molecular biology**	MC – T	04	80	20	100	03	3Hrs
	Practical - II		MC – P	04	40	10	50	02	3Hrs
Total				**08**	**120**	**30**	**150**	**05**	**--**
Semester - 3									
3	BT –MC - III	**Microbial technique, biophysics and biostatistics**	MC – T	04	80	20	100	03	3Hrs
	Practical - III		MC – P	04	40	10	50	02	3Hrs
4	Elective/ Optional	**Immunology and Immonotechniques** **Genomics and Proteomics**	EL/ OP -1	02	40	10	50	02	2Hrs
Total				**10**	**160**	**40**	**200**	**07**	**--**
Semester - 4									
5	BT – MC - IV	**Genetic Engineering and Bioinformatics**	MC – T	04	80	20	100	03	3Hrs
	Practical - IV		MC – P	04	40	10	50	02	3Hrs
6	Elective/	**Environmental**	EL/	02	40	10	50	02	2 Hrs

	Optional	**Biotechnology** **Medical Biotechnology and Bionanotechnology**	OP -2						
7	BT-Skill-1	**Bioinformatics**	Skill-1	04	40	10	50	02	3 Hrs
Total				**14**	**200**	**50**	**250**	**09**	--
Semester - 5									
8	BT –MC - V	**Plant Biotechnology**	MC – T	04	80	20	100	03	3Hrs
9	BT –MC - VI	**Animal Biotechnology**	MC – T	04	80	20	100	03	3Hrs
	Practical - V	**Plant and Animal Biotechnology**	MC – P	04	40	10	50	02	3Hrs
10	BT-Skill-2	**Molecular Diagnostics**	Skill-2	04	40	10	50	02	3Hrs
Total				**16**	**240**	**60**	**300**	**10**	--
Semester - 6									
11	BT –MC - VII	**Bioprocess Technology**	MC – T	04	80	20	100	03	3Hrs
12	BT –MC - VIII	**Advances in Biotechnology**	MC – T	04	80	20	100	03	3Hrs
	Practical- VI	**Bioprocess Technology and Advances in Biotechnology**	MC – P	04	40	10	50	02	3Hrs
13	BT-Skill-3	**Research Methodology**	Skill-3	04	40	10	50	02	3Hrs
Total				**16**	**240**	**60**	**300**	**10**	--
			Grand Total	**72**	**1080**	**270**	**1350**	**46**	

IV Semester B.Sc. Degree (SEP Scheme)

BIOTECHNOLOGY

Program Name	**B. Sc Biotechnology**		Semester	**Fourth**
Course Title	**Bioinformatics**			
Course No.	**BT -Skill –1**	**Practical**	No. of Credits	**02**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**10**		Summative Assessment Marks	**40**

The course provides a comprehensive introduction to bioinformatics with a focus on applications in the life sciences. It covers the fundamentals of biological databases, sequence analysis, molecular phylogenetics, protein structure analysis, ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) profiling, target prediction, and primer design. The curriculum emphasizes hands-on, experimental learning through structured computer-based exercises.

Key practical components include:

- Retrieval of nucleotide and protein sequences from public databases (e.g., GenBank, UniProt).
- Sequence similarity searches using BLAST.
- Multiple sequence alignment and phylogenetic tree construction.
- Protein structure visualization and analysis using freely available tools.
- Computational ADMET property prediction for drug discovery.
- Drug–disease target prediction using bioinformatics approaches.
- Primer design for PCR and related applications.
- Interpretation of bioinformatics outputs.

By integrating theoretical foundations with practical exercises, the course builds a strong base in bioinformatics concepts and equips learners with essential computational skills for modern biological research.

