NATIONAL EDUCATION POLICY-2020

Common Minimum Syllabus for all Uttarakhand State Universities and Colleges

Syllabus Proposed

2023-24

Sri Dev Suman Uttarakhand University

Badshahithol, Tehri (Garhwal)

पाठ्यक्रम निर्माण समिति, उत्तराखण्ड
Curriculum Design Committee, Uttarakhand

क्र0 सं0	नाम एवं पद	
1	**प्रो0 एन0 के0 जोशी** कुलपति, श्रीदेव सुमन उत्तराखण्ड विश्वविद्यालय, टिहरी	**अध्यक्ष**
2	कुलपति, कुमाऊँ विश्वविद्यालय, नैनीताल	**सदस्य**
3	**प्रो0 जगत सिंह बिष्ट** कुलपति, सोबन सिंह जीना विश्वविद्यालय, अल्मोड़ा	**सदस्य**
4	**प्रो0 सुरेखा डंगवाल** कुलपति, दून विश्वविद्यालय, देहरादून	**सदस्य**
5	**प्रो0 ओ0 पी0 एस0 नेगी** कुलपति, उत्तराखण्ड मुक्त विश्वविद्यालय, हल्द्वानी	**सदस्य**
6	**प्रो. एम0 एस0 एम0 रावत** सलाहकार–रूसा, रूसा निदेशालय, देहरादून	**सदस्य**
7	**प्रो0 के0 डी0 पुरोहित** सलाहकार–रूसा, रूसा निदेशालय, देहरादून	**सदस्य**

SyllabusExpertCommittee

S. No.	Name	Designation	Department	Affiliation
1.	Prof. N. Senthil Kumar	Professor	Department of Biotechnology	Mizoram University, Mizoram
2.	Prof. C.P Singh Bhaisora	Professor	Forensic Medicine	Government Medical College, Haldwani
3.	Prof. Rambir Singh	Professor	Department of Horticulture (Aromatic and Medicinal Plants)	Mizoram University, Mizoram
4.	Mr. Ashok Bansal	President	-	Kumaun and Garhwal Chamber of Commerce
5.	Prof. Dharmesh Silajiya	Dean and Professor	Forensic Medicine	National Forensic Science University, Gujarat
6.	Dr. Mahendra Rana	Associate Professor	Pharmaceutical Sciences	Sir J.C Bose Technical Campus, Kumaun University, Nainital

SyllabusPreparationCommittee

S.No.	Name	Designation	Department	Affiliation
1.	Prof. S.P.S Bisht	Dean	Biomedical Sciences	D.S. B Campus, KumaunUniversity,Nainital
2.	Dr. Mahendra Rana	Associate Professor	Department of Pharmaceutical Sciences	S J.C Bose Technical Campus, Kumaun University, Nainital
3.	Dr. Rashi Miglani	Project Associate-I	Biomedical Sciences	D.S. B Campus, KumaunUniversity,Nainital

YEAR	SEMESTER	PAPER CODE	PAPER TITLE	CREDITS
		Master in Medical Biotechnology		
1	I	PAPER-I	Medical Biotechnology - I	4
		PAPER-II	Human Physiology	4
		PAPER-III	Animal Tissue Culture	4
		PAPER-IV	Molecular Biology	4
		LAB	Lab Course 1	4
		Industrial Training/Survey/ResearchProject	With reference to Major Papers of Semester-I	4
			Total	**24**
	II	PAPER-I	Medical Biotechnology - II	4
		PAPER-II	Human Biochemistry	4
		PAPER-III	Medical Aspects of Microbial and Cellular Physiology	4
		PAPER-IV	Industrial Biotechnology	4
		LAB	Lab Course II	4
		Industrial Training/Survey/ResearchProject	With reference to Major Papers of Semester-II	4
	I or II	Minor Elective	Laboratory Safety Guidelines or Good Clinical and Laboratory Practices or Ethical Guidelines for medical research	4
			Total	**28**
			Credits I+II 52	

YEAR	SEMESTER	PAPER CODE	PAPER TITLE	CREDITS
		Master in Medical Biotechnology		
2	**III**	PAPER-I	Advance Bioinformatics	**4**
		PAPER-II	Genetic Engineering	**4**
		PAPER-III	Pharmaceutical Biotechnology	**4**
		PAPER-IV	Gene Based Diagnosis and Therapy	**4**
		LAB	Lab Course 1II	**4**
		Industrial Training/Survey/ResearchProject	With reference to Major Papers of Semester-III	**4**
			Total	**24**
	IV	PAPER-I	Biochemistry	**4**
		PAPER-II	Cell Biology	**4**
		PAPER-III	Immunology	**4**
		PAPER-IV	Research Methodology and Intellectual Property Rights (IPR)	**4**
		LAB	Lab Course IV	**4**

		Industrial Training/Survey/ResearchProject	With reference to Major Papers of Semester-IV	**4**
	Total			**24**
Credits III+IV	**48**			
Total	**100**			

CourseObjective(CO):

1. To produce Pharma industry-driven manpower by training and educating young graduates in Medical Biotechnology a rapidly expanding field focusing on the development and production of biopharmaceuticals that could lead to cures for many major diseases.

Outcomes of the course

1. High employability of the students in public and private sectors including various overseas opportunities in institutions and industry.

2. Globally, Medical Biotechnology courses are rare and no other course offers such a broad scope where, as well as theory, therefore students will be able to develop their skills with a key focus on practical content, studying pre-clinical studies, clinic and marketing that will help prepare you for a diverse career in either industry or academia.

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SYLLABUS (CBCS) M.Sc. MEDICAL BIOTECHNOLOGY
KUMAUN UNIVERSITY, NAINITAL, UTTARAKHAND.

1.	**Name of the Programme**	M.Sc. (Medical Biotechnology)
2.	**Type of Course (U.G/P. G)**	Post Graduate
3.	**Duration of Course**	4 Semester (2 Year course) CBCS
4.	**Objectives of Course**	To produce Pharma industry driven manpower by training and educating the young graduates in Medical Biotechnology a rapidly expanding field focusing on the development and production of biopharmaceuticals that could lead to cures for many major diseases.
5.	**Outcome of Course**	High employability of the students in public and private sectors including various overseas opportunities in institutions and industry. Globally, Medical Biotechnology courses are rare and no other course offers such a broad scope where, as well as theory, therefore students will be able to develop their skills with a key focus on practical content, studying pre-clinical studies, clinic and marketing that will help prepare you for a diverse career in either industry or academia.
	Number of Proposed seats (Intake)	20 (Twenty)

M. Sc. in Medical Biotechnology

FIRST SEMESTER (ODD SEMESTER)

