

**Scheme of Programme : Bachelor of Life Sciences in Biotechnology**

**Semester 1**

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
<b>Core Course(s)</b>														
CC-ID1	Genetics	240/BIO T/CC10 1	3	-	2	3	-	1	4	25	50	5	20	100
CC-ID2	Cell Biology	240/BIO T/CC10 2	3	-	2	3	-	1	4	25	50	5	20	100
CC-ID3	Basics of Biomolecules	240/BIO T/CC10 3	3	-	2	3	-	1	4	25	50	5	20	100
<b>Minor/ Vocational Course(s)</b>														
MIC-1	One from Pool								2					50
<b>Multidisciplinary Course(s)</b>														
MDC-1	One from Pool								3					75
<b>Ability Enhancement Course(s)</b>														
AEC-1	One from Pool								2					50
<b>Skill Enhancement Course(s)</b>														
SEC-1	One from Pool								3					75
<b>Value-added Course(s)</b>														
VAC-1	One from Pool								2					50
<b>Total Credits</b>									<b>24</b>					<b>600</b>

**Semester 2**

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
<b>Core Course(s)</b>														
CC-ID4	General Microbiology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID5	Cellular Metabolism		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID6	Molecular Biology		3	-	2	3	-	1	4	25	50	5	20	100
<b>Minor/ Vocational Course(s)</b>														
MIC-2	One from Pool								2					50
<b>Multidisciplinary Course(s)</b>														
MDC-2	One from Pool								3					75
<b>Ability Enhancement Course(s)</b>														
AEC-2	One from Pool								2					50
<b>Skill Enhancement Course(s)</b>														
SEC-2	One from Pool								3					75
<b>Value-added Course(s)</b>														
VAC-2	One from Pool								2					50
<b>Total Credits</b>									<b>24</b>					<b>600</b>

**Semester 3**

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
<b>Core Course(s)</b>														
CC-ID7	Bioanalytical Tools		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID8	Immunology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID9	Enzymology		2	-	2	2	-	1	3	15	35	5	20	75
<b>Minor/ Vocational Course(s)</b>														
MIC-3	One from Pool								4					100
<b>Multidisciplinary Course(s)</b>														
MDC-3	One from Pool								3					75
<b>Ability Enhancement Course(s)</b>														
AEC-3	One from Pool								2					50
<b>Total Credits</b>									<b>20</b>					<b>500</b>

### Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
<b>Core Course(s)</b>														
CC-ID10	Basics of Recombinant DNA Technology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID11	Medical Microbiology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID12	Animal Biotechnology		3	-	2	3	-	1	4	25	50	5	20	100
<b>Minor/ Vocational Course(s)</b>														
MIC/VOC-4	One from Pool								4					100
<b>Ability Enhancement Course(s)</b>														
AEC-4	One from Pool								2					50
<b>Value-added Course(s)</b>														
VAC-3	One from Pool								2					50
<b>Total Credits</b>									<b>20</b>					<b>500</b>

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
<b>Core Course(s)</b>														
CC-ID13	Bioinformatics		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID14	Genomics and Proteomics		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID15	Forensic Biotechnology		3	-	2	3	-	1	4	25	50	5	20	100
<b>Minor/ Vocational Course(s)</b>														
MIC-5	One from Pool								4					100
<b>Skill Enhancement Course(s)</b>														
Internshi p									4					100
<b>Total Credits</b>									<b>20</b>					<b>500</b>

**Semester 6**

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
<b>Core Course(s)</b>														
CC-ID16	Plant Biotechnology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID17	Bioprocess Technology		3	-	2	3	-	1	4	25	50	5	20	100
CC-ID18	Bioethics, IPR & Entrepreneurs- hip		2	-	2	2	-	1	3	15	35	5	20	75
<b>Minor/ Vocational Course(s)</b>														
MIC-6	One from Pool								4					100
MIC-7	One from Pool								4					100
<b>Skill Enhancement Course(s)</b>														
SEC-3	One from Pool								3					75
<b>Total Credits</b>									<b>22</b>					<b>550</b>