V Semester B.Sc. Degree (SEP Scheme)
BIOTECHNOLOGY

Program Name	**B. Sc Biotechnology**		Semester	**Fifth**
Course Title	**Plant Biotechnology**			
Course No.	**BT -MC – V T**	**Theory**	No. of Credits	**03**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**20**		Summative Assessment Marks	**80**

Unit 1: Fundamentals of Plant Tissue Culture 16 Hrs

Definition, history, and scope of plant tissue culture. Concept of cellular totipotency and differentiation. Plant tissue culture laboratory layout and facilities. Equipment used in tissue culture (laminar airflow cabinet, autoclave, culture racks, growth chamber). Sterilization methods and aseptic handling techniques.

Composition of plant tissue culture media. Preparation of Murashige and Skoog (MS) medium. Role of plant growth regulators (auxins, cytokinins, gibberellins). Selection of explants, surface sterilization, and inoculation procedures.

Callus culture, Direct and indirect organogenesis, organ cultures-embryo culture, meristem culture.

Unit 2: Advanced Techniques in Plant Tissue Culture16 Hrs

Somatic embryogenesis — concept, stages, and applications. Synthetic seed production and its applications.

Establishment and maintenance of cell suspension cultures — batch and continuous cultures. Production of secondary metabolites using cell cultures. Protoplast culture — isolation, culture, protoplast fusion techniques, somatic hybridization, and cybridization.

Haploid culture through anther and microspore culture. Somaclonal variation and its significance in crop improvement.

Unit 3: Plant Genetic Engineering and Molecular Techniques 16 Hrs

Principles of plant genetic transformation. Gene constructs, promoters, and selectable markers. Methods of gene transfer — Agrobacterium-mediated transformation, biolistic method, electroporation, and chemical-mediated transformation.

Selection, screening, and regeneration of transformed plants. Molecular confirmation of transgenic plants using PCR and reporter genes.

Brief introduction to genome editing tools (CRISPR-based approaches) in plants.

Unit 4: Applications of Plant Biotechnology 16 Hrs

Micropropagation for large-scale plant production. Production of disease-free plants. Germplasm conservation — cryopreservation and in vitro conservation. Marker-assisted selection in crop improvement.

Applications of plant genetic engineering in crop improvement, stress tolerance, and disease resistance. Role of plant biotechnology in sustainable agriculture and medicinal plant improvement.

Molecular pharming — production of therapeutic proteins, vaccines, and bioactive compounds using transgenic plants.

References:

1. Chawla, H. S. (2011). Introduction to Plant Biotechnology (3rd ed.). CRC Press / Science Publishers.
2. Bhojwani, S.S., and Razdan, M.K. (2004). Plant Tissue Culture: Theory and Practice. Amsterdam: Elsevier Science.
3. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction. 7th edition. Oxford: Wiley-Blackwell.
4. Glick, B.R., and Pasternak, J.J. (2018). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th edition. Washington, DC: ASM Press.
5. Reinert, J., and Bajaj, Y.P.S. (1997). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Berlin: Springer.
6. Sambrook, J., Fritsch, E.F., and Maniatis, T. (1989). Molecular Cloning: A Laboratory Manual. 2nd edition. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
7. Slater, A., Scott, N.W., and Fowler, M.R. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford: Oxford University Press.
8. Smith, R. (2012). Plant Tissue Culture: Techniques and Experiments. 3rd edition. San Diego, CA: Academic Press.
9. Taiz, L., and Zeiger, E. (2014). Plant Physiology. 5th edition. Sunderland, MA: Sinauer Associates.
10. Vasil, I.K., and Vasil, V. (2007). Molecular Improvement of Cereal Crops. Dordrecht: Springer
11. Primrose, S.B., & Twyman, R.M. (2016). Principles of Gene Manipulation (8th ed.). Blackwell Science. ISBN: 978-1405135442.

Program Name	**B. Sc Biotechnology**		Semester	**Fifth**
Course Title	**Animal biotechnology**			
Course No.	**BT -MC – VI T**	**Theory**	No. of Credits	**03**
Contact hours	**64hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**20**		Summative Assessment Marks	**80**

Unit 1:

Cell Culture **16 Hrs**

Historicaland scope, Requirements for cell culture- Laboratory design, culture vessels, equipment's, aseptic handling and safety regulations. Advantages and limitations.