Course Code	Course Type	COURSE (PAPER/SUBJECTS)	Credits	Maximum Marks		
				Internal	External	Total
MBT	CCC	Medical Biotechnology I	4	20	80	100
MBT	CCC	Human Physiology	4	20	80	100
MBT	CCC	Animal Tissue Culture	4	20	80	100
MBT	CCC	Molecular Biology	4	20	80	100
MBT	LAB	Lab Course	4	20	80	100
			Total: 20			

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of compulsory core courses (CCC) Lab course (LC) will be based on CCC. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Duration of Theoretical and Practical Examination Time: 03 Hours

M.Sc. MEDICAL BIOTECHNOLOGY	**I SEMESTER**
COURSE CODE: MBTCOURSE TYPE: CCC	
COURSE TITLE: MEDICAL BIOTECHNOLOGY I	
CREDIT: 04	**TEACHING HOURS:90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 18 Hours	Biotechnology in the Medical Industry (Pre-biotechnology products, impact of biotechnology, post-biotechnology products: biologics andbiopharmaceuticals)
UNIT-2 18 Hours	Genetic manipulationmethods, Fermentationtechnology, Scale-up process (Inoculum: preparation and development of inoculum for industrial fermentation, optimization of the fermentation process (pH, temperature, and oxygen requirements, Determination of the optimized feeding regimen and biomass quantification
UNIT-3 18 Hours	Improvement of selected microorganisms with increased productivity of the fermented products, Fermentation process: Batch and continuous fermentation and fermenters, Fermentation products in Medical Industry: Antibodies, Therapeutic proteins, Vitamins, Amino acids, MonoclonalAntibodies
SUGGESTED READINGS	1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C. 2. RA Goldshy et. al.: Kuby Immunology. 3. J.W. Goding: Monoclonal Antibodies. 4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry. 5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio. 6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication. 7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

M.Sc. MEDICAL BIOTECHNOLOGY	**I SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: HUMAN PHYSIOLOGY	
CREDIT: 04	**TEACHING HOURS: 90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 18 Hours	Introduction and background (homeostasis, control systems), Biophysics of blood flow Regulation of respiration, Auto-regulation of renal blood flow and the concept of clearance, Eye, Ear, Nose, Tongue and Skin: Functions & Disorders.
UNIT-2 18 Hours	Functions & Disorders, Pharynx, oesophagus, Stomach and Intestines, Liver & Pancreas, Peritoneum, Heart rate and the significance, Cardiac cycle, HR factors ECG-Machine, Recording, Abnormalities types Causative Factors Reporting & Interpretation
UNIT-3 18 Hours	Respiration, MechanismInspiration, Expiration Gasexchange mechanism Lung surfactant, compliance Lung volume and capacity Respiratory, Exercises Artificial Respiration Basis & Techniques
UNIT-4 16 Hours	Kidney, Urethra, bladder, Urethra, Female Reproductive System,Male Reproductive System, Mechanism of contraction, Difference between 3 types of muscles, Electro myography & mechanical recording of muscle contraction, Locomotion, Diseases of muscles Dystrophies, Nerve fibres, types,functions, injuries, impulses & velocity Hormones, Functions & Disorders Genetic testing, Eugenics and Aging
SUGGESTED READINGS	1. Textbook of Medical Physiology by C. Guyton 2. Physiology by C. Chatterjee 3. Human Anatomy &Physiology by Tortora 4. Medical physiology by Chaudhary 5. Anatomy and histology by Ross and Wilson 6. Human Anatomy and Physiology by Creager

M.Sc. MEDICAL BIOTECHNOLOGY	**I SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: ANIMAL TISSUE CULTURE	
CREDIT: 04	**THEORY HOURS: 90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 20 Hours	Historical background, the application of tissue culture, Terminology, Stages in cell culture, setting up the laboratory, Culturing cells, Maintaining the culture, Quantification of cells in cell culture, Cloning and selecting cell lines, Physical methods of cell separation, Hazards and safety in the cell culture laboratory
UNIT-2 18 Ours	General cell culture media design, Natural media, Synthetic media, Further considerations in media formulation, Nutritional components of media, the role of serum in cell culture, Choosing a medium for different cell type, Species verification, Intra-species contamination, Characterization of cell type and stage of differentiation, Microbial contamination
UNIT 3 12 Hours	Variation and instability in cell lines, Preservation of cell lines, freezing of cells, Thawing of cells, Quantification of cell viability, Cell banks, The limitation of traditional antibody preparation, The basis of hybridoma technology, The details of hybridoma technology, Long term storage of hybridoma cell lines, Contamination, Hybridomas from different species, Human hybridomas.
UNIT 4 14 Hours	Culture parameters, Scale-up of anchorage-dependant cells, Culture vessels, Suspension culture.
SUGGESTED READINGS	1. Cell and Tissue Culture: Lab Procedures in Biotechnology by Alan Doyle (ed) J. Bryan Griffith (ed) 2. Culture of Animal Cell by Freshney.

M.Sc. MEDICAL BIOTECHNOLOGY	**I SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: MOLECULAR BIOLOGY	
CREDIT: 04	**TEACHING HOURS: 90**
MARKS: 100	**THEORY EXAM: 80 CCC: 20**
UNIT-1	The Structure of Nucleic Acids, DNA/RNA as a Genetic Material Features of Prokaryotes and Eukaryotes gene, Semi-conservative mode of DNA replication Replication of DNA in prokaryotes-, Origin of replication, types of DNA polymerases, details of DNA synthesis process. Eukaryotic DNA replication- multiple replicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex (ORC), regulation of replication
UNIT-2	Different types of DNA damages, Mutation, types of mutation, spontaneous and induced mutation, detecting mutation, Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, SOS operon, Double strand break repair, transcription coupled repair, Homologous and site specific recombination, Models for homologous recombination Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C, Gene conversion
UNIT-3	General features of Transposable elements, Transposable elements in prokaryotes-IS element, Retroviruses Retrotransposon- Ty elements in yeasts, SINES and LINES, Transcription in Prokaryotes: RNA polymerase, sigma factor, Initiation, elongation, termination, Transcription in Eukaryotes: RNA polymerases,transcription of protein coding sequences by RNA polymerase-II, post-transcriptional modification, RNA splicing and RNA editing
UNIT-4	Genetic code, Translation in Prokaryotes and eukaryotes, post translational process-protein translocation, Gene regulation in Prokaryotes, Operon model, Gene regulation in eukaryotes, gene activators, enhancers and silencers
SUGGESTED READINGS	1. Benjamin Lewin. (2008) Genes IX, Jones and Bartelett Publishers Inc. 2. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), Molecular Biology of the Cell, 4th Edition, Garland Publishing 3. Raff, Keith Roberts, Peter Walter, (2003) Essential Cell Biology, 2nd Edition, Garland Publishing 4. Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) Molecular Biology of the Gene, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 5. Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.

