VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Biotechnology

Programme: Master of Science (M.Sc.) in Biotechnology

Duration: 2 Years (4 semesters)

Programme Overview:

Master of Science (M.Sc.) in Biotechnologyprogramme isa unique course in Masters which has a well synchronized curriculum, between Sciences – Biosciences and Technology. Department of Studies and Research in Biotechnology was set up in the year 2019 at Vijayanagara Sri Krishnadevaraya University, Ballari-583 105. The curriculum of M.Sc in Biotechnology is framed to provide knowledge on application of biological sciences towards the development of value added products, drug designing, improving quality of human life, agriculture, energy and environment, etc. The program includes experiences with basic laboratory skills, genetic engineering, protein purification, cell culture, quality assurance, quality control, bioinformatics, ethics and teamwork. Students who complete the program are preparedto work in a various position in companies such as pharmaceutical, molecular diagnostics, manufacturing, research, agriculture and cell banks. The hands-on approach also serves students interested in other laboratory expertise jobs such as those in the chemical and oil/gas industries. Later students can also acquire permanent positions while working at a biotech company as an intern while other students choose to continue their education at a research level. Overall, our interdisciplinary Biotechnology program combines advanced training in biology, chemistry, chemical engineering, and pharmaceutical sciences with critical business skills to bring you to the forefront of discovery and innovation, and accelerate your career.

Programme Educational Objectives (PEOs):

After 2-3 years of completion of theprogramme the graduates will be able to:

1. Gain necessary knowledge and develop specialized skills in the different areas of Biotechnology.
2. Think critically and creatively about the use of biotechnology to address local and global problems.
3. Implement the scientific skills for development of industrial applications and entrepreneurship.

Programme Outcomes (POs):

At the end of the programme the students will be able to:

5. Carry out research /investigation independently in specialized area of Biotechnology.
6. Write and present a substantial technical report/document.
7. Demonstrate a degree of mastery in the area of biotechnology to enable them in collaborative and multidisciplinary research.
8. Recognize the need for continuous learning and will prepare oneself to create, select, learn and apply appropriate techniques, resources, and modern instrumentation to solve complex biotechnological activities with an understanding of the limitations.
9. Demonstrate knowledge of biotechnology and management principles and apply to manage projects efficiently and economically with intellectual integrity and ethics for sustainable development of society.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Distribution of Courses/Papers in Postgraduate Programme as per Choice Based Credit System (CBCS) in

Biotechnology

M.Sc. I-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FIRST	DSC1	21BTH1C1L	Cell and Molecular Biotechnology	30	70	100	4	-	-	4	3
	DSC2	21BTH1C2L	Advanced Genetics	30	70	100	4	-	-	4	3
	DSC3	21BTH1C3L	Principles of Biochemistry	30	70	100	4	-	-	4	3
	DSC4	21BTH1C4L	General Microbiology	30	70	100	4	-	-	4	3
	SEC1	21BTH1S1L	Instrumentation & Biotechniques	20	30	50	1	-	2	2	2
	DSC1P1	21BTH1C1P	Molecular and Genetics lab	20	30	50	-	-	4	2	4
	DSC3P2	21BTH1C3P	Biochemistry lab	20	30	50	-	-	4	2	4
	DSC4P3	21BTH1C4P	Microbiology lab	20	30	50	-	-	4	2	4
Total Marks for I Semester						**600**				**24**	

M.Sc. II-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	Sem. Exam	Total	L	T	P		
SECOND	DSC5	21BTH2C5L	Immunology and Immunodiagnostic	30	70	100	4	-	-	4	3
	DSC6	21BTH2C6L	Genomics and Genetic Engineering	30	70	100	4	-	-	4	3
	DSC7	21BTH2C7L	Bioprocess Engineering and Technology	30	70	100	4	-	-	4	3
	DSC8	21BTH2C8L	Stem cell technology and Regenerative medicine	30	70	100	4	-	-	4	3
	SEC2	21BTH2S2L	Biopharmaceutical Techniques	20	30	50	1	-	2	2	2
	DSC5P4	21BTH2C5P	Immunology and Immunodiagnostic lab	20	30	50	-	-	4	2	4
	DSC6P5	21BTH2C6P	Genomics and Genetic Engineering lab	20	30	50	-	-	4	2	4
	DSC7P6	21BTH2C7P	Bioprocess Engineering and Technology lab	20	30	50	-	-	4	2	4
Total Marks for II Semester						**600**				**24**	