**UG PROGRAMME (INTERDISCIPLINARY)**

**B.Sc Biotechnology**

<b>Part A - Introduction</b>			
<b>Semester</b>	<b>I</b>		
<b>Name of the Course ID: 240/BIOT/CC101</b>	<b>GENETICS</b>		
<b>Course Learning Outcomes (CLO):</b> After completing this course, the learner will be able to: <ol style="list-style-type: none"><li>1. Appreciate the historical developments that have shaped the field of genetics.</li><li>2. Understand the principles of inheritance as formulated by Mendel and the correlation of these principles with the behavior of chromosomes during meiosis.</li><li>3. Develop a critical understanding of allelic and non-allelic interactions, sex-linked transmission, polygenic and extranuclear inheritance</li><li>4. Understand the organization of prokaryotic and eukaryotic genomes and the effect of chromosomal abnormalities leading to genetic disorders.</li><li>5. Analyse the effect of mutations on gene functions, dosage, and their interactions at population and evolutionary levels.</li><li>6. Apply the concepts of genetic linkage and crossing for calculating gene distances and generating genetic maps.</li><li>7. Apply the Hardy-Weinberg Law in the context of population genetics.</li><li>8. Develop analytical skills and critical thinking through pedigree analysis.</li></ol>			
	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
	3	1	4
Contact Hours	3	2	5
<b>Max. Marks:100</b> <b>Internal Assessment Marks: 30</b> (25 TI + 05 PI) <b>End Term Exam Marks: 70</b> (50 TE + 20 PE)	<b>Time: 3h (Theory), 4h (Practical)</b>		
<b>Part B- Contents of the Cfourse</b>			
<b>Instructions for Paper-Setter</b>			

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.

<u>UNIT I</u>	<b>CONTACT HOURS</b>
<p><b>Genetics</b> - Definition, history, and terminology.  <b>Mendelian genetics:</b> Mendel's work on transmission of traits, Principles of Inheritance, monohybrid, di-hybrid, and trihybrid crosses, Laws of Probability, test cross, backcross, Chromosome theory of inheritance (Sutton-Boveri) and its relation to cell division.  <b>Extensions of Mendel's Principles:</b> <b>Allelic interactions:</b>Incomplete and codominance, multiple alleles, pseudo alleles, essential and lethal genes, pleiotropy, penetrance, and expressivity. <b>Non-allelic interactions:</b> Complementary gene interaction; Dominant and Recessive Epistasis; Duplicate gene Interactions; Inhibitory gene interactions.  <b>Polygenic traits-</b> quantitative inheritance (human skin colour)</p>	<b>14</b>
<p style="text-align: center;"><u>UNIT II</u></p> <p><b>Linkage, Crossing Over, and Chromosomal Mapping</b>  Introduction to linkage and crossing over, Chromosome theory of Linkage, kinds of linkage, linkage groups, factors affecting and significance of linkage, types of Crossing over, Molecular mechanism of crossing over, kinds of Crossing over, Cytological basis of crossing over, factors affecting and significance of Crossing over, Recombination frequency as a measure of linkage intensity, two-factor and three-factor crosses, determination of map distance, determination of gene order, Interference and coincidence.  <b>Sex determination and sex linkage:</b> Mechanisms of sex determination, genic balance theory, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, inheritance of Sex-linked, Sex-influenced, and Sex-limited characters</p>	<b>10</b>
<u>UNIT III</u>	<b>14</b>