M.Sc. MEDICAL BIOTECHNOLOGY	I SEMESTER
COURSE CODE: MBT	**COURSE TYPE: PRACTICAL**
COURSE TITLE: Lab Course –I	
CREDIT: 04	**PRACTICAL HOURS: 90**
MARKS: 100	

LABORATORY WORK

1. Calibration of pH meter
2. Estimation of Proteins by Biuret Method
3. Estimation of Protein by Lowry Method
4. Estimation of Serum Albumin by BCG Method
5. Estimation of SGOT
6. Estimation of SGPT
7. Estimation of Serum Alkaline Phosphatase
8. Estimation of Serum Creatinine
9. Estimation of Urea Nitrogen
10. Estimation of Cholesterol by Zak's ferric Chloride Method
11. Estimation of Carbohydrates by Anthrone Method
12. Estimation of Carbohydrates by DNSA Method
13. Estimation of Carbohydrates by Phenol Sulphuric acid Method
14. Layout of Animal Tissue Culture laboratory
15. Preparation of culture media
16. Thawing of cell lines
17. Passaging of cell lines
18. Cell quantification and Cell viability
19. Cryopreservation of cell cultures
20. Isolation of Genomic DNA from *E.coli* DH5α
21. Purification of isolated genomic DNA
22. Quantification of DNA by UV Spectrophotometer
23. To perform Agarose Gel Electrophoresis
24. Replica Plate Techniques
25. Polymerase Chain Reactions
26. Isolation of genomic DNA from blood sample/tissues/any bio material

M. Sc. in Medical Biotechnology

SECOND SEMESTER

(EVEN SEMESTER)

Course Code	Course Type	COURSE (PAPER/SUBJECTS)	Credits	Maximum Marks		
				Internal	External	Total
MBT	CCC	Medical Biotechnology-II	4	20	80	100
MBT	CCC	Human Biochemistry	4	20	80	100
MBT	CCC	Medical Aspects of Microbial and Cellular Physiology	4	20	80	100
MBT	CCC	Industrial Biotechnology	4	20	80	100
MBL	LAB	Lab Course 2	4	20	80	100
			Total: 20			

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of compulsory core courses (CCC) Lab course (LC) will be based on CCC. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Duration of Theoretical and Practical Examination Time: 03 Hours

M.Sc. MEDICAL BIOTECHNOLOGY	**II SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: MEDICAL BIOTECHNOLOGY II	
CREDIT: 04	**TEACHING HOURS:90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 18 Hours	l Cell Culture: Historical Background, Importance of and progress in Animal Cell Culture, Technology, Biology of Animal Cell; Cellular Interactions, Importance of Serum and Serum Free Media, Culturing and Sub-Culturing of Animal Cells, InVitro Transformation of Animal Cells, Cell Differentiation & Cell Movement, Cloning of Animal Cells, Cell Line Preservation, Cell Line Characterization, Chromosome Spreading and Karyotype Analysis, Mycoplasma: Detection and Control, Monoclonal Antibody Production, Insect Cell Culture: AnOverview
UNIT-2 18 Hours	ell culture: History and evolution, Basics of aseptic culture, In vitro propagation, use of plant growth regulators in tissue culture, plant regeneration, organogenesis, somatic embryogenesis, protoplast isolation and culture, soma clonal variation, in vitro mutagenesis, in vitro selection, secondary metabolite production and cell transformation techniques (including protoplast fusion, direct DNA uptake and plant/ bacterial co- cultivation), use of in vitro techniques for cropimprovement.
UNIT-3 18 Hours	Proteomics, Genomics and Metabolomics: Introduction to the definitions of various 'omics', introduction to the general field of genomics and proteomics, introduction to some methods used in analyzing gene expression at the mRNA and protein level, basic principles of DNA/Protein microarrays and their applications.
UNIT-4 16 Hours	Physical aspects of the genome. Construction and study of various types of genome maps and large-scale sequencing. The human genome project and the plant genome program. Structural genomics and gene discovery, isolation, localization and characterization. Developing diagnostic tests for plant, animal and human diseases. Identification of biomarkers. Finding genetic markers for plant breeding purposes. Environmental impacts on gene expression. Protein complex structures and amino acids. Protein shapes as affecting its function. Amino acid sequencing. Cellular proteome changes in response to environmental and neighboring cells conditions. Cataloguing the proteins produced by different cells. Discovering the function of a protein. Determining three-dimensional structure of proteins. Protein crystallography. Integrons and transposons, Regulatory aspects of biotechnology-based products

SUGGESTED READINGS	1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C. 2. RA Goldshy et. al., : Kuby Immunology. 3. J.W. Goding: Monoclonal Antibodies. 4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry. 5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio. 6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication. 7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

M.Sc. MEDICAL BIOTECHNOLOGY		II SEMESTER
COURSE CODE: MBT		COURSE TYPE: CCC
COURSE TITLE: HUMAN BIOCHEMISTRY		
CREDIT: 04	TEACHING HOURS: 90	
MARKS: 100	THEORY EXAM: 80	CCC: 20

UNIT-1 18 Hours	Water & pH, Amino Acids & Peptides, Proteins: Myoglobin &Haemoglobin Carbohydrates of Physiologic Significance, Lipids of Physiologic Significance, First and second law of thermodynamics, internal energy, enthalpy, entropy, the concept of free energy, standard free energy change of chemical reaction, redox potential, ATP and high energy phosphate compounds, The Respiratory Chain & Oxidative Phosphorylation
UNIT-2 18 Hours	Glycolysis & the Oxidation of Pyruvate, The Citric Acid Cycle: The Catabolism of Acetyl-CoA, Gluconeogenesis & Control of the Blood Glucose, The Pentose Phosphate Pathway & Other Pathways of Hexose Metabolism, Biosynthesis and degradation of glycogen and its regulation, Starch and cellulose biosynthesis
UNIT-3 16 Hours	Biosynthesis of Fatty Acids, Oxidation of Fatty Acids: Ketogenesis, Metabolism of Unsaturated Fatty Acids & Eicosanoids, Cholesterol Synthesis, Transport, & Excretion, Biosynthesis of the Nutritionally Nonessential Amino Acids, Catabolism of Proteins & of Amino Acid Nitrogen, Catabolism of the Carbon Skeletons of Amino Acid, Conversion of Amino Acids to Specialize Products, Nucleotides,
UNIT-4 16 Hours	Biosynthesis and degradation purine and pyrimidine nucleotides,regulation, Hormonal regulation and fuel metabolism, Enzymes nature and classification, Enzyme function: Enzymes affect reaction rates not equilibria, Reaction rates and equilibria, Principles behind catalytic power and specificity of enzymes, Weak interaction between enzyme and substrate are optimized in the transition state, Enzyme use binding energy to provide reaction specificity and catalysis, Specific catalytic groups contribute to catalysis. Enzyme Kinetics, Enzyme Inhibition.