M.Sc. III-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	21BTH3C9L	Biostatistics and Bioinformatics	30	70	100	4	-	-	4	3
	DSC10	21BTH3C10L	Medical Biotechnology and Diagnostics	30	70	100	4	-	-	4	3
	DSE1	21BTH3E1AL	A. Pharmaceutical Biotechnology and drug designing	30	70	100	4	-	-	4	3
		21BTH3E1BL	B.Microbial Biotechnology								
		21BTH3E1CL	C. Biofuels and Bioenergy								
	DSE2	21BTH3E2AL	A. Agriculture Biotechnology	30	70	100	4	-	-	4	3
		21BTH3E2BL	B. Food Technology and Nutrigenomics								
		21BTH3E2CL	C. Marine Biotechnology								
	GEC1	21BTH3G1AL	A. Introduction to Biomaterials	20	30	50	2	-	-	2	2
		21BTH3G1BL	B. Gene expression and Transgenics								
		21BTH3G1CL	C..Biomedical Waste Management								
	SEC3	21BTH3S3 LP	Research Methodology	20	30	50	1	-	2	2	2
	DSC9P7	21BTH3C9P	Biostatistics and Bioinformatics lab	20	30	50	-	-	4	2	4
	DSC10P8	21BTH3C10P	Medical Biotechnology and Diagnostics lab	20	30	50	-	-	4	2	4
Total Marks for III Semester						**600**				**24**	

M.Sc. IV-SEMESTER

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
FOURTH	DSC11	21BTH4C11L	Plant Biotechnology	30	70	100	4	-	-	4	3
	DSC12	21BTH4C12L	Animal Biotechnology	30	70	100	4	-	-	4	3
	DSE3	21BTH4E3AL	A. Biosafety, Bioethics and IPR	30	70	100	4	-	-	4	3
		21BTH4E3BL	B. Environmental Bioengineering								
		21BTH4E3CL	C. Enzyme Technology								
	DSE4	21BTH4E4AL	A. Nanobiotechnology	30	70	100	4	-	-	4	3
		21BTH4E4BL	B. Proteomics and Protein Engineering								
		21BTH4E4CL	C. Cell signalling								
	GEC2	21BTH4G2AL	A. Introduction to Green engineering and Environmental issues	20	30	50	2	-	-	2	2
		21BTH4G2BL	B. Biology of Immune system								
		21BTH4G2CL	C.Biotechnology for Human Welfare								
	DSC11P9	21BTH4C11P	Plant and Animal Biotechnology lab	20	30	50	-	-	4	2	4
	Project	21BTH4C1R	Research Project	30	70	100	-	-	8	4	4
Total Marks for IV Semester						**600**				**24**	

(I-IV semester)- Total Marks: 2400 Total credits: 96

DSC – Department Specific Core, DSE – Discipline Specific Elective, SEC – Skill Enhancement Course, GEC – Generic Elective Course, IA – Internal Assessment, SEE – Semester End Examination, L – Lecture, T – Tutorial, P – Practical.

M.Sc. Biotechnology First Semester

Course: Cell and Molecular Biotechnology	**Course Code:**21BTH1C1L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. Introduce the students to classical and modern concepts in cell and molecular biology and its applications in biomedical research.
2. In particular, this course focuses on identifying key components that constitute living cells and to integrate the field of biochemistry, molecular cell biology and genetics. And also provides a basic and comprehensive grounding in multidisciplinary science of modern and classical biomedical science.