Culture Medium: Physico-chemical factors, Natural Media-Lymph clot, Blood plasma&serum and Embryo extract. Synthetic media- Composition of Balanced Salt solutions,Minimal Essential Medium and growth media. Importance of Serum.

Primary culture- Introduction, Animal selection, tissue, isolation and disaggregation; Mechanical and enzymatic disaggregation: Trypsin and collagenase. Cell expansion techniques- Flask cultures, test tube cultures; Cell quantitation. Organ cultures-characteristics, methods and limitations, Histotypic culture techniques. Suspension culture

Unit-II:

Cell Lines: **16 Hrs**

Biology of cultured cells- Culture Environment-Evolution of cell lines, functional environment of cultures. Sub culturing and designation of cell lines, Cell selection-Finite/continuous cell line, species, normal or transformed; growth characteristics and growth phases. Routine maintenance, Examples of cell lines.

Selection and Cloning of Cells: Objectives of cloning, cloning, monolayer and suspension cells; Limiting-dilution and Soft-Agar methods; Isolation techniques- irradiation, broken cover slip, and capillary technique. Cell synchronization- Physical and chemical methods.

Cell Viability and Cytotoxicity assays: Introduction. Toxicity and Viability Assays - Membrane integrity: Enzyme release, Dye exclusion, MTT and Fluorescent dyes.

Unit:III

Cell Process: **16 Hrs**

Cell separation: Physical methods- Density gradient centrifugation and Centrifugal elutriation. Biological Methods- Panning, Magnetic cell sorting and Fluorescence-activated cell sorter (FACS). Applications of separation methods. Cryo-preservation of Animal Cells and Tissues - Principles of freezing and thawing of cells. Cell Banks.

Scale up of animal cell culture: General methods practical consideration of growth kinetics, medium and nutrients, pH, oxygen. Monolayer cultures- Roller bottle modifications, large

capacity stationary cultures, unit process system microcarrier cultures. Suspension cultures - Stirred bioreactors, Airlift fomenters. Immobilized cultures - Immurement cultures, Entrapment cultures and Porous carriers.

Unit IV:

Application of Animal Cell culture: 16 Hrs

Artificial Animal Breeding:Artificial Insemination and Germ Cell Storage, *In vitro* Fertilization (IVF) and Embryo Transfer; Superovulation: Physiological Basis, Influencing Factors, Freezing of embryos, Embryo sexing, Micromanipulation of Embryos - Embryo Splitting, Nuclear Transplantation and Gene injection techniques, Advantages of Cell Manipulation.

Molecular Pharming**:** Introduction. Creating Transgenic, Biopharmaceuticals: Generation of Vaccines. Transgenic Animals; Methods for production of Transgenic Animals, Applications of Transgenic Mice, Transgenic fish, Transgenic Sheep, Transgenic Chickens Transgenic Pigs and cow.

References:

1. Watson, J.D. and Gilman, M. 1992.Recombinant DNA, 2nd ed. Scientific American Book New York.
2. Freshney, I. 1987. Culture of Animal Cells. A Manual of Basic Technique 2nd ed., New York.
3. Bird, B. R. and F. T. Forester. 1981. Basic Lab Techniques in cell Culture. IIS Dept. of Health and Human Services.
4. Spire, R. E. and J. B. Griffiths, 1987.Modern Application to Animal Cell Technology. Butterworth and Co., Ltd., Frome, Somersest.
5. Ashok Mukhopadhyay, 2009. Animal Cell Technology. I. K. International.
6. M. M. Ranga , 2010. Animal Biotechnology. 3rd Ed. Agrobios India.
7. Amita Sarkar.2009. Embryonic Stem cell. Discovery Publishing House Pvt. Ltd., New Delhi.
8. Stakey G. and Davis J. 2007. Medicines from Animal Culture. Jhon Wiley & Sons Ltd.
9. Ranga. 2006. Transgenic Animals. Agrobios (India)