SUGGESTED READINGS

1. A text of biochemistry, - A.V.S.S. Rama Rao 9th ed. (UBS Publisher's and Distributors Pvt. Ltd.)
2. Harper's Illustrated Biochemistry
3. Leninger: Principles of Biochemistry, 3nd Ed. – Nelson D. et al (Worth Publishers)
4. Biochemistry, 5th, - Ed. Breg, J.M. Tymoczko J.L. and Stryer L. (W.H. Freeman & Co.)
5. Lubert Stayer,(Latest) Biochemistry,II edition,W.H.Freeman and CO.NY

M.Sc. MEDICAL BIOTECHNOLOGY		II SEMESTER
COURSE CODE: MBT		COURSE TYPE: CCC
COURSE TITLE: MEDICAL ASPECTS OF MICROBIAL AND CELLULAR BIOLOGY		
CREDIT: 04	THEORY HOURS: 90	
MARKS: 100	THEORY EXAM: 80	CCA: 20
UNIT-1 20 Hours	Bacteria, Fungi and Viruses: Structure, Chemistry and Morphology, Cultural, Physiological and Reproductive features, Methods of isolation, Cultivation and Maintenance, Nomenclature, General classification, Molecular and Genotypic taxonomy. Industrially important microorganisms including Actinomycetes with examples and uses (a) Basic aspects of cell regulation. (b) Bio-energetics and Metabolism – biochemical mechanisms of generating ATP; Fuelling reactions of aerobic and anaerobic organisms. (c) Secondary metabolism and its applications.	
UNIT-2 19 Ours	Nucleic acids, the genetic code and protein synthesis:Synthesis of DNA – polymerization of nucleotides into DNA – Basic chemical structure, replication and its role in protein synthesis. Synthesis of proteins – the roles of RNA in Translation (mRNA, tRNA and rRNA). Manipulating cells in culture (a) Growth of microorganisms in culture pertaining to Bacteria; Principles of microbial nutrition; physical and chemical environment for microbial growth; Batch, continuous and synchronous cultures; Stability and degeneration of microbial cultures. (b) Growth of animal cells in culture; General procedures for cell culture; nutrient composition; primary, established and transformed cell cultures; applications of cell culture in medical industry and research. (c) Growth of viruses in culture; Propagation and enumeration; application of above techniques for antiviral screening.	
UNIT 3 12 Hours	Microbial Genetics: (a) Genetic organization of prokaryotic and eukaryotic cells; mutagenesis and repair mechanisms; types of mutants; application of mutagenesis in strain improvement; gene mapping of plasmids – types, purification, transfer and applications (b) Transformation, Conjugation, Transduction. (c) Phage genetics – gene organization, phage mutation and lysogeny. .	

UNIT 4 14 Hours	Immunology: Cellular basis for immune response, immunity to viruses, bacteria and fungi, immuno-deficiency diseases, hypersensitivity reactions and auto- immune diseases. Immunization – Active and Passive. Microbial pathology and chemotherapy: Identifying features of pathogenic bacteria, viruses and fungi, mechanism of microbial pathogenesis, etiology and pathology of common microbial diseases, currently recommended therapies for common bacterial, fungal and viral infection, mechanism of action of anti- microbial agents and possible sites for chemotherapy
SUGGESTED READINGS	1. Biotechnology – The biological principles: MD Trevan, S Boffey, KH Goulding and P. Stanbury. 2. Immobilisation of cells and enzymes: Hosevearkennady Cabral & Bicker staff. 3. Principles of Gene Manipulating: RW Old and S.B. Primrose. 4. Molecular Cell Biology: Harvey Lodish, David Baltimore, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, James Darnell. 5. Therapeutic Peptides and Proteins; Formulation, processing and delivery systems: Ajay K Banga. 6. Modern Biotechnology: S.B Primrose. 7. Industrial biotechnology: Vedpal S Malik and Padma Sridhar. 8. Immunology: Ivan Roitt, Jonathan Brostoff and David Male. 9. Gene transfer and expression protocols – methods in Molecular Biology,Vol. VII, Edit E.T. Murray. 10. Current protocols in Molecular Biology, Vol.I& II: F.M. Asubel, John Wiley Publishers. 11. Current protocols in cellular biology, Vol.I & II, John Wiley Publishers. 12. Cell Biology, Vol.I, II & III Edited by Julio E Celis.

M.Sc. MEDICAL BIOTECHNOLOGY	**II SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: INDUSTRIAL BIOTECHNOLOGY	
CREDIT: 04	**TEACHING HOURS:90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 18 Hours	Types of bioreactors: Plug flow reactors, continuously stirred tank flow reactors, loop reactors, airlift reactors, fed-batch reactors, fluidized bed reactors, rotatory disc reactors. Concept of Batch process, continuous process, recycled and non-recycled processes, liquid & solid state of fermentations. Concept of bioreactor designing & process optimization, mass transfer, heat transfer, mixing rheology of fermentation fluids, mean resistance time, substrate utilization rate, oxygenation, oxygen sag, yield coefficient.
UNIT-2 16 Hours	Downstream processing: Bioseparation; filtration, membrane filtration, centrifugation sedimentation, flocculation, purification, solvent extraction, ccounter-currentextraction, ion exchange, affinity techniques, concentration, crystallization, reserve osmosis, ultrafiltration, drying, storage and packaging.
UNIT-3 18 Hours	Absorption, covalent bonding, entrapment, encapsulation, cross-linking, types of reactors, diffusion characteristics, effective factors, instability factors, deactivation rates, relative length of half-life, Concept of control, basic control theory, turbidostatic &chemo static control. Basic principles of scale up, working parameters UNIT processes- production of enzymes, antibiotics Biosensor technology
UNIT-4 16 Hours	Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture, Basics of nanotechnology, nanomaterials and nanoparticles, nanotools, Nanoparticles in cancer therapeutics, Nanodiagnostics. *In vitro* nanodiagnostics − nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics, In vivo nanodiagnostics− gold nanoparticles, nanotubes, quantum dots− nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics.
SUGGESTED READINGS	1. A.H. Patel "Industrial Microbiology" Macmillan 2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005. 3. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000. 4. C.F. A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999. 5. K.G.Ramawat&Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

	6. Bionanotechnolgy: Lesson from Nature, David S. Goodsell, Willey-Liss, First edition, 2004 7. Industrial microbiology: An introduction. Mike J. Waites, Neil Morgan, John Rackey, Gary Higton, John S. Rockey 8. Bioreactor recovery in bioprocess technology. Biotol Series 9. Principles of fermentation technology. P. F. Stanbury et al.