UNIT I: Membrane Structure and Transport 11Hrs

Chemical composition of membrane, structure and function of membrane protein, membrane lipid and fluidity, lipid rafts, deformation of membranes. Transport across membrane: Transport of small molecules: Passive and active transport (P, V, F and ABC transporters); transport of large molecules: endocytosis and exocytosis. Protein sorting and vesicular trafficking: Transport of molecules into and out of the nucleus, transport of proteins into mitochondria and chloroplasts, transport from the ER through Golgi apparatus to lysosomes

UNIT II: Cytoskeleton, Interaction of Cells and their Environment 11Hrs

Cytoskeleton: Cytoskeleton proteins. Microfilaments: types, structure and function, Intermediate: structure and function, Microtubule: structure and functional organization, Cell interaction: Interaction between cell and extracellular matrix (ECM): ECM proteins (collagens, elastin, proteoglycans, fibronectins and laminins); Interaction between cells: Tight junction, anchoring junction, gap junction, Cell adhesion molecules: seletins, cadarins, immunoglobins

UNIT III: Cell Signaling, Cell Cycle and Cell Death 11Hrs

Cell Signaling and communication: general principle of communication, Cell surface receptors, G-protein mediated signaling, camp, receptors tyrosine kinases, second messengers, Cell cycle: overview, model organism and methods to study cell cycle, regulation of cell cycle, Cell death: apoptosis, necrosis, caspases, cell death pathways.

UNIT IV: Replication and Transcription in Prokaryotes and Eukaryotes 11Hrs

Chemical composition of DNA/RNA. DNA structure, DNA denaturation and renaturation. DNA replication: Mechanism of DNA replication in prokaryotes and eukaryotes. Transposable elements, Mechanisms of transposition. Structural features of prokaryotic and eukaryotic RNA - rRNA, tRNA, mRNA. Prokaryotic transcription: promoters and regulatory elements; RNA polymerase; initiation, elongation and termination; transcriptional regulation-positive and negative; operon concept-lac and trp operons. Eukaryotic transcription; promoters and regulatory elements; RNA polymerase structure and assembly; RNA polymerase I, II, III; initiation, elongation and termination. Post-transcriptional modifications: 5'-cap formation, 3'-end processing, splicing, RNA editing, catalytic RNA. Regulatory RNA: antisense RNAs, micro RNAs, RNA interference. RT-PCR.

UNIT V: Translation in Prokaryotic and Eukaryotic 11Hrs

Genetic code: Salient features, Universal genetic code; Wobble hypothesis. Translation: Mechanism of initiation, elongation and termination of translation process. Regulation of protein synthesis, Polyribosomes, Post-translational modifications; Transport of proteins and molecular chaperones; protein stability and degradation pathways.

Reference Books:

1. Molecular biology of the cell, 6th edition (2014), B.Alberts.,A. Johnson., J. Lewis., D.Morgan. and M. Raff, Garland Science, New York, USA. ISBN:978-0815344322.
2. Molecular cell biology, 7th edition (2013), H.Lodish., A. Berk., C.A. Kaiser and M.Krieger, W H Freeman and Company, New York, USA. ISBN:9781429234139.
3. Cell: molecular approach, 6thedition (2013), G.M. Cooper and R.E. Hausman, ASM Press, USA. ISBN:978-0878939640.
4. Cell and Molecular Biology, 7thedition (2013), G. Karp, John Wiley, New York, USA. ISBN: 9781118301791.
5. Cell biology, 2ndedition (2008), T.D. Pollard and W.C. Earnshaw, Saunders, USA. ISBN:9781416022558.
6. Cell and Molecular Biology. 3rdedition (2010),S.C Rastogi, New Age International publishers, India ISBN-10: 8122430791.

Course Outcomes (CO): After completion of this course student should able to

CO1	Apply knowledge of cell biology and molecular Biology in various cellular functions, inculcate a knowledge of various issues related to molecular cell biology, the application and research involved in functioning of the different cell organelles.
CO2	Design and analyse the experiments related with the different molecules involved in cell biology and use of the various techniques in the molecular cell biology to study

	the kinetics and rationale behind each phenomenon.
CO3	Identify, formulate, and solve problems arisen due to the inefficient functioning of the various life processes like cell-to-cell communication, cell cycle regulation, movement processes of a cell or system.
CO4	Use the techniques, skills, and modern tools necessary for imbalances in various life processes, design a molecular cell biology research project, collect and analyse data, and interpret results

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M.Sc. Biotechnology First Semester

Course: Advanced Genetics	**Course Code:**21BTH1C2L
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. The objectives of this course to take students through basics of genetics. The course will give an in- department knowledge on causes and diagnosis of human genetic disorders.
2. They will also learn the application of pedigree drawing and analysis of patterns of inheritance of genetic conditions in humans.