Program Name	**B. Sc Biotechnology**		Semester	**Fifth**
Course Title	**Plant and Animal biotechnology**			
Course No.	**BT -MC – VP**	**Practical**	No. of Credits	**02**
Contact hours	**64hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**10**		Summative Assessment Marks	**40**

Practical experiments:

1. Laboratory organization of basic and commercial plant tissue culture/animal cell culture
2. Aseptic techniques and sterile handling
3. Preparation of plant tissue culture media
4. Explant preparation and inoculation.
5. Callus culture technique.
6. Shoot tip/Meristem culture.
7. Anther culture technique
8. Synthetic seed production
9. Preparation of cell culture media: Preparation of basic cell culture media, such as Dulbecco's Modified Eagle Medium (DMEM), antibiotics, and other required additives.
10. Extraction of serum/plasma.
11. Filter sterilization: Practice filter sterilization for sensitive media ingredients.
12. Cell segregation and viability assessment

References:

10. Chawla, H. S. (2011). Introduction to Plant Biotechnology (3rd ed.). CRC Press / Science Publishers.
11. Bhojwani,S.S.,andRazdan,M.K.(2004).PlantTissueCulture:TheoryandPractic e.Amsterdam:ElsevierScience.
12. Brown,T.A.(2010).GeneCloningandDNAAnalysis:AnIntroduction.7thedition.Oxford :Wiley-Blackwell.
13. Glick,B.R.,andPasternak,J.J.(2018).MolecularBiotechnology:PrinciplesandApplications ofRecombinantDNA.5thedition.Washington,DC:ASM Press.
14. Reinert,J.,andBajaj,Y.P.S.(1997).AppliedandFundamentalAspectsofPlantCell,Tissueand OrganCulture.Berlin:Springer.
15. Sambrook,J.,Fritsch,E.F.,andManiatis,T.(1989).MolecularCloning:ALaboratoryManual .2ndedition.ColdSpringHarbor,NY:ColdSpringHarborLaboratoryPress.
16. Slater,A.,Scott,N.W.,andFowler,M.R.(2008).Plant Biotechnology:TheGeneticManipulationofPlants.Oxford:OxfordUniversity Press.
17. Smith,R.(2012).PlantTissue Culture:TechniquesandExperiments.3rdedition.SanDiego,CA:AcademicPress.
18. Taiz,L.,andZeiger,E.(2014).PlantPhysiology.5thedition.Sunderland,MA:Sinaue rAssociates.
19. Vasil, I.K.,andVasil,V.(2007).Molecular ImprovementofCerealCrops. Dordrecht:Springer
20. Primrose,S.B.,&Twyman,R.M.(2016).PrinciplesofGeneManipulation(8thed.).BlackwellS cience.ISBN:978-1405135442.

Program Name	**B. Sc Biotechnology**		Semester	**Fifth**
Course Title	**Molecular Diagnostics**			
Course No.	**BT -Skill –2**	**Practical**	No. of Credits	**02**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**10**		Summative Assessment Marks	**40**

This course provides comprehensive theoretical and practical training in biochemical, immunological, and genetic engineering techniques essential for modern diagnostics. Students will gain hands-on expertise in operating diagnostic instrumentation, interpreting complex data, and implementing rigorous quality control standards. By bridging the gap between theory and "bench-ready" practice, the curriculum prepares graduates for high-impact careers in clinical laboratories, biotechnology, and personalized medicine.

