Examination Scheme/structure of M.Sc Medical Biotechnology (Semester System) for two year PG program w.e.f. academic session 2024-25.

Semester I

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	24MBT201DS01	Cell and Molecular Biology	HC	4-0-0	4	70	30
2.	24MBT201DS02	Essentials of Microbiology	HC	4-0-0	4	70	30
3.	24MBT201DS03	Biomolecules and Metabolism	HC	4-0-0	4	70	30
4.	24MBT201DS04	Genetic Engineering	HC	4-0-0	4	70	30
5.	24MBT201DS05	Lab Course -1	HC	0-0-4	8	100	
6.	24MBT201SE01	Microbial Identification and Characterization	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Semester II

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory/ Practical	I.A.
1.	24MBT202DS01	Virology	HC	4-0-0	4	70	30
2.	24MBT202DS02	Immunology	HC	4-0-0	4	70	30
3.	24MBT202DS03	Biotechniques	HC	4-0-0	4	70	30
4.	24MBT202DS04	Animal Cell Culture	HC	4-0-0	4	70	30
5.	24MBT202DS05	Lab Course-II	HC	0-0-4	8	100	
6.	24MBT202SE01	Viral Immunology	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Second year of two year PG programme (Students should select any one option for the second year of 2 year PG programme)

Option I

Semester III

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	25MBT203DS01	Stem cell Biology	HC	4-0-0	4	70	30
2.	25MBT203DS02	Biology of Infectious Diseases	HC	4-0-0	4	70	30
3.	25MBT203DS03	Diagnostics	HC	4-0-0	4	70	30
4.	25MBT203DS04	Human Genome and Genetics	HC	4-0-0	4	70	30
5.	25MBT203DS05	Lab Course-III	HC	0-0-4	8	100	
6.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Semester IV

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	25MBT204DS01	Bioethics, Biosafety and IPR	HC	4-0-0	4	70	30
2.	25MBT204DS02	Public Health and Vaccinology	HC	4-0-0	4	70	30
3.	25MBT204DS03	Biostatistics and Bioinformatics	HC	4-0-0	4	70	30
4.	25MBT204DS04	Environmental toxicology and Health	HC	4-0-0	4	70	30
5.	25MBT204DS05	Scientific Communication skills	HC	4-0-0	4	70	30
6.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
Sub Total				**24**	**28**		

Option II

Semester III

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	25MBT203DS01	Stem cell Biology	HC	4-0-0	4	70	30
2.	25MBT203DS02	Biology of Infectious Diseases	HC	4-0-0	4	70	30
3.	25MBT203DS03	Diagnostics	HC	4-0-0	4	70	30
4.	25MBT203DS04	Human Genome and Genetics	HC	4-0-0	4	70	30
5.	25MBT203DS05	Lab Course-III	HC	0-0-4	8	100	
6.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Semester IV

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Practical	I.A
1.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
2.	25MBT204PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

Semester III **Option III***

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Practical	I.A.
1.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
2.	25MBT203PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

Semester IV

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Practical	**I.A**
1.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
2.	25MBT204PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

*Option III will be given to only those candidates who have done 4 year undergraduate programme.

Structure of One year Post Graduate Program

Option I

Semester I (Semester III of 2 year PG program)

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	25MBT203DS01	Stem cell Biology	HC	4-0-0	4	70	30
2.	25MBT203DS02	Biology of Infectious Diseases	HC	4-0-0	4	70	30
3.	25MBT203DS03	Diagnostics	HC	4-0-0	4	70	30
4.	25MBT203DS04	Human Genome and Genetics	HC	4-0-0	4	70	30
5.	25MBT203DS05	Lab Course-III	HC	0-0-4	8	100	
6.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Semester II (Semester IV of 2 year PG program)

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory	I.A.
1.	25MBT204DS01	Bioethics, Biosafety and IPR	HC	4-0-0	4	70	30
2.	25MBT204DS02	Public Health and Vaccinology	HC	4-0-0	4	70	30
3.	25MBT204DS03	Biostatistics and Bioinformatics	HC	4-0-0	4	70	30
4.	25MBT204DS04	Environmental toxicology and Health	HC	4-0-0	4	70	30
5.	25MBT204DS05	Scientific Communication skills	HC	4-0-0	4	70	30
6.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
Sub Total				**24**	**28**		

Option II

Semester I (Semester III of 2 year PG program)