UNIT I: Introduction to genetics **11Hrs**

Mendel's principles, Gene interaction & Modified ratios, Multiple alleles, multiple factor inheritance, Extra chromosomal inheritance. Linkage and crossing over and genetic mapping: sex-linked inheritance, cytological evidence of crossing over in maize, crossing over frequency and map distances, recombination models: maize, yeast and Neurospora. Population genetics: Hardy –Weinberg's law, factors influencing the equilibrium

UNIT II: Organization of genomes **11Hrs**

Prokaryotic genome organization - Bacteriophages, Bacteria, Viruses. Eukaryoticorganelle genomes, Eukaryotic nuclear genomes (Genetic features, C-value paradox, typesof coding and noncoding sequences and Split Genes). Mobile genetic elements inProkaryotes (bacteria) and Eukaryotes (*Drosophila,* maize and humans).

UNIT III: Genetic mapping of Mendelian traits **11Hrs**

History of human genetics, Pedigree, Pattern of inheritance. Identifying recombinants and non-recombinants in pedigrees, somatic cell fusion, cell hybrids and Radiation hybrids. Genetic and physical map distances, Twopoint mapping - LOD score analysis. Multipoint mapping. Homozygosity mapping. Genetic mapping of complex traits, Difficulties in mapping complex traits, Integration of Cytogenetic, genetic and physical maps.

UNIT IV: Genetic basis of syndromes and disorders 11Hrs

Monogenic diseases, Inborn errors of metabolism, Neurogenetic disorders, Genetic disorders of Haemopoetic systems, Genetic disorders of eye, Genetic disorders in skeleton and skin, Congenital heart diseases, Complex polygenic syndromes (Atherosclerosis, Diabetes mellitus and Rheumatoid Arthritis), Learning disorders.

UNIT V: Diagnosis, Genetic counseling and ethics 11Hrs

Prenatal diagnosis: (i) Noninvasive methods- X- radiation, Ultrasonography and Fetal echocardiography (ii) Invasive methods- Maternal serum screening, Amniocentesis, Chorionic villus sampling and Fetoscopy. Genetic counseling: Definition, Models of eugenics and human right, Psychotherapeutic counseling, Decision making, Risk assessment and counseling in Mendelian and multifactorial syndromes. Human genetics and legal, social and ethical considerations.

Reference Books:

1. Gardner E J & D P Snustad 1996. Principles of Genetics. John Willey, New York.
2. Sambamurthy, AVSS. 1999. Genetics. Narosa publ. New Delhi.
3. Stansfield WD 1991. Theory & Problems in genetics. McGraw Hill, New York.
4. Strickberger MW 1996. Genetics III edn. McMillan, New York.
5. Winchester AM 1967. Genetics. Oxford & IBH. New Delhi.
6. Cummings, M. R. 1994. Human Heredity: Principles and Issues. West Publishing Company.
7. Epstein, R. J. 2003. Human Molecular Biology. Cambridge Univ. Press, Cambridge
8. Jobling M. A., Hurles and Tyler-Smith. 2004. Human Evolutionary Genetics – Origin, People & Disease. Garland & Science
9. Khoury, M. J., J. Little and W. Burke. 2004. Human Genome Epidemiology. Oxford Univ. Press, Oxford.
10. Motulsky, V. 1977. Human Genetics. Springer & Verlag, Berlin.
11. Strachan, T. and A. P. Reads, 2004. Human Molecular Genetics 3. Garland Science, London.

Course Outcomes (CO): After completion of this course student should able to

CO1	Describe the fundamental genetic inheritance patterns
CO2	Understand relationship between phenotype and genotype in human genetic traits
CO3	Understand and demonstrate the drawing of human pedigree charts for genetic disorders
CO4	Develop capacity to solve quantitate and qualitative data based genetic problems

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M.Sc. Biotechnology First Semester

Course: Principles of Biochemistry	**Course Code:**21BTH1C3L
Teaching Hours/Week (L-T-P): 4- 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. A major goal of biochemistry is to study the cellular processes of living organisms and how these processes relate to the functioning of the organism.
2. And to provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

UNIT I: Chemical foundations of Biology **11Hrs**

The chemical unity of diverse living organisms, composition of living mater. Water - Physio-chemical properties of water. Biomolecular reactions. Macromolecules and their monomeric subunits, Bioenergetics - laws of thermodynamics, Gibb's Free energy, Activation energy, exergonic and endergonic reactions, biological energy transductions. Enzymes - nomenclature, classification, principle, regulation and mechanisms of enzyme catalysis, enzyme kinetics- MM equation, LB plot, Inhibition. Introduction to Metabolisms - Anabolism and Catabolism, Experimental approaches to study metabolism.