<p><b>Chromosome and genomic organization:</b> Organization of prokaryotic, viral, and eukaryotic nuclear genome, packaging of DNA molecule into chromosomes, chromosome morphology, chromosome types, concept of euchromatin and heterochromatin (Constitutive and facultative), Special types of chromosomes- Polytene chromosomes and Lampbrush Chromosomes.</p> <p><b>Mutations</b> Gene mutations: Definition and types of mutations, effects of physical, chemical &amp; biological mutagens, Ames test for mutagenic agents. Chromosomal aberrations:<b>Structural</b> aberrations (Deletions, Duplications, Inversions &amp; Translocations-reciprocal and Robertsonian), position effects of gene expression; <b>Numerical</b> aberrations(Euploidy and Aneuploidy)</p>	
<p style="text-align: center;"><b><u>UNIT IV</u></b></p> <p><b>Extrachromosomal Inheritance</b> Rules of extranuclear inheritance, Chloroplast mutation/Variation in Four o' clock plant and <i>Chlamydomonas</i>, Mitochondrial mutations in <i>Neurospora</i> and yeast, Maternal effects- snail shell coiling, Infective heredity- Kappa particles in <i>Paramecium</i>.genomic imprinting</p> <p><b>Population Genetics:</b> Allele frequencies, Genotype frequencies, Hardy-Weinberg Law and its application for calculating allelic and genotype frequencies, exceptions to the Hardy-Weinberg principle. Human <b>Pedigree analysis</b> – Symbols of Pedigree, Pedigrees of Sex-linked &amp; Autosomal (dominant &amp; recessive) traits.</p>	7
<p><b>List of Practical:</b></p> <ol style="list-style-type: none"> <li>1. Study of Mendelian Traits: Straight hair (recessive), Curly hair, Widow's peak, Dimpled cheeks, Mid digital hair, Hitchhiker's thumb, Clasp of hands, and Hypertrichosis, Attached ear lobe</li> <li>2. Simple genetic problems based on theory.</li> <li>3. Use of probability in solving problems of genetics. (Sum rule &amp; Multiplication rule)</li> <li>4. Simulation exercises using beads or seeds to study the gene interactions: 9:3:4; 12:3:1; 9:7; 9:3:3:1 (comb shapes in roosters); 15:1; 13:3.</li> <li>5. Linkage maps based on data from two-point and three-point test cross.</li> <li>6. Smear technique to demonstrate sex chromatin in buccal epithelial cells.</li> <li>7. To Observe Polyploidy in Colchicine Treated Squash of Onion Root Tips.</li> <li>8. PTC testing in a population and calculation of allele and genotype frequencies.</li> </ol>	

9. Pedigree analysis (Autosomal Dominant trait, Autosomal recessive trait, X-linked Dominant traits, X-linked recessive traits, Y-linked traits)

### **Part C-Learning Resources**

#### Suggested readings:

1. D.P. Snustad, and M.J. Simmon , Genetics, 7th Ed., John Wiley & Sons. (Singapore) 2015 ISBN: 978-1- 119-14228-7.
2. B.A Pierce, Genetics - A Conceptual Approach,. 4 th Ed., W.H. Freeman & Co. (New York) 2012 ISBN:13: 978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis,. 10th Ed., W.H. Freeman & Company (New York). 2010 ISBN:10: 1- 4292-2943-8 2.
4. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition.
5. Peter, J. Russell. (2009), iGenetics: A molecular approach. 3rd Edition.
6. P.K. Gupta. Elements of Genetics. Rastogi Publications
7. Verma P.S. & Agarwal V.K (2009) Genetics. S. Chand Publications
8. B. D. Singh FUNDAMENTALS OF GENETICS (13<sup>th</sup> Edition)- Medtech Science Press

<b>Part A - Introduction</b>	
<b>Semester</b>	<b>I</b>
<b>Name of the Course ID: 240/BIOT/CC102</b>	<b>CELL BIOLOGY</b>
<p><b>Course Learning Outcomes (CLO):</b>            After completing the course, the learner will be able to :</p> <ol style="list-style-type: none"> <li>1. Understand the structures and functions of basic components of plant and animal cell, especially macromolecules, membranes and organelles</li> <li>2. acquire knowledge about the organizational and functional aspects of cell and cell organelles</li> <li>3. cultivate knowledge regarding basics of components of cell wall cell membrane and its role in transport.</li> <li>4. Understand the basic principles of life ,how a cell divides and how it is so highly regulated</li> <li>5. Acquire knowledge regarding cell death and what happens when a cell do not follow the rules of cell cycle.</li> <li>6. Understand the concept of cell signalling, cell interactions and structures involved in these.</li> </ol>	

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

<b>Part B- Contents of the Course</b>
<p align="center"><b>Instructions for Paper-Setter</b></p> <p>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 &amp; four others selecting one question from each unit. All questions carry equal marks.</p>