The Key Practical components include:

- Validation of serum biomarkers such as Glucose, Creatine, lipids, haemoglobin.
- Validation of Antigen and antibody interaction by haemagglutination, immunodiffusion, ELISA, Immunoblotting
- Morphological identification and counting of immune cells
- Erythrocyte sedimentation rate (ESR) from blood sample.
- Analysis of DNA- Agarose gel electrophoresis, Polymerase chain reaction

By merging theoretical foundations with practical application, this course establishes a diagnostic strategy and equips learners with the essential skills required for diagnosis of diseases.

VI Semester B.Sc. Degree (SEP Scheme)
BIOTECHNOLOGY

Program Name	**B. Sc Biotechnology**		Semester	**Sixth**
Course Title	**Bioprocess Technology**			
Course No.	**BT -MC – VII T**	**Theory**	No. of Credits	**03**
Contact hours	**64hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**20**		Summative Assessment Marks	**80**

Unit I – Fundamentals of Bioprocess Technology 16 Hrs

Introduction to bioprocess technology: definition, historical development, and scope. Overview of major bioprocess industries including pharmaceutical, food, agriculture, and environmental sectors.

Microorganisms used in bioprocessing such as bacteria, yeast, and fungi and their role in the production of industrial products.

Microbial growth kinetics, growth curve phases, and principles of microbial cultivation. Factors influencing microbial growth and productivity including temperature, pH, oxygen availability, nutrients, and mixing.

Unit II – Upstream Processing and Fermentation Technology 16 Hrs

Principles and components of upstream processing. Selection, improvement, and maintenance of industrial microbial strains. Inoculum development and inoculum scale-up strategies.

Media formulation, optimization, and preparation. Sterilization of media, air, and bioprocess equipment.

Fundamentals of fermentation technology. Types of fermentation processes including aerobic and anaerobic fermentation. Fermentation techniques such as submerged and solid-state fermentation. Overview of industrial fermentation process flow.

Unit III – Bioreactors and Bioprocess Monitoring 16 Hrs

Design and construction of bioreactors. Basic components and working principles of bioreactors.

Types of bioreactors including stirred tank, airlift, and packed bed reactors. Operating parameters affecting bioprocess performance such as temperature, pH, dissolved oxygen, agitation, aeration, and foam formation.

Bioprocess monitoring and control systems. Sensors and analytical probes. Introduction to bioprocess automation and principles of scale-up from laboratory to pilot and industrial scale.

Unit IV – Downstream Processing and Industrial Applications 16 Hrs

Principles and stages of downstream processing.

Cell separation and harvesting techniques including filtration and centrifugation. Cell disruption methods for intracellular products. Product recovery and purification strategies. Separation and purification techniques such as precipitation, chromatography, and membrane-based processes.

Industrial applications of bioprocess technology in the production of antibiotics (Streptomycin), enzymes (amylase), vaccines (Hepatitis B vaccine), biofuels (Bioethanol), and Wine.

Reference Books

1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2017). *Principles of Fermentation Technology* (3rd ed.). Oxford: Butterworth-Heinemann.
2. Doran, P. M. (2013). *Bioprocess Engineering Principles* (2nd ed.). London: Academic Press.
3. Shuler, M. L., & Kargi, F. (2017). *Bioprocess Engineering: Basic Concepts* (3rd ed.). New Delhi: Prentice Hall of India.
4. Nielsen, J., Villadsen, J., & Lidén, G. (2017). *Bioreaction Engineering Principles* (3rd ed.). New York: Springer.
5. Crueger, W., &Crueger, A. (2000). *Biotechnology: A Textbook of Industrial Microbiology* (2nd ed.). New Delhi: Panima Publishing.
6. Dutta, K. L. (2010). *Biochemical Engineering.* New Delhi: CBS Publishers.
7. Prescott, S. C., & Dunn, C. G. (2004). *Industrial Microbiology* (4th ed.). New Delhi: CBS Publishers.
8. Sibi, G. (2018). Industrial Microbiology and Biotechnology. Himalaya Publishing House.
9. B. Sivasankar. (2006). Bioseparations: Principles and Techniques. PHI; New title edition.
10. U. Satyanarayana. (2020). Biotechnology. Books and Allied (P) Ltd