UNIT II: Carbohydrates **11Hrs**

Classification, Structure and Isomerism. Monosaccharides, Oligosaccharides, Polysaccharides- Structure and Properties. Metabolism of Carbohydrates- Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle, Regulations of Glycolysis and Gluconeogenesis. Metabolism of Amino sugars, Sialic acids, Mucopolysaccharides and Glycoproteins.

UNIT III: Amino acids **11Hrs**

Structures, classification, properties. Biosynthesis of Aspartate, Pyruvate and Aromatic amino acids families. Amphibolic activity of amino acids. Protein - classification, types, characteristics and structures, functions. Methods for determining protein conformations. Symmetry and functional properties, Protein folding, Denaturation & Renaturation, Ramachandran plot, Solid state synthesis of peptides, Sequence determination. Degradation of Proteins and Amino acids, Urea cycle and its significance.

UNIT IV: Lipids **11Hrs**

Classification, sources and biological functions. Biosynthesis of fatty acids and its regulation, Hydroxy fatty acids, Acylglycerols. Membrane lipids- Phospholipids, Sphingolipids & Eicosanoids. Cholesterol biosynthesis and its regulation. Fatty acid degradation. Lipoproteins- types and functions. Methods of inter organ transport of fatty acids. Formation of ketone bodies. Classification, structure and physiological roles of Vitamins.

UNIT V: Nucleic acids **11Hrs**

Nitrogenous bases, nucleosides & nucleotides, Structure of RNAs and DNA, Forces stabilizing nucleic acid structures. Fractionation, sequencing and chemical synthesis of oligonucleotides. Denaturation and Hybridization. Synthesis and Catabolism of Purines and Pyrimidines, Synthesis of Deoxy ribonucleotides. Biosynthesis of nucleotide coenzymes, nucleotide degradation. Intermediary metabolism.

Reference Books:

1. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth), 2015
2. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. Macmillon Pub, 2017
3. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan), 2015
4. Text Book of Biochemistry by West et. al., (Mac Millan), 2012
5. Principles of Biochemistry by Smith et. al., (Mc Graw Hill), 1983
6. Harper's Biochemistry (Langeman), 2018
7. Biochemistry by D.Voet and J.G.Voet (John weily).
8. Enzymes by Palmer (East), 2008
9. Biochemistry by U. Satyanarayana (Books & Allied (P) Ltd), 2008

Course Outcomes (CO): After completion of this course student should able to

CO1	To demonstrate the structural and functional role of biomolecules essential for cellular reactions.
CO2	Illustrate the catalytic mechanisms involved in synthesis of chemical energy from biomolecules
CO3	Explain the physiological significance of anabolic and catabolic pathways used to drive cellular functions
CO4	Enlist the chemical and biological differences between DNA, RNA and their role in cellular behaviour.

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M.Sc. Biotechnology First Semester

Course: General microbiology	**Course Code:**21BTH1C4L
Teaching Hours/Week (L-T-P): 4- 0 - 0	**No. of Credits:** 04
Internal Assessment: 30 Marks	**Semester End Examination:** 70 Marks

Course Objectives:

1. Thorough comparison and understanding on classification, structure and cultivation of various groups of microorganisms to understand the diversity in microbial life is designed in this course.
2. This basic understanding will provide as a strong foundation to understanding the applications of microbiology.

UNIT I: History and Classification of Microorganisms 11Hrs

Systematic position of microorganisms in living world, classification of microorganisms: Hackle's three kingdom concept, Whittaker's five kingdom concept, three domain concept of CralWoese. Historical account of bacterial classification, detail account of bacterial classification according to the 1st edition of Bergy's manual of systematic bacteriology (up to sections). Detail account of bacterial classification according to the 2nd edition of Bergy's manual of systematic bacteriology (up to orders).