S. No	Course Code	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory / Practical	I.A.
1.	25MBT203DS01	Stem cell Biology	HC	4-0-0	4	70	30
2.	25MBT203DS02	Biology of Infectious Diseases	HC	4-0-0	4	70	30
3.	25MBT203DS03	Diagnostics	HC	4-0-0	4	70	30
4.	25MBT203DS04	Human Genome and Genetics	HC	4-0-0	4	70	30
5.	25MBT203DS05	Lab Course-III	HC	0-0-4	8	100	

6.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
Sub Total				**24**	**32**		

Semester II (Semester IV of 2 year PG program)

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Theory	I.A
1.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
2.	25MBT204PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

Option III

Semester III

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Practical	I.A.
3.	25MBT203SE01	Essentials of Stem Cell Culture	HC	0-0-4	8	100	
4.	25MBT203PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

Semester IV

S. No	Course No	Title of Paper	Type	L-T-P Credits	Hours	Marks	
						Practical	I.A
3.	25MBT204SE01	Disease Diagnostics	HC	0-0-4	8	100	
4.	25MBT204PD01	Dissertation/Project work	HC	0-0-20	40	350	150
Sub Total				**24**	**48**		

SEMESTER-I

SYLLABUS

M.Sc. Medical Biotechnology Semester –I

Course Title: Cell & Molecular Biology

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT201DS01 **Time: 3h**

Learning Objectives:

1. To describe the basic concept of cell cycle.
2. To provide knowledge about how cells communicate with one another and control different biological mechanisms.
3. To learn about genetic damages that affect genome integrity and the underlying mechanism to repair it.
4. To learn about flow of genetic information among eukaryotes and prokaryotes.

Learning Outcomes:

1. Students will be able to differentiate between meiosis and mitosis and will be able to learn about different factors that control cell cycle progression.
2. Students will be able to explain the role of different protein/ enzymes involved in cell signaling.
3. They will be able to understand the mechanism of genetic damage caused by mutation and the role of various repair systems in neglecting the effect of these mutations.
4. Students will be able to explain mechanism of DNA replication, transcription , translation and other related processes

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Cell division and cell cycle: Mitosis and meiosis, steps in cell cycle, and control of cell cycle.
Cell signaling: Hormones and their receptors, second messengers, signaling through G protein coupled receptors
Cancer: Oncogenes, Tumor suppressor genes, Cancer and the cell cycle; Apoptosis, Necrosis.

UNIT II

Prokaryotic and Eukaryotic replication: models for replication, Unit of replication, replication initiation, elongation and termination, replication inhibitors
Prokaryotic and Eukaryotic transcription: RNA polymerases, General and specific transcription factors, Promoters, insulator, repressor, enhancer, modifications in RNA: Cap formation, polyadenylation, Splicing and RNA Editing

UNIT III

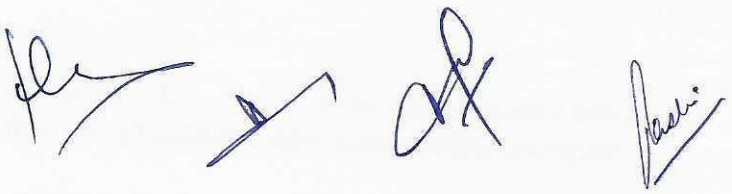
Prokaryotic and eukaryotic translation: Translation machinery, initiation, elongation and termination, factors, translational inhibitors, post translational modifications
Gene regulation in Bacteria, Gene silencing, Overview of ribozyme technology

UNIT IV

Mutation: Types and causes, mutant types – lethal, conditional, biochemical, loss of function, gain of function DNA Repair: Direct reversal, Excision repair -nucleotide and base excision, Mismatch repair Translesion DNA synthesis, Recombination repair, SOS Response Homologous Recombination:Models for recombination, Enzymes and proteins involved in recombination, Site-specific recombination

Recommended books:

1. Cell and molecular biology-Concept and experiment. 2nd edn., Harris,D(Ed.), Karp, G.1999. John wiley & sons, sons, New York.
2. Principles of cell and molecular biology. 2nd edn., Mclaughlin,S., Trost,K., Mac Elree,E.(eds)., Kleinsmith,L.J.& Kish, V.M., 1995. Harper Collins Publisher, New York.
3. Cell and Molecular Biology. 8th edn., De Robertis, E.D.P. and De Roberts, E, M.F.1995. B.I.Waverly Pvt. Ltd., New Delhi.
4. The Biology of Cancer. Robert A. Weinberg
5. Lewin, B. (2008). Genes-IX. Jones and Barlett Publishers, Inc., USA.
6. Burton E.Tropp (2008) Molecular biology: Genes to Proteins. Jones and Barlett Publishers, Inc., USA Bartlet, 4th edition
7. Watson J.D et al (2004) Molecular biology of the gene. Pearson education, 5th edition
8. Darnell J.E, Lodish F.H and Baltimore D (1986) Molecular cell Biology. Scientific American Books
9. Freifelder, D.C. (2008). Molecular Biology. Narosa Publishing House, New Delhi, 2nd ed.
10. Brown T. A (2006) Genome 3. Garland Science; 3 edition
11. Criag N and Wolberger C (2014) Molecular Biology: Principles of Genome Function.Oxford University Press; 2 edition
12. Cooper G.M. and Hausman R.E (2013). The Cell: A molecular approach. Sinnaur Associates Inc. Publisher, USA, 6th edition



M.Sc. Medical Biotechnology Semester -I
Course Title: Essentials of Microbiology

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT201DS02 **Time: 3h**

Learning Objectives:
1. To impart details of principles and historical aspects of microbiology.
2. Understanding the theory and practicality of sterilization and disinfection.
3. Basic principles of microbial nutrition, Microbial Evolution, Systematic and Taxonomy.
4. Familiarization with microbial structure, diversity, growth and metabolism.

Learning Outcomes:
1. Students will be able to explain the basic concept of aseptic microbiological procedures.
2. Students will get familiarity with the diverse types of microbes, methods to classify them and their food habits.
3. Students will be able to appreciate the functioning and applications of various techniques to grow microbes in laboratory & industry.
4. Students will have familiarization with the structural details of bacteria with metabolic diversity.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I
The Beginning of Microbiology, Discovery of the microbial world by Antony van Leeuwenhoek: Controversy over spontaneous generation, developments of microbiology in the twentieth century, Development of pure culture methods,Principles of microbial nutrition, culture media, Theory and practice of sterilization, Microbial Evolution, Systematic and Taxonomy, New approaches to bacterial taxonomy classification including ribotyping, Ribosomal RNA sequencing, Nomenclature and Bergey's Manual

UNIT II
Prokaryotic Cell structure: Cell wall of eubacteria (peptidoglycan) and related molecules; Outer-membrane of Gram negative bacteria; Flagella and motility; Cell inclusions like end spores, gas vesicles.

Prokaryotic Diversity: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci: Mycobacteria: Rickettsias, Chlamydia and Mycoplasma. Archaea: Archaea as earliest Life forms: Halophiles; Methanogens; Hyperthermophilic archaea; Thermoplasma

UNIT III
Microbial Growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; Culture collection and maintenance of cultures.

Bacterial Genetic System: Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons

UNIT IV

Overview of Basic Metabolism & Microbial Nutrition Metabolic Diversity among Microorganisms, Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; Methanogenesis and acetogenesis; Fermentations - diversity, Syntrophy, Nitrogen metabolism; Nitrogen fixation; Genes, Mutation and Mutagenesis UV and chemical mutagenesis Types of mutation; Ames test for mutagenesis

Recommended Books

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (1999) Microbiology. W.C.B.Oxford.
2. Brock, T.D. (1990) Microbiology: A textbook of Industrial Microbiology. 2nd edition, Sameur Association.
3. Tortora, G.J., Funke, B.R. and Case, (1996) Microbiology: An introduction, Benjamin Cummings.
4. Atlas, R.M. (1998) Microbiology: Fundamental and applications. 2nd edition, Macmillan Publishing Company, New York.
5. Pelezar, M.J., Chan, E.G.S. and Krieg, N.R. (1998) Microbiology.
6. Heritage, J., Evance, E.G.V. and Killington, R.A. (1999) Microbiology in action. Cambridge University Press.
7. Lim, D.V. (1989) Microbiology, West Publishing Company, New York.
8. Polasaa, H. Microbial gene technology. South Asian Publishers. New Delhi
9. Textbook of Microbiology and Immunology by Subhash Chandra Parija Elsevier; Second edition
10. Topley and Wilson's Microbiology and Microbial Infections by Leslie CollierEdward Arnold 9th edition
11. Microbiology An Introduction by Gerard J. Tortora Benjamin-Cummings Publishing Company; 10th edition

M.Sc. Medical Biotechnology Semester -I
Course Title: Biomolecules and Metabolism

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT201DS03 **Time: 3h**

Learning Objectives:

1. To understand the role of weak interactions in metabolism
2. Introduce them to physiological buffers and their importance
3. To learn Classification, physicochemical properties and biological function and carbohydrates.
4. To understand the metabolism of Lipids, Proteins Carbohydrates, Nucleic acids and Porphyrin

Learning Outcomes:

1. By the end of the course the students will be able to understand the role of Thermodynamics in Biochemistry
2. They will be able to understand the role of Physiological buffers in maintaining homeostasis
3. To understand the role of various metabolic pathways and their importance
4. To identify the presence of different biomolecules in given samples

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Principles of biophysical chemistry (pH, buffer, Principles of thermodynamics, Water as biological solvent) Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Acid base balance and their importance in clinical biochemistry

Carbohydrates: Classification, structure, occurrence and biological functions. Physicochemical properties of monosaccharides, oligosaccharides. Glycoproteins and proteoglycans.

Carbohydrate Metabolism: Reactions and energetics of glycolysis. Alcoholic and lactic fermentations, Reactions and energetics of TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of HMP pathway.

UNIT I I

Lipid: Classification, structure, occurrence and biological functions of lipids. Nomenclature and properties of fatty acids and triglycerides.

Lipid metabolism: Transport and mobilization of lipids, oxidation of saturated fatty acids (α-, β-, ω-), oxidation of unsaturated and odd-chain fatty acids, role of carnitine in transport of fatty acid, energetics of β-oxidation scheme, metabolism of ketone bodies and its biological significance. Biosynthesis of saturated and unsaturated fatty acids. Biosynthesis of triglycerides, phospholipids, Sphingolipids, cholesterol and prostaglandins.

UNIT III

Amino acids: Physicochemical and structural properties of amino acids, Titration curve, isoelectric point.

Proteins: Classification, structure, peptide bond, Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds. Properties and biological functions of proteins. Amino acid sequencing techniques.

Amino acid metabolism: General reactions of amino acid metabolism- Transamination, Deamination and Oxidative decarboxylation. Biosynthesis and degradation of amino acids and their regulation. Urea cycle and its regulation

UNIT IV

Nucleic acids: properties of DNA in solution, Composition of RNA and DNA, generalized structure plan of nucleic acids, features of A, B, H and Z DNA, Structure and roles of different types of DNAs and RNAs

Nucleic acid Metabolism: Sources of atoms in purine and pyrimidine molecules, biosynthesis and degradation of purines and pyrimidines, regulation of purine and pyrimidine biosynthesis, structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis.

Porphyrin Metabolism: Biosynthesis and degradation of porphyrins.

Recommended Books

1. Biochemical calculations (1976) by Irwin H. Seghal (John Wiley and Sons Inc.).
2. Biochemistry (2004) by Voet Donald Voet, Judith G. (J Wiley and Sons.).
3. Physical biochemistry (1982) by D. Freifelder (W.H. Freeman and Company).
4. Lehninger's principles of biochemistry by D. L. Nelson and M. M.
5. Biochemistry (1995) by Lubert Stryer (W.H. Freeman).
6. Biochemistry (1998) by Geoffrey L. Zubay (Wm.C. Brown).
7. Biochemistry (2006) by Reginald H. Garrett , Charles M. Grisham (Brooks/Cole)
8. Complex carbohydrate (1975) by Nathan Sharon (Addison-Wesley Pub. Co., Advanced Book Program).
9. An introduction to practical biochemistry (2004) by Plummer D.T. (Tata McGraw Hill Publishers Co. Ltd., New Delhi).

M.Sc. Medical Biotechnology Semester -I
Course Title: Genetic Engineering

MM. Th 70 (EA) + 30 (IA) **Course Code: 24MBT201DS04** **Time: 3h**

Learning Objectives:

1. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
2. To expose students to application of recombinant DNA technology in biotechnological research.
3. To provide knowledge about main engines of implementation and transmission of a genetic material at molecular and cellular levels.
4. To familiarize methods of change of a genetic material and construction of transgenic organisms.

Learning Outcomes:

1. Students will be able to describe how transgenic bacteria, plants, and animals may be used to generate products useful to humans.
2. Students get practical skills in the field of manipulation of genetic material.
3. Students will be able to explain how genes can be removed from chromosomes and inserted into different chromosomes.
4. Students will be able to explain how to screen for clones that contain a desired gene fragment.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Scope of Genetic Engineering, Nucleic Acid Purification, Yield Analysis, Nucleic Acid Amplification and its Applications, Restriction and modification enzymes, Gene Cloning Vectors, Restriction Mapping of DNA Fragments and Map Construction, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Nucleic Acid Sequencing, Library construction and screening.