M.Sc. MEDICAL BIOTECHNOLOGY		II SEMESTER
COURSE CODE: MBT		COURSE TYPE: CCC
COURSE TITLE: Laboratory Course 2		
CREDIT: 04	TEACHING HOURS:90	
MARKS: 100	THEORY EXAM: 80	CCA: 20

Human Physiology	1. Blood grouping 2. Haemoglobin estimation 3. Total WBC and RBC count 4. Erythrocyte sedimentation rate 5. Differential Counting of Blood 6. PVC count
Medical aspects of Microbial and Cellular Biology	**1. Isolation and identification of bacterial pathogen from clinical specimen** a. Urine sample b. Pus sample c. Blood sample/any other **2. Antibiotic sensitivity test (Disk diffusion method and well diffusion method)** **3. Widal test** **4. Techniques for diagnosis of viral infections** a. HIV b. HBsAg c. Dengue **5. Techniques for diagnosis of parasitic infections** a. Malaria b. Intestinal parasitic infection **6. Techniques for identification of pathogenic fungi** a. Germ tube test b. LPCB preparation for molds c. Slide culture technique **&** 1. Microscopes- Compound microscopes 2. Observations of permanent slide · Different types of Animal Cell 3. Mitosis cell division in Onion Root-Tip Cells 4. Meiotic cell division in grasshopper testis 5. Buccal smear – Identification of Barr Body

	6. Isolation of Mitochondria/chloroplast 7. Counting of cells using Haemocytometer 8. Permanent slide preparation
Industrial Biotechnology	1. Introduction to bioreactor and its parts 2. Antibiotic assay to determine MIC (Minimum inhibitory concentration) 3. Production of enzymes / industrial bio products 4. Study of Downstream processing 5. Industrial visit 6. Vitamin assay

M. Sc. in Medical Biotechnology

THIRD SEMESTER (ODD SEMESTER)

Course Code	Course Type	COURSE (PAPER/SUBJECTS)	Credits	Maximum Marks		
				Internal	External	Total
MBT	CCC	Advance Bioinformatics	4	20	80	100
MBT	CCC	Genetic Engineering	4	20	80	100
MBT	CCC	Pharmaceuticals Biotechnology	4	20	80	100
MBT	CCC	Gene Based Diagnosis and Therapy	4	20	80	100
MBT	LC	Lab Course-3	4	20	80	100
			Total: 20			

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of compulsory core courses (CCC) Lab course (LC) will be based on CCC. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Duration of Theoretical and Practical Examination Time: 03 Hours

M.Sc. MEDICAL BIOTECHNOLOGY	**III SEMESTER**
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: ADVANCE BIOINFORMATICS	
CREDIT: 04	**TEACHING HOURS: 90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 15 Hours	Motif and cis-Regulatory Module (CRM) Modeling: learning motif models, learning models of cis-regulatory modules, Gibbs sampling, Dirichlet priors, parameter tying, heuristic search, HMM structure search, sequence entropy and mutual information, duration modeling, semi-Markov models Gene Finding: the gene finding task, maximal dependence decomposition, interpolated Markov models, back-off models, pairwise HMMs, Genscan, Twinscan, SLAM
UNIT-2 15 Hours	RNA-Seq: RNA-Seq technology, transcript quantification with RNA-Seq RNA Analysis: predicting RNA secondary structure, Nussinov/energy-minimization algorithms, stochastic context free grammars, Inside/Inside-Outside/CYK algorithms, searching sequences for a given RNA secondary structure, RSEARCH, RNA gene recognition via comparative sequence analysis, microRNA gene/target prediction
UNIT-3 20 Hours	Large-Scale and Whole-Genome Sequence Alignment: large-scale alignment, whole-genome alignment, parametric alignment, suffix trees, locality sensitive hashing, k-mer tries, sparse dynamic programming, longest increasing subsequence problem, Markov random fields, MUMmer, LAGAN/MLAGAN, Mauve, Mercator
UNIT-4 20 Hours	Biological network inference and evolution: Network inference, models of biological network evolution, network alignment Genotype Analysis: haplotype inference, genome-wide association studies (GWAS), quantitative trait loci (QTL) mapping Protein Structure Prediction: secondary structure prediction, threading, branch and bound search, ROSETTA

SUGGESTED READINGS	

1. D. Baxevanis and F. Oulette, (2002) “Bioinformatics : A practical guide to the analysis of genes and proteins”, Wiley Indian Edition
2. Cynthia Gibas and Per Jambeck (2001), “Developing Bioinformatics Computer Skills”. O’Reilly press, Shorff Publishers and Distributors Pvt. Ltd., Mumbai.
3. Bryan Bergeron MD (2003), “Bioinformatics Computing”. Prentice Hall India (Economy Edition)
4. Stuart Brown (2000) “Bioinformatics – A biologists guide to Biocomputing and Internet”. Eaton Publishing
5. Jean-Michel Claverie and Cedric Notredame (2003) Bioinformatics – A Beginners Guide. Wiley – Dreamtech India Pvt. Ltd.
6. T. K. Attwood & D. J. Parry-Smith (2001), “Introduction to Bioinformatics”, Pearson Education Ltd, Low Price Edition.
7. Bioinformatics: Sequence and Genome Analysis. D. W. Mount (2001) Cold Spring Harbor Laboratory Press.
8. Arthur M. Lesk (2002) “Introduction to Bioinformatics” Oxford University Press

M.Sc. MEDICAL BIOTECHNOLOGY		III SEMESTER
COURSE CODE: MBT	COURSE TYPE: CCC	
COURSE TITLE: GENETIC ENGINEERING		
CREDIT: 04	TEACHING HOURS:90	
MARKS: 100	THEORY EXAM: 80	CCA: 20

UNIT-1 18 Hours	The recombinant DNA concept, Milestones in genetic engineering, Tools of Genetic Engineering; Enzymes, Nuclease, The Restriction Endonucleases, Phosphodiesterase, Polynucleotide kinase, DNA ligase, DNA polymerase I, Reverse transcriptase, Terminal deoxynucleotidyl transferase, Poly A polymerase
UNIT-2 18 Hours	Salient features of cloning vector, types of cloning vectors- plasmids, cosmids, phages (lambda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes- YACs and MACs
UNIT-3 18 Hours	Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors, Techniques of gene transfer - transformation, transfection, micro injection, electroporation, lipofection and biolistics, Screening Cloned Populations of Recombinants, Preparation of gene libraries and c-DNA libraries
UNIT-4 18 Hours	Chemical synthesis of DNA, DNS sequencing techniques, PCR, Mapping of genome-genetic & physical map, physical mapping and map based cloning, molecular markers in genome analysis- RFLP, RAPD & AFLP analysis, molecular markers PCR based, FISH , Microarray, Northern Blotting, Southern blotting, MicroRNAs and RNA Interference. Transgenic & Gene knock out technologies, Targeted gene replacements, Applications of GE in medicine & industry
SUGGESTED READINGS	1. Molecular Biology of the gene - J. Watson 2. Genes VI, VII and VIII - Benjamin Lewin 3. Molecular Biotechnology Principles and application of recombinant DNA 4. Molecular Biology - Robert F. Weaver 5. Plant Molecular Biology: A practical approach. - C.H. Shaw (2006), Panima Pub. Corp. 6. Molecular cloning Vol. 1-3. Sambrook and Russel. 2001. CSH press. 7. Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publ. 8. Principles and techniques of biochemistry and molecular biology, 6th Ed. Wilson Keith and Walker John