<b>UNIT I</b>	<b>CONTACT HOURS</b>
<ul style="list-style-type: none"> <li>a) Historical perspectives. Discovery of cell, the cell theory, ultra structure of a prokaryotic cell &amp; eukaryotic cell- (both plant and animal cells)</li> <li>b) Structure and function of cell wall - Bacterial and Plant. Ultra structure of plasma membrane – fluid mosaic model, membrane fluidity, Transport across membranes - Symport, antiport, uniport, active and passive transport, Transport of macromolecules across plasma membrane.</li> <li>c) Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes.</li> </ul>	<b>12</b>
<p><b>UNIT II</b></p> <ul style="list-style-type: none"> <li>a) Structure &amp; Functions of cell organelles: Endoplasmic Reticulum (SER &amp; RER), golgi apparatus, Lysosomes,</li> <li>b) Microbodies (peroxysomes and glyoxysomes), Ribosomes and its types, centrioles, basal bodies.</li> <li>c) Structure, functions &amp; biogenesis of mitochondria, chloroplast.</li> <li>d) Cytoskeletal structures: microtubules, microfilaments (actin, myosin), Intermediate filament</li> </ul>	<b>12</b>
<b>UNIT III</b>	<b>11</b>

<p>a) Structure and organization of nucleus: nuclear membrane, organization of chromosomes-structural organization of chromatids, centromere, chromatin, telomere</p> <p>b) Cell division: Cell cycle, mitosis and meiosis, regulations of cell cycle and check points and proteins involved in cell cycle check points.</p>	
<p><b>UNIT IV</b></p> <p><b>a)</b> Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix,</p> <p><b>b)</b> Programmed cell death, Apoptosis</p> <p><b>c)</b> Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics of cancer cells, Oncogenes, tumour suppressor gene.</p>	<p><b>10</b></p>
<p><b>List of Practicals</b></p> <ol style="list-style-type: none"> <li>1. Operation and working principle of simple and compound microscope.</li> <li>2. To study plant cell by temporary mount.</li> <li>3. Observation of permanent slides (Prokaryotic, animal &amp; plant cell)</li> <li>4. Use of Micrometry, measurement of onion epidermal cells and yeast.</li> <li>5. Vital staining of mitochondria with Janus Green B in buccal epithelium or plant epidermal cells.</li> <li>6. Study the effect of temperature &amp; organic solvent on semi permeable membrane.</li> <li>7. Demonstration of Technique of dialysis.</li> <li>8. Study of plasmolysis and deplasmolysis in cells</li> <li>9. Study of different mitotic stages in onion root tip cells</li> <li>10. Study of meiosis in plant flower buds</li> </ol>	
<p><b>Part C-Learning Resources</b></p> <ol style="list-style-type: none"> <li>a) Geoffrey M. Cooper ,Robert E. Hausman, 2007. The Cell-A molecular approach(Fourth Edition)- ASM Press Washington D.C.</li> <li>b) Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley &amp; Sons.Inc.</li> <li>c) Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell, 2009. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company.</li> <li>d) P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand&amp; Company Ltd., New Delhi;</li> <li>e) Ambrose, and Dorothy, M., Easty 1970. Cell Biology, ELBS Publications</li> <li>f) Bruce Alberts, Alexander Johnson, Julian Lewis, et al., 2014 Molecular Biology of Cell –Garland publications</li> <li>g) Gardener, E.J., Simmons M.J. and Snustad D.P. 1991. Principles of Genetics –John Wiley and Son Publications.</li> </ol>	

<b>Part A - Introduction</b>			
<b>Semester</b>	<b>I</b>		
<b>Name of the Course ID: 240/BIOT/CC103</b>	<b>BASICS OF BIOMOLECULES</b>		
<b>Course Learning Outcomes (CLO):</b>			
<p>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.</p> <p>2. Students will learn the structure and properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, complex lipids, and their importance in biological systems</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>6. The students will be able to implement the use of instruments like and UV-VIS spectroscopy, centrifugation, and chromatography.</p>			
	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
	3	1	4
Contact Hours	3	2	5
<b>Max. Marks:100</b> <b>100 (50TE+ 25TI + 05 PI + 20PE)</b>	<b>Time: 3h (Theory), 4h (Practical)</b>		
<b>Part B- Contents of the Course</b>			
<b>Instructions for Paper-Setter</b>			

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.