UNIT II

Cloning interacting genes-Two-and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays Site-directed Mutagenesis, Gene Regulation: DNA transfection, Northern blot, Primer extension, S1 mapping, Reporter assays

Unit-III

Expression systems and protein Engineering: Prokaryotic and Eukaryotic expression systems, strategies for heterologous genes, Vector engineering and codon optimization, in vitro transcription and translation, Protein Engineering, Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

UNIT IV

Gene therapy: Gene replacement/augmentation, gene editing, Transgenic models, Targeted gene replacement, Gene regulation and silencing, TALENS, CRISPER-Cas9 system, RNA Interference using siRNA, miRNA, Personalized medicines, Therapeutic cloning, Ethical aspects of genetic engineering.

Recommended Books

1. Gene cloning and DNA analysis – An Introduction (2006) 5th edition, T.A Brown, Blackwell publisher.
2. Essential genes (2006), Benjamin Lewin, Pearson education international.
3. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, NewYork.
4. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primrose and R.M Twyman, Blackwell publishing.
5. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.
7. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.
8. Molecular Biology of Gene (2008) 6th edition, Watson, Baker,Bell. Gann,Levine and Losick, Pearson education Inc.
9. Biotechnology-Applying the genetic Revolution (2009), Clark and Pazdernik, Academic Press
10. Molecular Cloning : A Laboratory Manual (2000), J. Sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York

M.Sc. Medical Biotechnology Semester-I

Course Title: Lab Course I
Course Code: 24MBT201DS05

MM. 100

Learning Objectives:

1. To learn the practical aspects of mitosis/meiosis
2. To learn aseptic techniques of microbes handling and culturing
3. To perform various staining, biochemical and metabolic tests on microorganisms
4. To learn the practical aspects of SDS-PAGE, Plasmid extraction, DNA extraction
5. To learn the isolation of genomic DNA, gene amplification and restriction digestion

Learning Outcomes:

1. By the end of the course the students will be able to understand mitosis and meiosis
2. They will be able to handle microorganism safety and perform various experiments on microbes
3. They will be able to estimate protein, carbohydrates, lipids
4. Students will be able to perform SDS-PAGE, Western Blot etc
5. Student will be able to perform basic genetic engineering including nucleic acid isolation, amplification, reverse transcription, restriction and ligation of DNA

List of Practicals

1. To study the different stages of Mitosis/Meiosis through slides
2. Isolation of DNA by Phenol: Chloroform Extraction method
3. Estimation of DNA by diphenylamine reaction
4. Isolation of RNA by TriZol method
5. Determination of RNA by orcinol method
6. Gel Electrophoresis of DNA/RNA
7. To perform and learn the process of sterilization
8. To visualize bacteria by simple and negative staining procedure
9. To plot the calibration curve for protein estimation by Lowry method
10. Reverse transcription technique.
11. Polymerase Chain Reaction to amplify a housekeeping gene.
12. Restriction digestion of DNA with different restriction enzymes
13. Ligation Reaction of EcoR1 Digested DNA
14. Preparation of competent cells and Transformation

M.Sc. Medical Biotechnology Semester- I
Course Title: Microbial Identification and Characterization
Course Code: 24MBT201SE01

MM. 100

Learning Objectives:

1. To learn the practical aspects of microbial isolation
2. To learn aseptic techniques of microbes handling and culturing
3. To perform various staining, biochemical and metabolic tests on microorganisms
4. To learn the practical aspects of protein, carbohydrate and DNA estimation

Learning Outcomes:

1. By the end of the course the students will be able to understand microbial handling.
2. They will be able to characterize microbe by staining and biochemical methods
3. They will be able to determine protein, carbohydrate and DNA content
4. They will be able to classify the unknown microbe.