M.Sc. MEDICAL BIOTECHNOLOGY		III SEMESTER
COURSE CODE: MBT		COURSE TYPE: CCC
COURSE TITLE: PHARMACEUTICAL BIOTECHNOLOGY		
CREDIT: 04	TEACHING HOURS: 90	
MARKS: 100	THEORY EXAM: 80	CCA: 20

UNIT-1 15 Hours	Expression system, Cultivation systems, Cultivation medium, Contaminants, Microbiological consideration, Excipients used in Parental formulations of Biotech products, Shelf life of protein-based pharmaceuticals
UNIT-2 15 Hours	Delivery of proteins: Routes of administration and adsorption enhancement Approaches for rate-controlled and target site-specific, Delivery by the parental route
UNIT-3 20 Hours	ADME of protein therapeutics, Bioavailability and Bioequivalency, Pharmacodynamics of protein therapeutics, Interspecies scaling, Heterogeneity of protein therapeutics Chemical modification of protein therapeutics, Immunogenicity
UNIT-4 20 Hours	Genomics, proteomics and pharmacogenetics/genomics, genetically engineered animals Protein engineering, Peptide chemistry and peptidomimetics, Nucleic acid technologies Catalytic antibodies, Glycobiology, Biotechnology and drug discovery **Nanotechnology:** An overview, Characteristics of Nanoparticles
SUGGESTED READINGS	1. Proteins: Biochemistry and Biotechnology - Gary Walsh 2. Foye's Principles of Medicinal Chemistry –William David A. and Lemke Thomas L. 3. Pharmaceutical Biotechnology, 2nd ed. by Crommelin D.J.A. &Sindelar R. D. 4. C. M. Niemeyer and C. A. Mirkin- (Editor), Nanobiotechnology: Concepts, Applications and Perspectives, Wiley Press 5. Nanobiotechnology by Subbiah Balaji

M.Sc. MEDICAL BIOTECHNOLOGY	III SEMESTER
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: GENE BASED DIAGNOSIS AND THERAPY	
CREDIT: 04	**TEACHING HOURS:90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**
UNIT-1 18 Hours	Autosomal dominant inheritance (HD, MD, CDD etc), Autosomal recessive inheritance (SCA, CF etc), Sex linked and mitochondrial (DMD, hemophilia, LHON), PKU, Alzheimer, Parkinsonism, Tay-Sachs, Mongolism, Cri-du-chat, Edwards, X and Y chromosomal, Prenatal and Postnatal studies, Chromosome analysis Haplotype, Physical and Cytogenetic mapping, SNP, RFLP, TRE, PCR-OLA, SSCP, RAPD
UNIT-2 18 Hours	Genetics of Alzheimer's disease- Causative genes for familial Alzheimer's disease (APP, PSEN1, PSEN2)-Alzheimer's disease susceptibility genes (APOE, BACE1, BACE2, NCSTN, PEN2, SORL1), Environmental factors in Alzheimer's disease pathogenesis, Genetics of Parkinson's disease-Causative genes for familial Parkinson's disease susceptibility genes, Environmental factors in Parkinson's disease pathogenesis, Genetics of Amyotrophic lateral sclerosis-Causative genes for familial Amyotrophic lateral sclerosis-Amyotrophic lateral sclerosis susceptibility genes and Environmental factors Amyotrophic lateral sclerosis pathogenesis, Role of environment on epigenetics of neurodegenerative diseases, Teratology, Molecular genetics of coronary heart disease, Schizophrenia,Diabetes mellitus.
UNIT-3 18 Hours	General gene therapy strategies, Targeted killing of specific cells, Targeted mutation correction, Targeted inhibition of gene expression. Gene replacement therapy by viral vectors: Oncovirus, Lentivirus, Adenovirus, adenoassociated virus, Herpes Simplex virus, Naked DNA or direct injection or particle bombardment-gene gun, Liposome mediated DNA transfer, Receptor mediated endocytosis, Repair of mutations in situ through the cellular DNA repair machinery, Antisense induced exon splicing, In-utero fetal gene therapy
UNIT-4 18 Hours	Gene Knockouts, Gene disruption-p53, prion diseases, immunological, short RNA, Gene therapy for non-inheritable diseases, stem cell therapy, somatic cell gene therapy and germ line gene therapy, Gene therapy: problem, solutions and future prospects Controversial issues in medical genetics In vitro fertilization, Prenatal sex determination, Surrogate therapy, Genetic counselling, Germline gene therapy, ELSI, NBAC, IPR, Patenting, Human transgene

SUGGESTED READINGS	1.Human Molecular Genetics- Tom Strachan 2. Concepts of Genetics- William s. Klug 3. Emery's Elements of Medical Genetics- Robert F. Mueller & Ian D. Young

M.Sc. MEDICAL BIOTECHNOLOGY		III SEMESTER
COURSE CODE: MBT		COURSE TYPE: CCC
COURSE TITLE: Laboratory Course 3		
CREDIT: 04	TEACHING HOURS:90	
MARKS: 100	THEORY EXAM: 80	CCA: 20
Genetic Engineering	1. Competent Cell Preparation 2. Transformation 3. Isolation of plasmid DNA by alkaline lysis mini preparation 4. Restriction digestion of vector DNA 5. Restriction digestion of lambda DNA **6.** Gel Elusion 7. Random Fragment Length Polymorphism 8. Random Amplified Polymorphic DNA	
Pharmaceutical Biotechnology	1. Antibiotic production from biological sources. 2. To perform antibiotic assay. 3. Determination of Minimum Inhibitory Concentration (*MIC)* of given antibiotics. 4. Sterility testing of pharma products. 5. Toxicity testing. 6. Industrial visit	
Immunology	1. Animal handling 2. Blood collection 3. Routes of drug administration 4. Dissection of mice lymphoid organ (spleen) 5. Latex agglutination method 6. Determination of Phagocytic index 7. Clinical diagnostic immunoblotting/ SDS PAGE 8. ELISA 9. Immunoassay – immuno diffusion method, rocket electrophoresis 10. ICT for malaria and HIV detection	

