Scheme of Programme : Bachelor of Life Sciences in Biotechnology

(Scheme UG A1: Undergraduate Programmes: Biotechnology (Multidisciplinary)

Semester 1

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS				
										TI	TE	PI	PE	Total
Core Course(s)														
CC-A1	Introduction to Biotechnology	240/BIOTL/ CC101	3	-	2	3	-	1	4	25	50	5	20	100

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS				
										TI	TE	PI	PE	Total
Core Course(s)														
CC-A2	Biomolecules	240/BIOTL/ CC201	3	-	2	3	-	1	4	25	50	5	20	100

Semester 3

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS				
										TI	TE	PI	PE	Total
Core Course(s)														
CC-A3	General Microbiology	240/BIOTL/ CC301	3	-	2	3	-	1	4	25	50	5	20	100

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A4	Basics in Molecular Biology	240/BIOTL/ CC401	3	-	2	3	-	1	4	25	50	5	20	100

Internship is to be done during summer break after 4th Semester, Marks will be added in 5th Semester.

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A5	Fundamentals of Immunology	240/BIOTL/ CC501	3	-	2	3	-	1	4	25	50	5	20	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A6	Basics of Recombinant	240/BIOTL/ CC601	3	-	2	3	-	1	4	25	50	5	20	100

	DNA Technology													

Semester 7; 8 (Honours) and Semester 8 (Honours with Research): Detailed Scheme will be prepared in due course of time.

Multidisciplinary Programme- BIOTECHNOLOGY

Part A - Introduction			
Semester	**I**		
Name of the Course MD: 240/BIOTL/CC101	**Introduction to Biotechnology**		
Course Learning Outcomes (CLO): On successful completion of the course the students will gain and be able to demonstrate following knowledge: 1. Understand the concepts of biotechnology to get an insight of how biotechnology is related to other sciences and how Bhartiya Gyan Prampra contributed in biotechnology. 2. Gain knowledge about the scope and applications of biotechnology. Learners will get an insight of scope and applications of biotechnology in agriculture, environment, food, pharma, dairy and other industries. The students will be able to demonstrate the knowledge of the applications of biotechnology for sustainable development and human welfare. 3. Gain knowledge about genetic manipulations; recombinant DNA technology and genetic engineering. The learner will get an insight of how quantity and quality can be improved in plants and animals by using biotechnology. 4. Gain knowledge about the role of biotechnology in Bioinformatics, Nanotechnology and other allied fields 5. Gain knowledge of structure, working, maintenance/calibration and safety measures during handling of biotech lab instruments and biochemicals. Also get insight of maintenance of aseptic conditions and proper disposal of biochemicals. 6. Gain knowledge about intellectual property rights, risk assessments, safety guidelines and ethical issues related to biotechnology.			
Credits	**Theory**	**Practical**	**Total**
	3	1	4

Contact Hours	3	2	5
Max. Marks:100(50TE+ 25TI + 05 PI + 20PE)	**Time: 2h (Theory), 2h (Practical)**		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting one questions from each section. All questions carry equal marks.

UNIT I **Biotechnology:** Definition, different types and colors (white, red, green, blue) of biotechnology, biotechnology as an interdisciplinary pursuit, scope and future of biotechnology, Biotechnology research in India, Biotechnology in context of developing world, Role of Bhartiya Gyan Prampra or Indian knowledge System (IKS) in biotechnology. **Genetic engineering:** Introduction of recombinant DNA technology and genetic engineering, basic concept of genetically modified organisms, history of genetic manipulations. **Genomics and proteomics:** brief account on gene and genomes, Proteins and proteome, DNA fingerprinting. **Tissue culture:** Brief about plant and animal tissue culture. **Fermentation biotechnology:** Brief about Fermentation technology and food processing.	**CONTACT HOURS** **12**
UNIT II **Application of biotechnology:** Application of biotechnology in agriculture, dairy processing, food industry, pharmaceutical industry, forensic analysis, environment protection; waste treatment and bioremediation.	**12**
UNIT III **Biotechnology for sustainable development and human welfare:** Brief about Biofuels, bioplastics, petroleum refining, bioleaching and biomining. Brief about hybridoma technology and monoclonal antibodies, In vitro fertilization, and embryo transfer technology.	**11**
UNIT IV	**10**

Role of biotechnology in allied fields; Bioinformatics, Nanotechnology, Biomedical microelectromechanical systems (Bio-Mems), Biosensor. **IPR, biosafety and bioethics:** a brief account on intellectual property and Intellectual property rights; patent, trademark, copyright, trade secret and geographical indication. Brief account of safety guidelines and risk assessment in biotechnology, Ethical issues related to Biotechnology.	