Program Name	**B. Sc Biotechnology**		Semester	**Sixth**
Course Title	**Advances in Biotechnology**			
Course No.	**BT -MC – VIII T**	**Theory**	No. of Credits	**03**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**20**		Summative Assessment Marks	**80**

Unit 1: Stem Cell biotechnology: 16 hrs

Introduction, potency and hierarchy-Totipotent, pluripotent, multipotent and unipotent cells. Stem cell self-renewal and differentiation. Early embryonic development-blastocyst and the origin of Embryonic Stem Cells (ESCs).

Stem Cell characterization: Isolation, culture and ethical considerations. Adult Stem Cells (Mesenchymal & Hematopoietic): Sourcing from bone marrow and umbilical cord blood. Characterization Techniques: Flow Cytometry (FACS) and Immunocytochemistry .

Clinical applications: Tissue Engineering- scaffolds and biomaterials, designing 3D structures biocompatible polymers. Organoids and Spheroids: growing "mini-organs", drug testing and disease modelling. Therapeutic applications, Stem cell banks.

Unit 2: Medicine Biotechnology: 16 hrs

Biopharmaceuticals: Introduction, small-molecule drugs (aspirin) and large-molecule biopharmaceuticals (insulin, monoclonal antibodies).Classification: Proteins, peptides, monoclonal antibodies (mAbs), Recombinant and RNA vaccines and nucleic acid-based drugs. Cancer immunotherapeutics.

Hormone and cytokine Therapy: Introduction, uses of Insulin (Humulin), Human growth hormone. Somatostatin and Erythropoietin hormones. Cytokines as Therapeutics agents, Preparation of Cytokines by Recombinant DNA Technology.

Antisense Therapeutics – Introduction, Applications of RNAi, Advantages of Antisense drugs. RNA Interference Technology. Mechanism of RNAi, siRNA Synthesis and delivery Strategies. Micro RNA.

Unit 3: Pharmaceutical Biotechnology:16 hrs

Animal Handling: Introduction to various laboratory animal and their requirements; An overview behaviour of animal; animal control tools; animal Restraint; handling; animal markings; Ageing requirement;

Pharmacokinetics: Drugs-Natural and synthetic, Routes of drug administration; dosage fixation, ADME analysis, Toxicity analysis.

Quality Control & Regulatory Affairs: Good Laboratory practices (GLP) and Good Manufacturing practices (GMP): Biosimilars: The generic version of biological drugs and the regulatory hurdles for approval: Clinical Trials: Phases I, II, and III for biotechnological products.

Unit 4: Regulatory and Legal Biotechnology 16 Hrs

Intellectual Property Rights (IPR), purpose and importance in biotechnology. Types-patents, copyrights, trademarks, trade secrets and geographical indications. Fundamentals of patents — basic requirements, filing process and protection of biotechnology inventions. IPR issues related to biological resources, traditional knowledge and biodiversity.

Biosafety and its importance in biotechnology laboratories and industries. Basic concepts of biological risk assessment and containment levels. Safe handling of genetically modified organisms (GMOs). Overview of national and international biosafety guidelines. Laboratory safety measures and proper waste disposal practices.

Bioethics and ethical principles in biological research. Ethical issues related to genetic engineering, transgenic organisms, and biomedical applications. Social and environmental impacts of biotechnology. Overview of ethical and regulatory frameworks guiding biotechnology research and applications.

References:

1. Prathibha N and Venugopal Rao V. 2010. Medical Biotechnology, 1st ed. Oxford Univ. Press, New Delhi.

2. Gery Walsh. 2007. Pharmaceutical Biotechnology Concepts and Applications 1st ed., John Wiley & Sons Ltd., England.

3. Mountain. A, U.M Ney. Vol 5. 2010D.Schomburg. Biotechnology.2nd Edition. V.C.H & Wiley Company.

4.. Fisher. Mikos Bronzino. 2007. Tissue Engineering. C.R.S Press.