<p><b>UNIT I Amino acids &amp; Proteins: Structure &amp; Function</b></p> <ul style="list-style-type: none"> <li>a) Amino Acid: Structure, specific rotation, electrochemical properties, classification based on R-group, nutritional requirement, and metabolic fate</li> <li>b) Representation of peptide bond; Chemical bonds involved in protein structure</li> <li>c) Protein configuration: Primary structure, Secondary structure (<math>\alpha</math>- helix and <math>\beta</math>-pleated sheet), Tertiary structure (myoglobin) and Quaternary structure (Hemoglobin)</li> <li>d) Classification of Proteins: Based on shape, composition, biological function. Denaturation and renaturation of proteins</li> </ul>	<p style="text-align: center;"><b>CONTACT HOURS</b> <b>12</b></p>
<p><b>UNIT II Carbohydrates: Structure and Function</b></p> <ul style="list-style-type: none"> <li>a) Nomenclature and Definition; Classification: Monosaccharides, Oligosaccharides and Polysaccharides</li> <li>b) Monosaccharides: Isomerism; Mutarotation; Structure-Linear form and Ring form, pyranose and furanose structure; anomer; epimers</li> <li>c) Oligosaccharides: reducing and non-reducing sugar; disaccharides (sucrose, lactose, maltose, cellobiose, isomaltose, trehalose); artificial sweeteners</li> <li>d) Polysaccharides: Homopolysaccharides (Starch, Glycogen, Cellulose, Pectin &amp; Chitin), Heteropolysaccharides (Hyaluronic acid &amp; Chondroitin)</li> </ul>	<p style="text-align: center;"><b>12</b></p>
<p><b>UNIT III Lipids: Structure and functions</b></p> <ul style="list-style-type: none"> <li>a) Importance and definition of lipids; basic structural components; Fatty Acid-saturated and unsaturated fatty acids (nomenclature &amp; structure); Biological roles of lipids</li> <li>b) Simple lipids (Fats &amp; Oils); Compound (Phospholipids &amp; Glycolipids)</li> <li>c) Derived Lipids (Steroids: cholesterol – its structure and biological properties; Terpenes; Carotenoids)</li> </ul>	<p style="text-align: center;"><b>11</b></p>

**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
  - a) Biuret test
  - b) Ninhydrin test
  - c) Lowry's test
7. To perform paper chromatography test to separate mixture of amino acids.
8. To perform qualitative & quantitative determination of nucleic acids.
9. To perform tests to find the presence of lipids in a sample.

**Part C-Learning Resources****Suggested readings:**

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

## SEMESTER-II

### INTERDISCIPLINARY - BIOTECHNOLOGY

Part A - Introduction			
<b>Semester</b>	<b>II</b>		
<b>Name of the Course ID: 240/BIOT/CC201</b>	<b>GENERAL MICROBIOLOGY</b>		
<b>Course Learning Outcomes (CLO):</b> After completing this course, the learner will be able to: <ol style="list-style-type: none"><li>1. Learn the historical developments in the field of Microbiology.</li><li>2. Understand the criteria used for classification of bacteria and their diversity</li><li>3. Understand the modes of nutrition in bacteria and the methods to cultivate them.</li><li>4. Develop the basic knowledge of microbial growth and reproduction.</li><li>5. Apply the concepts of control of microorganisms by physical methods and by chemicals or chemotherapeutic agents.</li><li>6. Learn the environmental and ecological niche of microorganisms and their impact in environment.</li><li>7. Analyse the effect of microbial water pollution and learn the waste water treatment processes.</li><li>8. Develop knowledge about the role of micro-organisms in food and their impact on humans via food.</li></ol>			
	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
	3	1	4
<b>Contact Hours</b>	3	2	5
<b>Max. Marks:100 (50TE+ 25TI + 05 PI + 20PE)</b>	<b>Time: 3h (Theory), 2h (Practical)</b>		
<b>Part B- Contents of the Course</b>			
<b>Instructions for Paper-Setter</b> 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.			
<b><u>UNIT I</u></b> <b>Fundamentals of microbiology:</b> History and Evolution of Microbiology with special reference to the major scientific contributions.	<b>CONTACT HOURS</b>  <b>12</b>		