List of Practical:

1. To study the different methods of sterilization and maintenance of aseptic conditions of biotech labs.
2. Study of structure, working and maintenance of lab instruments: Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.
3. To study working, maintenance, calibration and precautions during handling of pH-meter, weighing balance, microscopes and other miscellaneous biotech lab instruments.
4. Preparation of normal, molar, percent solutions.
5. Preparation of buffer solutions and determination of their pH.
6. Precautions in handling of biochemicals and study of their proper disposal after use.

Part C-Learning Resources

1. Biotechnology: expanding horizons- B. D. Singh
2. Elements of Biotechnology- PK Gupta
3. Biotechnology for beginners– Reinhard Renneberg Academic Press
4. BBB: Basics of Biology and Biotechnology- NM Jain
5. Introduction to Biotechnology-NM Jain
6. Biotechnology 5th edition- Johan E. Smith

Part A - Introduction	
Semester	**II**
Name of the Course MDA2: 240/BIOTL/CC201:	**BIOMOLECULES**

Course Learning Outcomes (CLO):

1. After successful completion of the programme, students will gain significant knowledge of structural biochemistry and how these small biomolecules attribute in constructing higher living organism.

2.Students will learn the structure and properties of carbohydrates, proteins,lipids, cholesterol, DNA, RNA, complex lipids, and theirimportance in biological systems

3. Students will acquire an in-dept knowledge of nucleic acid(structural and properties) which will help in understanding the basis molecular processes of living beings.

4.The students will know the distribution, arrangement, and properties of biomolecules in dietary products, which will impart awareness in adapting healthy lifestyle and student can be acquainted in assisting dietician and nutritionist.

5. Students will know how to test the presence of biomolecules in our surrounding and how to differentiate between carbohydrates/ proteins/ lipids and nucleic acid. This will help in assessing the nutrition value of the food consumed.

6. The students will be able to implement the use of instruments like and UV-VIS spectroscopy, centrifugation, and chromatography.

	Theory	Practical	Total
Credits	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **100 (50TE+ 25TI + 05 PI + 20PE)**	**Time: 2h (Theory), 2h (Practical)**		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT I Amino acids & Proteins: Structure & Function a) Amino Acid: Structure, specific rotation, electrochemical properties, classification based on R-group, nutritional requirement, and metabolic fate b) Representation of peptide bond; Chemical bonds involved in protein structure c) Protein configuration: Primary structure, Secondary structure (α- helix and β-pleated sheet), Tertiary structure (myoglobin) and Quaternary structure (Hemoglobin)	**CONTACT HOURS** **12**

d) Classification of Proteins: Based on shape, composition, biological function. Denaturation and renaturation of proteins	
UNIT II Carbohydrates: Structure and Function a) Nomenclature and Definition; Classification: Monosaccharides, Oligosaccharides and Polysaccharides b) Monosaccharides: Isomerism; Mutarotation; Structure-Linear form and Ring form, pyranose and furanose structure; anomer; epimers c) Oligosaccharides: reducing and non-reducing sugar; disaccharides (sucrose, lactose, maltose, cellobiose, isomaltose, trehalose); artificial sweeteners d) Polysaccharides:Homopolysaccharides (Starch, Glycogen, Cellulose, Pectin & Chitin), Heteropolysaccharides (Hyaluronic acid & Chondroitin)	**12**
UNIT III Lipids: Structure and functions a) Importance and definition of lipids; basic structural components; Fatty Acid-saturated and unsaturated fatty acids (nomenclature& structure); Biological roles of lipids b) Simple lipids (Fats & Oils); Compound (Phospholipids & Glycolipids) c) Derived Lipids (Steroids: cholesterol – its structure and biological properties; Terpenes; Carotenoids)	**11**
UNIT IV Nucleic acids: Structure and functions a) Introduction; Types of nucleic acids; Structural components of nucleic acids b) Nitrogenous bases: Structure of Pyrimidine & Purine derivatives; modified nitrogenous bases; tautomerism in nitrogenous bases; Nucleosides: nomenclature & structure c) Nucleotides: nomenclature & structure (ribonucleotide &deoxyribonucleotides), functions of nucleotides d) Double helical model of DNA structure, Chargaff's Rule, Variants of double helical DNA (A, B, C and Z-DNA), denaturation and annealing of DNA.	**10**
List of Practicals 1. Preparation of solutions, buffers with specific concentration and pH. 2. Preparation of stock and working solution. 3. To perform qualitative tests to find the presence of carbohydrates in a sample. 4. To perform tests to differentiate between monosaccharide, disaccharide, and polysaccharide. 5. To perform tests to identify reducing and non-reducing sugars.	