5. David.P.C. Clark Nanitte J Pazdernik.2009. Biotechnology Applying the Genetic Revolution. Elsevier Academic Press

6. Thomas M. Devlin. 2006. Text of Biochemistry with clinical correlations. VI edition. by Wiley-Liss., Hoboken, New Jersey.

7. Jonathan Pevsner, "Bioinformatics and Functional Genomics" 2003 John Wiley & Sons, Inc.

8. Essentials of genomics and Bioinformatics by CW Sensen. Wiley-VCH publication.

Program Name	**B. Sc Biotechnology**		Semester	**Sixth**
Course Title	**Bioprocess Technology and Advances in Biotechnology**			
Course No.	**BT -MC – VIP**	**Practical**	No. of Credits	**02**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**10**		Summative Assessment Marks	**40**

Experiments:

1. Good laboratory practices and good manufacturing practices
2. Determination of acidity of milk by titrimetric method.
3. Amylase production test (Demonstration of starch hydrolysis)
4. Casein hydrolysis test
5. Production of gelatinase (Hydrolysis of gelatin)
6. Microbial production (demonstration) and quantitative estimation of citric acid
7. Production of wine from grapes
8. Estimation of unfermented sugar and percentage of alcohol in the wine sample
9. Determination protein from the crude extract by ammonium sulphate precipitation method
10. Computational analysis of ADMET
11. Case study on bioethics

References:

1. Aneja, K. R. (2018). Experiments in microbiology, plant pathology and biotechnology (5th ed.). New Age International Publishers.
2. Crueger, W., &Crueger, A. (1990). Biotechnology: A textbook of industrial microbiology (2nd ed.). Sinauer Associates.
   Jayaraman, J. (2011). Laboratory manual in biochemistry. New Age International Publishers.
3. Leach, A. R., & Gillet, V. J. (2007). An introduction to chemoinformatics (2nd ed.). Springer.
4. Nally, J. D. (Ed.). (2017). Good manufacturing practices for pharmaceuticals (6th ed.). CRC Press.
5. Plummer, D. T. (1987). An introduction to practical biochemistry (3rd ed.). McGraw-Hill.
6. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). Microbiology (10th ed.). McGraw-Hill Education.
7. Roy, K. (2020). Computational toxicology: Methods and protocols. Springer Nature.

8. Sateesh, M. K. (2010). Bioethics and biosafety. I. K. International Publishing House Pvt. Ltd.
9. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Butterworth-Heinemann.

Program Name	**B. Sc Biotechnology**		Semester	**Sixth**
Course Title	**Research Methodology**			
Course No.	**BT -Skill –3**	**Practical**	No. of Credits	**02**
Contact hours	**64 hrs**		Duration of Exam	**3 Hours**
Formative Assessment Marks	**10**		Summative Assessment Marks	**40**

The course module equips students with the essential tools to transform raw laboratory data into professional scientific contributions. By mastering biostatistics, learners will gain the ability to collect, analyze, and represent data. The Literature Review component ensures students can navigate global databases and help them to master Scientific Writing and Presentation,

The Key practical components include:

- Basics in biostatics through MS-Excel, - Sample collection, Mean, Median and Mode, standard deviation, Coefficient of variation and Data representation.
- Literature review: Sources of Literature, conventional sources-indexes and abstracts, journals; Computer-based sources -Pub med, Science Direct, Search engines, Google Scholar, Research gate.
- Scientific Report Writing and Presentations: Writing principles, Components of Reports- Table, Graphs, Figure, Bibliography. Format of the Research report. Research Paper, Dissertation/ Thesis, Project proposal. Data presentation in oral and poster presentations for seminars/conferences.

By merging theoretical foundations with practical application, this module establishes a the students top prepare students to involve in research activities.