<p><b>Classification of microorganisms:</b> Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.</p> <p><b>Microbial Diversity:</b> Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms e.g. – bacteria, algae, Fungi and Protozoa.</p>	
<p><b><u>UNIT II</u></b></p> <p><b>Cultivation and Maintenance of microorganisms:</b> Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.</p> <p><b>Microbial growth:</b> Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.</p> <p><b>Bacterial Reproduction:</b> Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria</p>	<p><b>11</b></p>
<p><b><u>UNIT III</u></b></p> <p><b>Viruses:</b> General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses, example of each and their importance. Brief idea of lytic cycle and lysogeny.</p> <p><b>Control of Microorganisms:</b> By <b>Physical Agents:</b> Principle, construction and applications of 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 – <math>\gamma</math>-rays and non-ionizing radiation – UV rays</p> <p><b>Chemical methods:</b> Alcohols, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents.</p> <p><b>&amp; Chemo- therapeutic Agents.</b></p>	<p><b>12</b></p>

<p><b>UNIT IV</b>  <b>Microbial ecology:</b> Microenvironment &amp; Niche. Interactions of microorganisms with living and non-living. Soil microorganisms and functions of microorganisms in soil.  <b>Food and Water Microbiology:</b> Bacterial pollutants of water, coliforms and non- coliforms. Sewage composition and its disposal.  <b>Important microorganism in food microbiology:</b> Molds, Yeasts, bacteria.  <b>Major food born infections and intoxications,</b> Fermented Foods.</p>	<p><b>10</b></p>
<p><b>List of Practical:</b></p> <ol style="list-style-type: none"> <li>1. Rules to follow in Microbiology laboratory &amp; To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and biotechnology laboratory.</li> <li>2. Staining method – simple staining, gram staining, spore staining and negative staining</li> <li>3. Staining of <i>Aspergillus niger</i> by lactophenol cotton blue. [A. niger from rotten citrus fruit]</li> <li>4. Bacterial cell motility – hanging drop technique.</li> <li>5. Determination of cell size by micrometry.</li> <li>6. Preparation of cotton plugs for sterilization of media.</li> <li>7. Preparation of culture media for bacteria, fungi and their cultivation.</li> <li>8. Plating techniques: Spread plate, pour plate and streak plate.</li> <li>9. Isolation of bacteria from soil, water and air.</li> <li>10. To determine the total number of bacteria in a culture by Direct Microscopic Count.</li> <li>11. To determine the viable number of bacteria in a culture by standard plate count.</li> <li>12. Determination of Bacterial growth curve.</li> </ol>	
<p><b>Part C-Learning Resources</b> Suggested readings:</p> <ol style="list-style-type: none"> <li>1. Jay JM, Loessner MJ and Golden DA (2005). Modern Food Microbiology.7<sup>th</sup>edition, CBS Publishers and Distributors, Delhi, India.</li> <li>2. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's microbiology, McGraw-HillEducation.</li> <li>3. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms.12<sup>th</sup> edition.Pearson/Benjamin Cummings.</li> <li>4. Pelczar MJ, Chan ECS and Krieg NR.(1993). Microbiology.5th edition. McGraw Hill Book Company.</li> <li>5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.</li> <li>6. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An introduction, PearsonEducation.</li> </ol>	

<b>Part A - Introduction</b>			
<b>Semester</b>	<b>II</b>		
<b>Name of the Course ID: 240/BIOT/CC202</b>	<b>CELLULAR METABOLISM</b>		
<b>Course Learning Outcomes (CLO):</b>			
<ol style="list-style-type: none"> <li>1. Students will appreciate how the collection of thousands inanimate molecules that constitute living organisms interact to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the non-living thing.</li> <li>2. Students will basics of metabolism inculcating inside human body.</li> <li>3. Students will have knowledge how these small biomolecules attribute in constructing higher living organism.</li> <li>4. This will broaden their understanding of how biochemical changes relate to physiological alteration in the body. The study of biochemistry will provide thoughtful vision how abnormal functioning of these biomolecules can lead to adverse pathological conditions.</li> <li>5. Students will learn basic metabolic pathways that leads to energy generation, carbohydrates assimilation, oxidation of fatty acids etc. Abnormality in the functioning of these metabolic pathways is directly related with adverse medical conditions.</li> <li>6. Students will gain knowledge of several regulatory pathways, that affects metabolic pathways.</li> </ol>			
	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
	3	1	4
Contact Hours	3	2	5
<b>Max. Marks:100</b> <b>(50TE+ 25TI + 05 PI + 20PE)</b>	<b>Time: 3h (Theory), 4h (Practical)</b>		
<b>Part B- Contents of the Course</b>			
<b>Instructions for Paper-Setter</b>			

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.