6. To perform qualitative tests to find the presence of proteins in a sample
7. Biuret test
8. Ninhydrin test
9. Lowry's test
10. To perform paper chromatography test to separate mixture of amino acids.
11. To perform qualitative & quantitative determination of nucleic acids.
12. To perform tests to find the presence of lipids in a sample.

Part C-Learning Resources

Suggested readings:

1. Fundamentals of Biochemistry by J.L. Jain (S. Chand & Company Ltd.)
2. The Foundations of Biochemistry by Lehninger
3.Biochemistry – J.M.Berg, J.L.Tymockzo, L.Stryer, 5th ed
4. Biochemistry-Reginald H. Garret, Charles M. Grisham 6th ed
5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
6. Essentials Of Biochemistry, U. Satyanarayana, U. Chakrapani, (2021), Publisher- Elsevier

Part A - Introduction	
Semester	**III**
Name of the Course MD A3: 240/BIOTL/CC301	**GENERAL MICROBIOLOGY**

Course Learning Outcomes (CLO):

After completing this course, the learner will be able to:

- Learn the historical developments in the field of Microbiology.
- Understand the criteria used for classification of bacteria and their diversity
- Understand the modes of nutrition in bacteria and the methods to cultivate them.
- Develop the basic knowledge of microbial growth and reproduction.
- Apply the concepts of control of microorganisms by physical methods and by chemicals or chemotherapeutic agents.
- Learn the environmental and ecological niche of microorganisms and their impact in environment.
- Analyse the effect of microbial water pollution and learn the waste water treatment processes.
- Develop knowledge about the role of micro-organisms in food and their impact on humans via food.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 (50TE+ 25TI + 05 PI + 20PE)	**Time: 2h (Theory), 2h (Practical)**		

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT I	CONTACT HOURS
Fundamentals of microbiology: History and Evolution of Microbiology with special reference to the major scientific contributions. **Microbial Classification & Diversity:** Microbial taxonomy, criteria used for classifying bacteria including molecular approaches, current classification of bacteria. **Microbial Diversity:** Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and morphology.	**12**
UNIT II **Ultrastructure of Bacteria:** Cell envelope - capsule and slime layer, Cell-wall: Composition and detailed structure of Gram positive and Gram negative cell walls, mechanism of Gram's staining. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cellular appendages - pili, flagella and fimbriae, inclusion bodies, Plasmid DNA and chromosomal DNA, Endospores and sporulation in bacteria. **Viruses:** General characteristics of viruses, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids with one example of each. Brief idea of lytic cycle and lysogeny.	**10**

Microbial Cultivation and preservation: Nutritional categories of micro-organisms. Culture media and its types, methods of Isolation/Purification. Preservation and maintenance of pure cultures.	
UNIT III **Bacterial Genetics**: Conjugation, transduction (generalized and specialized), and transformation. **Microbial Growth:** Growth curve, Generation time, synchronous, batch and continuous culture, measurement of growth and factors affecting growth of bacteria. **Control of Microorganisms by Physical Agents**: moist heat sterilization- Boiling, Pasteurization, Fractional sterilization (Tyndallization) and autoclave. Dry heat sterilization – Incineration and hot air oven. Filtration– Diatomaceous earth filter, Seitz filter, membrane filter and HEPA; Radiation: Ionizing radiation – γ-rays and non-ionizing radiation – UV rays	**12**
UNIT IV **Control of Microorganisms by Chemical methods:** Alcohols, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents. **Control of Microorganisms by Chemotherapeutic agents:** Source, effective against and mode of action of major chemotherapeutic agents **Microbial ecology**: Interactions of microorganisms with living and non-living. Soil microorganisms and functions of microorganisms in soil. **Water Microbiology:** Bacterial pollutants of water, coliforms and non- coliforms. Sewage composition and its disposal.	**11**
List of Practical: 1. Rules to follow in Microbiology laboratory & To study the principle and applications of important instruments (Laminar air flow unit, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and biotechnology laboratory. 2. Staining method – simple staining, gram staining and negative staining 3. Staining of *Aspergillus niger* by lactophenol cotton blue. [*A. niger* from rotten citrus fruit] 4. Bacterial cell motility – hanging drop technique. 5. Determination of cell size by micrometry. 6. Preparation of cotton plugs for sterilization of media. 7. Preparation of culture media for bacteria, fungi and their cultivation. 8. Plating techniques: Spread plate, pour plate and streak plate. 9. Isolation of bacteria from soil, water and air.	

