Syllabus

2nd Semester

B.Sc. in Biotechnology

Semester 2

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
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
Minor/ Vocational Course(s)														
MIC-2	**One from Pool**								2					50
Multidisciplinary Course(s)														
MDC-2	**One from Pool**								3					75
Ability Enhancement Course(s)														
AEC-2	**One from Pool**								2					50
Skill Enhancement Course(s)														
SEC-2	**One from Pool**								3					75
Value-added Course(s)														
VAC-2	**One from Pool**								2					50
Total Credits									24					600

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240|BIOT|CC201

SEMESTER-II

INTERDISCIPLINARY - BIOTECHNOLOGY

Part A - Introduction			
Semester			**II**
Name of the Course ID: 240|BIOT|CC201			**GENERAL MICROBIOLOGY**
Course Learning Outcomes (CLO): After completing this course, the learner will be able to: 1. Learn the historical developments in the field of Microbiology. 2. Understand the criteria used for classification of bacteria and their diversity 3. Understand the modes of nutrition in bacteria and the methods to cultivate them. 4. Develop the basic knowledge of microbial growth and reproduction. 5. Apply the concepts of control of microorganisms by physical methods and by chemicals or chemotherapeutic agents. 6. Learn the environmental and ecological niche of microorganisms and their impact in environment. 7. Analyse the effect of microbial water pollution and learn the waste water treatment processes. 8. Develop knowledge about the role of micro-organisms in food and their impact on humans via food.			
	Theory	**Practical**	**Total**
Contact Hours	3	1	4
	3	2	5
Max. Marks:100 (50TE+ 25TI + 05 PI + 20PE)	**Time: 3h (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.	12

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Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. **Microbial Diversity:** Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of micro-organisms e.g. – bacteria, algae, Fungi and Protozoa.	
UNIT II **Cultivation and Maintenance of microorganisms:** Nutritional categories of micro-organisms, methods of isolation, Purification and preservation. **Microbial growth**: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. **Bacterial Reproduction:** Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria	**11**
UNIT III **Viruses:** 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. **Control of Microorganisms:** By **PhysicalAgents**: 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 – γ-rays and non-ionizing radiation – UV rays **Chemical methods:** Alcohols, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents. **& Chemo- therapeutic Agents**.	**12**

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UNIT IV **Microbial ecology**: Microenvironment & Niche. Interactions of microorganisms with living and non-living. Soil microorganisms and functions of microorganisms in soil. **Food and Water Microbiology:** Bacterial pollutants of water, coliforms and non- coliforms. Sewage composition and its disposal. Important microorganism in food microbiology: Molds, Yeasts, bacteria. Major food born infections and intoxications, Fermented Foods.	**10**

List of Practical:

1. Rules to follow in Microbiology laboratory & 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.
2. Staining method – simple staining, gram staining, spore 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.
10. To determine the total number of bacteria in a culture by Direct Microscopic Count.
11. To determine the viable number of bacteria in a culture by standard plate count.
12. Determination of Bacterial growth curve.

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, PearsonEducation.

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240/BIOT/CC202

Part A - Introduction	
Semester	**II**
Name of the Course ID: 240/BIOT/CC202	**CELLULAR METABOLISM**

Course Learning Outcomes (CLO):

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.
2. Students will basics of metabolism inculcating inside human body.
3. Students will have knowledge how these small biomolecules attribute in constructing higher living organism.
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.
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.
6. Students will gain knowledge of several regulatory pathways, that affects metabolic pathways.

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

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UNIT I Metabolism Overview and Bioenergetics a) Metabolism overview & its terminology; metabolic pathways; catabolism versus anabolism, Central Pathways, Anaplerotic Pathways, Secondary pathways b) Key chemical reactions in metabolism (oxidation-reduction; ligation; isomerization; group-transfer; hydrolytic & addition-removal of functional groups) c) ATP as Universal Currency of Free Energy in Biological Systems d) Regulation of Metabolic Pathways	**CONTACT HOURS** **10**
UNIT II Carbohydrate Metabolism 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 b) Citric acid cycle or Krebs cycle (overview, enzymes involved, reaction steps, & its energetics); Amphibolic roles of the citric acid cycle; Modification of TCA cycle: Glyoxylate Cycle; c) Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and Glycogenesis.	**12**
UNIT III Lipid & Protein Oxidation a) Overview of fatty acids: General considerations, activation of fatty acids, reactions of fatty acid oxidation b) Oxidation of Even-chain Saturated Fatty Acids (Knoop's β Oxidation Pathway); Oxidation of Unsaturated Fatty Acids. 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. d) Ketogenesis: General considerations, Biosynthesis, and utilization of ketone bodies, Ketogenic and antiketogenic substances; metabolic water	**12**
e) Metabolic fates of amino acids, urea cycle, fate of glucogenic and ketogenic amino acids.	

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UNIT IV Electron Transport & Oxidative Phosphorylation a) Electron flow as source of ATP energy; Site of oxidative phosphorylation; ATP synthetase b) Electron-transport complexes (respiratory chain); Proton motive force; Chemiosmotic model c) Oxidation of extra-mitochondrial NADH (Malate-oxaloacetate-aspartate shuttle &Glycerophosphate-dihydroxyacetone phosphate shuttle) d) Respiratory Inhibitors: Inhibitors of electron transport; Inhibitors of oxidative phosphorylation; Uncouplers of oxidative phosphorylation; Ionophores of oxidative phosphorylation	**11**

List of Practicals

1. Preparation of buffers at a specific molarity and pH
2. To demonstrate the formation of standard curve and its role in calculating concentration of un-known sample.
3. To estimate total protein in liver homogenate.
4. To estimate the blood glucose level.
5. To estimate serum creatinine level.
6. To demonstrate fate of pyruvate under anaerobic conditions (alcoholic fermentation).
7. To demonstrate endergonic and exergonic reactions.
8. To construct energy yield in terms of ATP of aerobic oxidation of 2 moles of Glucose.
9. To construct stochiometric balance sheet and energy yield in terms of ATP of C18 fatty acid oxidation.
10. To learn about urine urea nitrogen test, its purpose, and result analysis.

Part C-Learning Resources

Reference Books:

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

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240/BIOT/CC203

Part A - Introduction			
Semester			**II**
Name of the Course ID: 240/BIOT/CC203			**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.			
	Theory	**Practical**	**Total**
Contact Hours	3	1	4
	3	2	5
Max. Marks:100 **(50TE+ 25TI + 05 PI + 20PE)**	**Time: 3h (Theory), 4h (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 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.	**CONTACT HOURS** **12**

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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). Inhibitors of replication	
UNIT II a) Mutation and its types- spontaneous, induced, reverse, suppressor mutations; chemical mutagens- alkylating agent, nitrous acid, hydroxylamine: physical mutagen- radiation. b) DNA repair- Photo-reactivation, base excision repair, nucleotide excision repair, mismatch repair, translation synthesis, recombinational repair, non-homologous end joining, SOS repair	**12**
UNIT III a) Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription, c) RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing. d) Inhibitors of transcription.	**11**
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. Demonstration of working models of replication and transcription. 2. Demonstration of working models of translation. 3. Isolation of genomic DNA from bacterial cells. 4. Isolation of total RNA from mammalian cells. 5. Estimation of DNA by diphenylamine reaction. 6. Estimation of RNA by orcinol method 7. Quantitative Estimation of DNA and RNA by UV Spectrophotometry 8. Estimate purity of DNA sample by calculating DNA/protein ratio.	

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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

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