<p><b>UNIT I Metabolism Overview and Bioenergetics</b></p> <ul style="list-style-type: none"> <li>a) Metabolism overview &amp; its terminology; metabolic pathways; catabolism versus anabolism, Central Pathways, Anaplerotic Pathways, Secondary pathways</li> <li>b) Key chemical reactions in metabolism (oxidation-reduction; ligation; isomerization; group-transfer; hydrolytic &amp; addition-removal of functional groups)</li> <li>c) ATP as Universal Currency of Free Energy in Biological Systems</li> <li>d) Regulation of Metabolic Pathways</li> </ul>	<p style="text-align: center;"><b>CONTACT HOURS</b></p> <p style="text-align: center;"><b>10</b></p>
<p><b>UNIT II Carbohydrate Metabolism</b></p> <ul style="list-style-type: none"> <li>a) Glycolysis (phases, enzymes involved and energetics); Fate of pyruvate under aerobic and anaerobic conditions: Muscle glycolysis and alcoholic fermentation. Oxidative Decarboxylation of Pyruvate to Acetyl-CoA</li> <li>b) Citric acid cycle or Krebs cycle (overview, enzymes involved, reaction steps, &amp; its energetics); Amphibolic roles of the citric acid cycle; Modification of TCA cycle: Glyoxylate Cycle;</li> <li>c) Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and Glycogenesis.</li> </ul>	<p style="text-align: center;"><b>12</b></p>
<p><b>UNIT III Lipid &amp; Protein Oxidation</b></p> <ul style="list-style-type: none"> <li>a) Overview of fatty acids: General considerations, activation of fatty acids, reactions of fatty acid oxidation</li> <li>b) Oxidation of Even-chain Saturated Fatty Acids (Knoop's <math>\beta</math> Oxidation Pathway); Oxidation of Unsaturated Fatty Acids.</li> <li>c) Basics of Fatty Acids biosynthesis: Acetyl-CoA transport into the cytosol, Production of malonyl-CoA, Intermediates in fatty acid synthesis and the ACP, The fatty acid synthase complex.</li> <li>d) Ketogenesis: General considerations, Biosynthesis, and utilization of ketone bodies, Ketogenic and antiketogenic substances; metabolic water</li> </ul>	<p style="text-align: center;"><b>12</b></p>
<ul style="list-style-type: none"> <li>e) Metabolic fates of amino acids, urea cycle, fate of glucogenic and ketogenic amino acids.</li> </ul>	

<p><b>UNIT IV Electron Transport &amp; Oxidative Phosphorylation</b></p> <p>a) Electron flow as source of ATP energy; Site of oxidative phosphorylation; ATP synthetase</p> <p>b) Electron-transport complexes (respiratory chain); Proton motive force; Chemiosmotic model</p> <p>c) Oxidation of extra-mitochondrial NADH (Malate-oxaloacetate-aspartate shuttle &amp; Glycerophosphate-dihydroxyacetone phosphate shuttle)</p> <p>d) Respiratory Inhibitors: Inhibitors of electron transport; Inhibitors of oxidative phosphorylation; Uncouplers of oxidative phosphorylation; Ionophores of oxidative phosphorylation</p>	<p><b>11</b></p>
<p><b>List of Practicals</b></p> <ol style="list-style-type: none"> <li>1. Preparation of buffers at a specific molarity and pH</li> <li>2. To demonstrate the formation of standard curve and its role in calculating concentration of un-known sample.</li> <li>3. To estimate total protein in liver homogenate.</li> <li>4. To estimate the blood glucose level.</li> <li>5. To estimate serum creatinine level.</li> <li>6. To demonstrate fate of pyruvate under anaerobic conditions (alcoholic fermentation).</li> <li>7. To demonstrate endergonic and exergonic reactions.</li> <li>8. To construct energy yield in terms of ATP of aerobic oxidation of 2 moles of Glucose.</li> <li>9. To construct stoichiometric balance sheet and energy yield in terms of ATP of C18 fatty acid oxidation.</li> <li>10. To learn about urine urea nitrogen test, its purpose, and result analysis.</li> </ol>	
<p><b>Part C-Learning Resources</b></p> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Fundamentals of Biochemistry by J.L. Jain (S. Chand &amp; Company Ltd.)</li> <li>2. The Foundations of Biochemistry by Lehninger</li> <li>3. Biochemistry – J. M. Berg, J. L. Tymoczko, L. Stryer, 5th ed</li> <li>4. Biochemistry-Reginald H. Garret, Charles M. Grisham 6th ed</li> <li>5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.</li> <li>6. Essentials Of Biochemistry, U. Satyanarayana, U. Chakrapani, (2021), Publisher- Elsevier</li> </ol>	