UNIT II: Bacteria and Archae 11Hrs

Morphology and ultra-structure of bacteria; morphological types: L-forms. Structure and function of cell components: bacteria and archaeal cell wall; bacteria and archaeal flagella; fimbriae and pili; capsule- type, slime layers; cell inclusions; nucleoid. Endospore: structure, formation and germination of bacterial endospore. Bacteria growth: growth requirements-nutritional and environmental factors; types of culture media; aerobic and anaerobic culture; shaker and still culture; batch, continuous and synchronous culture; growth kinetics, growth curve and measurement of growth.

UNIT III: Fungi and Algae 11Hrs

Structure, reproduction and classification of fungi, general characteristics of Myxomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes. Fungal growth: culture media for fungal growth, growth requirements and parameters affecting growth; Economic importance of fungi. Algae: distribution, classification, nutrition, structure and reproduction; green algae, diatoms, euglenoids, brown and red algae

UNIT IV: Protozoa and Acellular forms 11Hrs

Protozoa: distribution, classification, nutrition, structure and reproduction. Discovery and origin of viruses. General properties of viruses: morphology, ultra-structure, capsid and their arrangements, types of envelopes and their composition and life cycle. Cultivation of viruses: embryonated eggs, experimental animals and cell lines. Composition, replication and significance of viroids and prions.

UNIT V: Staining and Control of Microorganisms 11Hrs

Gram's staining, Acid fast, Metachromatic granules, nuclear staining, capsule, silver impregnation, Flagella and other special staining methods. Microbial death curve, concept of bioburden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents. Genetics of antibiotic resistance. Control of microorganisms by physical agents: heat, filtration and radiation. Chemical control of microorganisms: Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

Reference Books:

1. Prescott's Microbiology 9th edition (2014) M.J .Willey,M.L.Sherwood, M.L. and J.C. Woolverton, McGraw-Hill Companies. Inc. New York.ISBN: 9780077510664
2. Microbiology, 8th edition. (2013) G.J. Black, John Wiley & Sons, USA.ISBN: 9781118213414
3. Microbiology, 5th edition. (1993) J.M.Pelczar, E.C.S. Chan, and R.N. Krieg, McGraw –Hill Companies, Inc. New York.ISBN:9780074623206
4. Brock Biology of Microorganisms, 14th edition. (2014) T.M.Madigan, M.J.Martinko, S.K.Bender, H.D.Buckley, A.D.Stahl and T.Brock, Pearson Education, Inc. San Francisco.ISBN: 9781292068312
5. Introductory mycology. 4th Edition (2002) C.J.Alexapoulos, C.W.Mims and M.Blackwell, Wiley India.ISBN :9788126511082
6. Textbook of Microbiology, 8th edition (2010) R. Ananthanarayan and J.C.K.Panikar, University Press Private Limited, India. ISBN: 978-9350905340
7. Microbiology: A Laboratory Manual, 11th Edition (2017) J.G.Cappuccino, and N.ShermanPearson,USA. ISBN: 978-0321840226.

Course Outcomes (CO): After completion of this course student should able to

CO1	Establish an understanding of the basic techniques (concept of aseptic work, cultivation and identification) in microbiology
CO2	Describe different aspects of microbial nutrition and growth
CO3	Describe microbial interactions and their significance in environment
CO4	Describe nonspecific body defences and the immune responses and apply this

	understanding to the infectious disease process as well as the prevention and control of infectious diseases
CO5	Develop and execute oral and writing skills necessary for effective communication of the course, the ability to think critically regarding a topic and the delivery of scientific principles to both scientists and non-scientists community

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M.Sc. Biotechnology First Semester

Course: Instrumentation &Biotechniques	**Course Code:**21BTH1S1L
Teaching Hours/Week (L-T-P): 1- 0 - 2	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. The course aims to give the student a detailed view of newly developed principles and methods of biotechnology.
2. The course provides a basic and technical understanding of the biotechnological methods and stresses a novel approach to the study the basic techniques there by imparting to the students the concept of integrative approach.

UNIT I: Basic techniques **07Hrs**

Electrochemistry: pH and buffers, potentiometric and conductometric titration. Principle and application of light, phase contrast, fluorescence, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, cytophotometry and flow cytometry. Preparation of microbial, animal and plant samples for microscopy. Centrifugation: Basic principle and application; Differential, density and Ultracentrifugation. Electrophoresis: Principle and applications of Native and SDS PAGE; Agarose and 2D gel electrophoresis.