Part C-Learning Resources Suggested readings:

1. Jay JM, Loessner MJ and Golden DA (2005). Modern Food Microbiology.7thedition. CBS Publishers and Distributors, Delhi, India.
2. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's microbiology, McGraw-HillEducation.
3. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms.12th edition.Pearson/Benjamin Cummings.
4. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology.5th edition. McGraw Hill Book Company.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
6. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An introduction, Pearson Education.

Part A - Introduction			
Semester	**IV**		
Name of the Course MD A4: 240/BIOTL/CC401	**Basics of MOLECULAR BIOLOGY**		
Course Learning Outcomes (CLO): After completing the course, the learner will be able to : 1. Gain Knowledge about DNA as genetic material and various experiments leading to this discovery. 2. Understand process of replication in both prokaryotic and eukaryotic systems, various enzymes involved in the process and inhibitors of the replication 3. Gain Knowledge of mutations and its various types. They will get in depth knowledge regarding multiple repair systems present cellular level. 4. Get an insight into process of transcription in both prokaryotic and eukaryotic system, post transcriptional changes all the types of RNA. 5. Understand the Process involved in translation, various proteins required for the process, post translational modifications. 6. acquire knowledge about regulation of gene expression.			
Credits	**Theory**	**Practical**	**Total**
	3	1	4
Contact Hours	3	2	5
Max. Marks:100	**Time: 2h (Theory), 2h (Practical)**		

(50TE+ 25TI + 05 PI + 20PE)	

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

	CONTACT HOURS
UNIT I a. Introduction to Molecular Biology, Types of genetic materials- Experiments of Griffith, Avery, MacLeod and McCarty; Hershey and chase; John Cairns experiment; Meselson- Stahl experiment, Central dogma of life. b. Replication of DNA, Models of DNA replication, Mechanism of DNA replication in prokaryotes (initiation, elongation, replication fork, replication machinery, termination) c. Enzymes and proteins involved in DNA replication (Nucleases, DNA polymerases, DNA helicases, Gyrases, SSBP, Topoisomerase, Primase). d. Inhibitors of replication	12
UNIT II a) Mutagens: Defination & types ; Physical mutagen- radiation,Chemical mutagens- alkylating agent, nitrous acid, hydroxylamine; Ames test b) DNA Damage & its types, Gene Mutation and its types (Substitution, Indel, Gene amplification) c) DNA repair- Photoreactivation, Base excision repair, Nucleotide excision repair, Mismatch repair, Translesion synthesis, Recombinational repair, Non-homologous end joining	12
UNIT III a) Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription, b) RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.	11

c) Inhibitors of transcription.	
UNIT IV a) Genetic code - characteristics and properties, Wobble hypothesis. b) Protein biosynthesis in prokaryotes and eukaryotes, post translational modifications, protein degradation, Inhibitors of protein synthesis. c) Regulation of gene expression (*lac* & *trp* operons)	**10**

List of Practicals

1. Isolation of genomic DNA from bacterial cells.
2. Isolation of total RNA from mammalian cells.
3. Estimation of DNA by diphenylamine reaction.
4. Estimation of RNA by orcinol method
5. Quantitative Estimation of DNA and RNA by UV Spectrophotometry
6. Estimate purity of DNA sample by calculating DNA/protein ratio.

Part C-Learning Resources

a) David L. Nelson & Michael M. Cox. (2017) Lehninger principles of biochemistry (7th Edition) W H Freeman & Co.
b) Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Dernell. J. Molecular Cell Biology (Fourth Edition). – W.H.Freeman and Company. 2009
c) Cooper G M & Hausman E, The Cell - A Molecular Approach. (6th edition), Sinauer Associates 2013
d) P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi. 2012
e) Lewin. B , GENES X, (10th edition), Jones & Bartlett Learning, 2011