<b>Part A - Introduction</b>			
<b>Semester</b>	<b>II</b>		
<b>Name of the Course ID: 240/BIOT/CC203</b>	<b>MOLECULAR BIOLOGY</b>		
<b>Course Learning Outcomes (CLO):</b> After completing the course, the learner will be able to : <ol style="list-style-type: none"> <li>1. Gain Knowledge about DNA as genetic material and various experiments leading to this discovery.</li> <li>2. Understand process of replication in both prokaryotic and eukaryotic systems, various enzymes involved in the process and inhibitors of the replication</li> <li>3. Gain Knowledge of mutations and its various types. They will get in depth knowledge regarding multiple repair systems present cellular level.</li> <li>4. Get an insight into process of transcription in both prokaryotic and eukaryotic system, post transcriptional changes all the types of RNA.</li> <li>5. Understand the Process involved in translation, various proteins required for the process, post translational modifications.</li> <li>6. Acquire knowledge about regulation of gene expression.</li> </ol>			
	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
	3	1	4
Contact Hours	3	2	5
<b>Max. Marks:100</b> <b>(50TE+ 25TI + 05 PI + 20PE)</b>	<b>Time: 3h (Theory), 4h (Practical)</b>		

<b>Part B- Contents of the Course</b>	
<b>Instructions for Paper-Setter</b>	
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.	
<b>UNIT I</b>	<b>CONTACT HOURS</b>
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>12</b>

<p>b) Replication of DNA, Models of DNA replication, Mechanism of DNA replication in prokaryotes (initiation, elongation, replication fork, replication machinery, termination)</p> <p>c) Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSBP, topoisomerase, primase). Inhibitors of replication</p>	
<p><b>UNIT II</b></p> <p>a) Mutation and its types- spontaneous, induced, reverse, suppressor mutations; chemical mutagens- alkylating agent, nitrous acid, hydroxylamine: physical mutagen- radiation.</p> <p>b) DNA repair- Photo-reactivation, base excision repair, nucleotide excision repair, mismatch repair, translation synthesis, recombinational repair, non-homologous end joining, SOS repair</p>	<b>12</b>
<p><b>UNIT III</b></p> <p>a) Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription,</p> <p>c) RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.</p> <p>d) Inhibitors of transcription.</p>	<b>11</b>
<p><b>UNIT IV</b></p> <p>a) Genetic code - characteristics and properties, Wobble hypothesis.</p> <p>b) Protein biosynthesis in prokaryotes and eukaryotes, post translational modifications, protein degradation, Inhibitors of protein synthesis.</p> <p>c) Regulation of gene expression (<i>lac</i> &amp; <i>trp</i> operons)</p>	<b>10</b>
<p><b>List of Practicals</b></p> <ol style="list-style-type: none"> <li>1. Demonstration of working models of replication and transcription.</li> <li>2. Demonstration of working models of translation.</li> <li>3. Isolation of genomic DNA from bacterial cells.</li> <li>4. Isolation of total RNA from mammalian cells.</li> <li>5. Estimation of DNA by diphenylamine reaction.</li> <li>6. Estimation of RNA by orcinol method</li> <li>7. Quantitative Estimation of DNA and RNA by UV Spectrophotometry</li> <li>8. Estimate purity of DNA sample by calculating DNA/protein ratio.</li> </ol>	

### **Part C-Learning Resources**

- a) David L. Nelson & Michael M. Cox. (2017) Lehninger principles of biochemistry (7<sup>th</sup> 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. (6<sup>th</sup> 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, (10<sup>th</sup> edition), Jones & Bartlett Learning, 2011