UNIT II: Chromatography and Spectroscopy techniques **07Hrs**

Theory of Chromatography; Migration. Dispersion. Chromatographic Resolution. Types: Gel filtration, Paper, thin-layer and partition chromatography. Affinity Chromatography: Ion Exchange chromatography, Purification of specific groups of molecules (GST fusion proteins, Poly (His) fusion proteins, Tandem affinity purifications). Chromatin Immunoprecipitation Assay (ChIP assay), Chip Seq.Spectroscopy: principle, instrumentation and application of UV-visible, fluorescent, CD, NMR, ESR spectroscopy, Atomic absorption spectroscopy, Plasma emission spectroscopy, X-ray diffraction, Mass spectroscopy, MALDI-TOF.

UNIT III: Practicals **28Hrs**

Laboratory 1: To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.

Laboratory 2: To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
Laboratory 3: Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography.
Laboratory 4: Separation of cell organelles using gradient centrifuging techniques.
Laboratory 5: Immunochromatographic assay, Enzyme-linked immunosorbent assay
Laboratory 6: *In-situ* hybridization
Laboratory 7: Western blotting
Laboratory 8: Conventional PCR
Laboratory 9:Real time PCR quantification

Reference Books:

1. Cappuccino, J. G., & Welsh, C. (2016). Microbiology: a Laboratory Manual. Benjamin- Cummings Publishing Company. ISBN: 978-0321840226.
2. Molecular Diagnostics: Current Research and Applications (2014), T, J. Hugget and O' Grady, J. Caister Academic Press. ISBN: 9781908230645.
3. Molecular Cloning: A Laboratory Manual, 4th edition (2014), R. G. Michael, Cold Spring Harbor Laboratory Press, ISBN: 978-1-93611.
4. Shrama BK, Instrumental method of chemical analysis
5. DA Skoog. Instrumental methods of analysis
6. Plummer, An introduction to practical Biochemistry
7. Chatwal and Anand, Instrumentation

Course Outcomes (CO): After completion of this course student should able to

CO1	Familiarity with working principals, tools and techniques of analytical techniques
CO2	Apprehend the functioning, maintenance and safety aspects of the apparatus used in a Biotechnology lab.
CO3	Assimilate the principles and applications of centrifuge, electrophoresis, chromatography and spectroscopy in research and related experiments.
CO4	To understand the strengths, limitations and creative use of techniques for problem solving.

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M.Sc. Biotechnology First Semester

Course: Molecular and Genetics lab	**Course Code:**21BTH1C1P
Teaching Hours/Week (L-T-P): 0 - 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes.
2. To solve transmission genetics problems, makeaccurate predictions about inheritance of genetic traits, and map thelocations of genes.

List of Experiments

1. Preparation of cytological studies for identification of stages of mitosis using root tips
2. Preparation of cytological studies for identification of stages of meiosis–I using flower buds: chiasma frequency
3. Comparative assessment of mitotic indices and karyotyping
4. Demonstration of chromosomal (structural and numerical) aberrations
5. Cell cycle analysis using flow cytometry
6. Analysis of apoptosis and necrosis using flowcytometry / fluorescence microscopy.
7. Safety consideration in a molecular biology laboratory
8. Isolation of Genomic DNA from bacteria and plant material
9. Isolation of RNA from yeast and plant tissue
10. Calculations in Molecular biology: -
    (a) Calculating DNA in mM and conversion to picomoles
    (b) Oligonucleotide Quantitation
    (c) Calculating Molecular weight of a vector
    (d) Calculations in Oligonucleotide synthesis
    (e) Calculating Tm and concentration of primers.
11. Induction of Human leukocyte culture.
12. Preparation of Human chromosomes and G banding.
13. Karyotyping of normal chromosomes and syndromes.
14. Creation of pedigrees and study on patterns of Inheritance in man – numerical on pedigree analysis- autosomal patterns, X–linked patterns, Y–linked patterns, mitochondrial inheritance patterns

15. Studies on phenotypes of different diseases and syndromes.
16. Barr body analysis.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. Molecular Cloning, Laboratory Manual, Maniatis, E.F. Fritsch and J. Sambrook (Cold Spring Harber Laboratory, New York).
2. Techniques in Molecular Biology (1992), J. Walker and W. Castra (GeomHelns, London).
3. Practical Methods in Molecular Biology (1991), R.F. Schecleif and PC. Wensik (SpringerVerlag).
4. Sharma AK & A Sharma. 1980. Chromosome techniques: Theory & Practice. Batterworth.