Bioinformatics	1. Introduction to SPDBV (deep view). 2. Basic exercise in protein structure visualization. 3. Basic exercise in protein structure visualization coloring. 4. To study the PubMed using internet. 5. To study the NCBI website using internet 6. BLAST 7. FASTA
Gene based diagnosis and Therapy Practical	1. Total RNA extraction & quantification. 2. Southern hybridization of bacterial genome with non-radioactive probe. 3. DNA fingerprinting using RFLP method 4. Single Nucleotide polymorphism analysis. 5. Amplification of human gene with specific primer by PCR technique and analysis by agarose gel electrophoresis. 6. Demonstration of cloning of genomic DNA in standard plasmid vectors & measurement of gene expression using reporter assay

M. Sc. in Medical Biotechnology

FOURTH SEMESTER

(EVEN SEMESTER)

Course Code	Course Type	COURSE (PAPER/SUBJECTS)	Credits	Maximum Marks		
				Internal	External	Total
MBT	Theory	Biochemistry	4	20	80	100
MBT	Theory	Cell Biology	4	20	80	100
MBT	Theory	Immunology	4	20	80	100
MBT	Theory	Research Methodology and Intellectual Property Rights (IPR)	4	20	80	100
MBT	Lab	Lab Course 4	4	20	80	100
Minimum credits in complete semester it would be 20			**Total: 20**			

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of compulsory core courses (CCC) Lab course (LC) will be based on CCC. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Duration of Theoretical and Practical Examination Time: 03 Hours

M.Sc.MEDICAL BIOTECHNOLOGY		IVSEMESTER
COURSECODE:MBT		COURSETYPE:CCC
COURSETITLE:BIOCHEMISTRY		
CREDIT: 04	TEACHINGHOURS:90	
MARKS: 100	THEORYEXAM:80	CCA:20

UNIT-I 18 Hours	**Amino Acids and Proteins** **Protein Structure:** Primary Structure, Secondary, tertiary and Quaternary structure of protein: α-helix, ß-pleated sheets, Ramachandranplot.Factorsaffectingsecondaryandtertiarystructure(pH, ionic strength, solvents). Simple and conjugated protein: Fibrous and globular Proteins (Collagen, Elastin, Keratins, Hemoglobin, Myoglobin). Super secondary structures of Protein: Conceptof Motiff, types of structural motifs in proteins. Domains, structural diversity of differentdomains anddomainswapping, intrinsically disordered proteins (IDP). **Protein Folding:** Molecular chaperones**,** Amyloids, Ubiquitin mediated protein degradation and N-end rule
UNIT-2 18 Hours	**Enzymes:** Introduction, Naming and Classification of enzymes, Catalytic strategies (Covalent catalysis, acid-base catalysis, Metal-ion catalysis and Enzyme Activity). Enzyme Kinetics: Substrate, active site,transitionstate,activationenergy,equilibriumconstantK_m,V_{max},specificity,Michaelis-Mentenequation.ReactionMechanism:Acid-basecatalysisandcovalentcatalysis. Enzyme Inhibition: Competitive inhibition, Non-competitive inhibition. Regulatory enzymes, Isozymes, Zymogens, Ribozymes.
UNIT-3 18 Hours	**DNA Replication -** Prokaryotic and eukaryotic DNA replication, Molecular Mechanisms of DNA replication, Enzymes, and accessory Proteins involved in DNA replication. DNA Damage and Repair (Direct repair, Excision repair, Mismatch repair, Recombinational repair, Repair of double-strand DNA break, SOS response), Recombination, Homologous Recombination Holliday junction, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination, Rec-A proteins and other recombinases.

UNIT-4 18 Hours	**Transcription-** Prokaryotic and Eukaryotic transcription, RNA polymerase, General and specific transcription factors, transcription signals, promoter sites, rho and sigma factor, Regulatory elements and mechanisms of transcription regulation Transcription termination, Transcriptional and post-transcriptional modification: 5'-Cap formation, 3'-end processing and polyadenylation, Splicing; Ribonucleoproteins, RNA editing, nuclear export of mRNA and stability. **Translation**-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational modifications of proteins. Genetic code: Properties, codon usage patterns and codon bias (Wobble Hypothesis).

SUGGESTED READINGS	1. Proteins: Structure and Function; David Whitford; 1st Ed; Wiley, 2005. 2. Biochemistry by Donald Voet and Judith G. Voet; Ed. 4th; Wiley; 2010. 3. Lehninger principles of biochemistry by David L. Nelson and Michael M. Cox; Ed. 6th; W.H. Freeman, 2012. 4. Biochemistry by Christopher K. Mathews and Kensal E. van Holde and Kevin G. sAhern; Ed. 3rd; Prentice Hall, 1999. 5. Biochemistry by Jeremy M. Berg and John L. Tymoczko and Lubert-Stryer; Ed. 6th; W.H. Freeman, 2008. 6. Fundamentals of Protein structure and function, Buxbaum Engelberg; Springer, 2015. 7. Life Sciences, Fundamentals and Practice-I and II, Pathfinder Publication, New Delhi, India. 2021

M.Sc.MEDICAL BIOTECHNOLOGY		IV SEMESTER
COURSE CODE: MBT		COURSETYPE:CCC
COURSETITLE:CELLBIOLOGY		
CREDIT: 04	TEACHINGHOURS:90	
MARKS:100	THEORYEXAM:80	CCA:20

UNIT-1 18 Hours	**Cell Structure and Functions:** structure of eukaryotic cells; Plasma membrane; Transport across the plasma membrane, endocytosis, exocytosis. Cellular organelles; Ribosome, Mitochondria, ER, Golgi complex. Cytoskeleton: Cell motility andshape,protein sorting,Transportofproteins.
UNIT-2 18 Hours	**Cell Structure and Functions:** Microfilamentsand actin filaments, Cell-cellinteraction,Celljunctions,Adhesion proteins, Cell matrix interaction, Integrins, Functional roleof adhesionproteins.Molecular aspects of cell division; Cell cycle anditscontrol - molecular events and model system, cell cycle regulation.
UNIT-3 18 Hours	**Cellular communication:** general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cellular responses to environmental signals in bacteria and animals; cell signaling molecules, Receptors, GPCR and G protein, Ion channel linked receptor, Enzyme-linked receptor, Nitric oxide, Quorum sensing.
UNIT-4 18 Hours	Biology of cancer: Molecular basis of cancer, Proto-oncogenes, Tumor suppressor genes, Carcinogen, Retinoblastoma, Oncovirus or tumor virus, coronavirus Apoptosis and necrosis.
SUGGESTED READINGS	1. Molecular biology of the cell by Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff; Ed. 5th; Garland Science; 2008. 2. Molecular biology of the cell: the problem book by John Wilson and Tim Hunt; Ed. 5th; Garland Science; 2008. 3. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th; W H Freeman and Company; New York; 2008. 4. Cell: molecular approach by Geoffrey M. Cooper and Robert E. Hausman; Ed. 4th;

ASM Press; 2007.