Course Outcomes (CO): After completion of this course student should able to

CO1	Apply skills in genetics, cell and molecular biology that are generally useful in biological and medical research.
CO2	Demonstrate an understanding of some basic molecular genetic techniques
CO3	Demonstrate nucleic acid extraction, resolution, and detection.

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M.Sc. Biotechnology First Semester

Course: Biochemistry lab	**Course Code:** 21BTH1C3P
Teaching Hours/Week (L-T-P): 0- 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. Learn fundamental approaches for experimentally investigating biochemical problems.
2. Learn the theoretical foundations for themethods used, and understand the applicability of the biochemical methods to realistic situations.

List of Experiments

1. Preparation of Standard solutions (Molar & Normal) and various buffers.
2. Preparation of Titration curve & determination of pKa values for and aminoacids (Glycine).
3. Differential estimations of carbohydrates - reducing vs non-reducing.
4. Estimation of sugars by DNS method.
5. Colorimetric estimation of amino acids by Ninhydrin reagent
6. Colorimetric estimation of protein by Bradford &Folin-Ciocalteu's reagent.
7. Estimation of RNA by Orcinol method.
8. Estimation of DNA by Diphenylamine method
9. Estimation of vitamin C by dichlorophenol indophenol method
10. Chromatography: Column Chromatography - Separation of Photosynthetic Pigments and recording their absorption spectra in the visible range.
11. Separation of amino acids / sugars by Ascending Paper Chromatography.
12. Separation of lipids/ sugars/amino acids by Thin Layer Chromatography.
13. Enzyme Kinetics
    (a) Phosphatase assay (Rat liver)
    (b) Protease assay (Bacterial / fungal cell)
14. Determination of Km and Vmax of alkaline phosphatase / salivary amylase
15. pH of the reaction medium and the Enzyme velocity.
16. Temperature of the reaction medium and the Enzyme velocity.
17. Enzyme concentration in the reaction medium and the Enzyme velocity.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

Reference Books:

1. Hawk's physiological chemistry Ed. by Oser (Mc Graw Hill).
2. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
3. An introduction to practical biochemistry by D.T.Plummer (Mc Graw Hill).
4. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).

Course Outcomes (CO): After completion of this course student should able to

CO1	Analyse and identify the protein and carbohydrate concentrations by using qualitative and quantitative methods
CO2	Choose appropriate analytical techniques to study biomolecules at research labs and industries
CO3	To understand the strengths, limitations and creative use of techniques for problem solving

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M.Sc. Biotechnology First Semester

Course: Microbiology lab	**Course Code:**21BTH1C4P
Teaching Hours/Week (L-T-P):0- 0 - 4	**No. of Credits:** 02
Internal Assessment: 20 Marks	**Semester End Examination:** 30 Marks

Course Objectives:

1. To explain bacteriological diagnosis using microscopy, cultural and biochemical tests.
2. To justify the use of various enrichment, selective and differential media to enrich and isolate various physiological groups from natural environments as well as clinical specimens.

List of Experiments

1. Study of aseptic techniques in Microbiology.
2. Study of Apparatus and Instrumentations use in Microbiology experiments.
3. Microbial culture media and their preparation of various microorganisms.
4. Isolation and Identification of microbes from soil and water samples by Serial dilution method plating method.
5. Study of growth of a microorganism and growth curve.
6. Study of colony characters of bacteria.
7. Microbial staining techniques (simple and differential staining, cell wall, endospores, intracellular lipids, acid-fast, flagella, viability)
8. Slants and stab culture. Storage of microorganisms
9. Microbial motility tests by Hanging Drop method
10. Study of Fungi: *Aspergillus, Fusarium, Pencillum* and *Candida*

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

Reference Books:

1. Handbook of Microbiological Media by Atlas R.L.
2. Manual of Clinical Microbiology by Lennettee E.H.
3. Manual of Clinical Microbiology by Murray PR.
4. A Laboratory manual of Microbiology: Microbes in action.