5. Cell biology by Thomas D. Pollard and William C. Earnshaw; Ed. 2nd; Saunders; 2008.
6. Topley and Wilson's Microbiology and Microbial Infections by Leslie Collier and Albert Balows and Max Sussman; Ed. 9th; 6-Volume Set; A Hodder Arnold Publication, 2000.
7. Life Sciences, Fundamentals and Practice-I and II, Pathfinder Publication, New Delhi, India. 2021

M.Sc.MEDICAL BIOTECHNOLOGY		IVSEMESTER
COURSECODE:MBT		COURSETYPE:CCC
COURSETITLE:IMMUNOLOGY		
CREDIT: 04	TEACHINGHOURS:90	
MARKS: 100	THEORYEXAM:80	CCA:20

UNIT-1 15 Hours	History and scope of Immunology:Introduction to Immune System, concepts of Innateand acquired Immune responses, Active and passive Immunity, Natural and artificialimmunity, primary and secondary immune responses. Lymphoid system: Primary and SecondaryLymphoidorgans.Bonemarrow,spleen, various lymph nodes, MALT, GALT,NALT, ILT. Cells involved in the Immune Response: Structural and functional featuresof cells involved in immune responses and their relative significance. Lymphocytes(B&T lymphocytes), NK Cells. Mononuclear Phagocytes, Antigen-presenting cells,Polymorphonuclearcells,eosinophils,basophilsandmastcells,
UNIT-2 15 Hours	Antigens: Requirements for immunogenicity (Foreignness, size, chemical complexity, dose and route of administration), Haptanes, Antigen-antibody interactions- affinity and avidity, cross-reactivity, Factors affecting antigen-antibody interactions, Adjuvant. Major Histocompatibility complex (MHC): Classes of MHC, Important aspects of MHC. Antigen processing and presentation: Processing and presentation of endogenous antigens by cytosolic pathway, Processing and presentation of exogenous antigens by Endocytic pathway
UNIT-3 20 Hours	Immunoglobulins: Structure and function, Basic structure of antibody molecule (Deduction of Ab structure, Immunoglobins domains), different classes of immunoglobin (IgG, IgM, IgA, IgE and IgD). Action of antibody (Opsonization, Toxin neutralization, activation of complement, Immune complex formation and Antibody-dependent cell-mediated cytotoxicity). Antigenic determinants on immunoglobins-Isotypes, allotypes, idiotypes.

UNIT-4 20 Hours	Hypersensitivity: Type I, II, III, IV Hypersensitivity. Autoimmune disease, transplantation-Isograft, allograft, Xenograft and Autograft. Immunodeficiency diseases: Primary and Secondary Immunodeficiency. Vaccines: Types of antigens used in vaccines, whole organism vaccines-Live but attenuated vaccines, inactivated (killed) vaccines, purified antigen vaccines, DNA Vaccines, Recombinant vector vaccines
SUGGESTED READINGS	1. Fundamental Immunology William Paul (Ed) 2017. Lippincott Williams & Wilkins. 2. Kuby Immunology by Thomas Kindt and Richard A. Goldsby and Barbara A. th Osborne; Ed. 6 edition. W.H. Freeman and Company, New York; 2007 3. Cellular and molecular immunology by Abul K. Abbas and Andrew H. Lichtman and Shiv Pillai; Ed. 6th; Saunders, 2007. 4. Immunology; Ed.7th by David Male and Jonathan Brastoff and David B. Both and Ivan Roitt; Mosby Elsevier; 2006. 5. Immunobiology: the immune system in health and disease by Charles A. Janeway and Paul Travers and Mark Walport and Mark J. Shlomchik; 7th Ed; Garland Science; 2008. 6. Immunology of infection diseases by Stefan H.E. Kaufmann and Alan Sher and Rafi Ahmed; ASM Press, Washington; 2002. 7. Essentials of immunology & serology by Jacqueline H. Stanley; DELMAR; Australia; 2002.

M.Sc. MEDICAL BIOTECHNOLOGY		**IV SEMESTER**
COURSE CODE: MBT		**COURSE TYPE: CCC**
COURSE TITLE: Research Methodology and Intellectual Property Rights (IPR)		
CREDIT: 04		**THEORY HOURS: 90**
MARKS: 100	**THEORY EXAM: 80**	**CCA: 20**
UNIT-1 20 Hours	Understanding the language of research – Concept, Construct, Definition, Variable. Research Process, Problem Identification & Formulation – Research Question, Qualitative and Quantitative Research, Interpretation of Data and Academic Writing, Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism	
UNIT-2 20 Hours	Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance, Research Design: Exploratory Research Design, Descriptive Research Designs and Experimental Design. Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Sample types, Concept of Independent & Dependent variables, Levels of measurement – Nominal, Ordinal, Interval and Ratio. Data Analysis, Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.	
UNIT-3 15 Hours	Intellectual property rights and its types-Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of new GMOs, Basics of patents (Types, patent application and Specifications), concept of Prior Art and patent filling procedures, Process patent vs product patent.	
UNIT-4 20 Hours	Introduction to General Agreement on Tariffs and Trade (GATT), World Trade Organization (WTO), World Intellectual Property Organization (WIPO) and Trade Related Intellectual, Property Rights (TRIPS), Indian Patent Act.	

SUGGESTED READINGS	1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition 2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press. 3. Research Methodology – C.R.Kothari 4. Intellectual Property Rights in India (2015) 2nd edition, V.K Ahuja. 5. Intellectual Property Rights (2014), Neeraj Pandey and DharniKhushdeep, PHI Learning Pvt Ltd.

M.Sc. MEDICAL BIOTECHNOLOGY	IV SEMESTER
COURSE CODE: MBT	**COURSE TYPE: CCC**
COURSE TITLE: Laboratory Course 4	
CREDIT: 04	**TEACHING HOURS:90**
MARKS: 100	**THEORY EXAM: 80 CCA: 20**

Laboratory Course

1. Principle and utility of microscopy.
2. Observation of distinguishing features of different eukaryotic cells.
3. Measurement of stomatal cells
4. Preparation of blood smear and differential staining of blood cells.
5. Identification of Blood groups
6. Study of divisional stages in Mitosis.
7. Study of divisional stages in Meiosis.
8. Isolation of plant cellular DNA.
9. Observation of growth and differentiation in single cells.
10. Isolation of chloroplasts.
11. Simple genetic problems solving
12. Human Karyotype analysis
13. Simple Mendelian traits in humans and pedigree analysis.
14. Identify various immune cells and enumerate them
15. Competently perform serological diagnostic tests such as RF, ASO, CRP.
16. Identify blood groups and types.
17. Analyze the components of human sera by performing agarose and polyacrylamide gelelectrophoresis
18. Identification of Carbohydrates, Proteins and Lipids.