List of Practicals

1. Isolation of microbes in pure culture by streak plate method
2. Isolation of microbes in pure culture by spread plate and pour plate method
3. Determination of protein content of microbial mass
4. Characterization of isolated microbe by Gram Staining
5. Characterization of microbial isolate by capsule staining
6. Characterization of microbial isolate by biochemical tests
7. Determination of total microbial count by direct method
8. Determination of total viable count by standard plate count
9. Estimation of effect of UV exposure on growth curve of microbe.
10. Estimation of phenol coefficient for determining efficacy of antimicrobial compound
11. Estimation of carbohydrate content of given microbe
12. Estimation of total DNA content of the given microbe

SEMESTER-II

SYLLABUS

M.Sc. Medical Biotechnology Semester - II

Course Title: Virology

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT202DS01 **Time: 3h**

Learning Objectives:

1. To understand the history and principles of virology
2. To understand the maintenance and handling of laboratory animals and requirements of virological laboratory
3. Familiarization with virological methods: Cultivation and purification of viruses
4. To explain the types of virus-cell interaction

Learning Outcomes:

1. By the end of the course the students will be able to Handle and care of the laboratory animals – Mice, Rat, Rabbit
2. Design an ideal virology laboratory
3. Perform the experiments for diagnosis of virus infection
4. Design strategy for screening of new antiviral drugs

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Introduction: History and principles of virology, Structure and morphology of animal and plant viruses, Infrastructure for virology research: Principles of biosafety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory.

UNIT II

Virological methods: Cultivation and purification of viruses; estimation of yields, methods for purification. Diagnostic methods: Immunodiagnosis, haemagglutination and haemagglutination inhibition tests, Complement fixation, and imuno-histochemistry. Microscopic techniques: Fluorescence, confocal and electron microscopic techniques principles and applications.

UNIT III

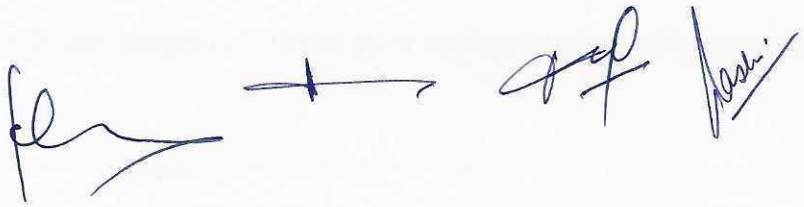
Viruses and virus-cell interaction: Virus Group Clinical features, epidemiology, diagnosis and treatment of following viral group: Viral Haemorrhagic Fevers (Dengue & Chikungunya), Viral Encephalitis (JEV & WNV), Viral Enteric Diseases (Rota virus & Norovirus), Types of Virus-Cell Interactions, Cytocidal Changes in Virus-Infected Cells, Non Cytocidal Changes in Virus-Infected Cells, Inclusion Bodies, Polarity of Viral Budding, Ultrastructural Changes in Virus-Infected Cells, Virus-Induced Cell Death: Apoptosis Versus Necrosis

UNIT IV

Antivirals: Interferons, designing and screening for antivirals, mechanisms of action, antiviral libraries, antiretrovirals - mechanism of action and drug resistance. Modern approaches of virus control: Antisense RNA, siRNA, ribozymes.

Books recommended

1. "Principles of Virology" by S. Jane Flint, Vincent R. Racaniello, Glenn F. Rall, and Anna Marie Skalka.
2. "Fields Virology" by David M. Knipe and Peter M. Howley.
3. "Virology: Molecular Biology and Pathogenesis" by Leonard C. Norkin.
4. "Fundamental Virology" by David M. Knipe and Peter M. Howley.
5. "Introduction to Modern Virology" by Nigel Dimmock, Andrew Easton, and Keith Leppard.
6. "Virology: A Laboratory Manual" by Florence G. Burleson and Thomas M. Chambers.
7. "Viral Pathogenesis and Immunity" by Neal Nathanson.
8. "Medical Virology" by Gordon G. Carmichael.
9. "Virology Methods Manual" by Brian W. J. Mahy and Hillar O. Kangro.
10. "Human Virology" by Leslie Collier, John Oxford, and Paul Kellam.
11. "Animal Virology" D. Baltimore



M.Sc. Medical Biotechnology Semester -II
Course Title: Immunology

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT202DS02 **Time: 3h**

Learning Objectives:

1. To explain the concept of Innate and acquired Immunity.
2. To Learn about Generation of humoral and cell mediated immune response.
3. Understand about Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis.
4. To familiarize with basics of Hypersensitivity, Autoimmunity, Transplantation, Tumor Immunology, AIDS and other Immunodeficiency.

Learning Outcomes:

1. By the end of the course the students will be able to understand the importance of Innate and Adaptive Immunity.
2. Students will be able to understand the role of antigen antibody interactions in various immunotechniques.
3. They will be able to explain the mechanisms generating diversity and specificity in the Immune System.
4. They will be able to understand the behavior of the body towards complex disorders.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Innate and acquired immunity; Cells of the Immune system: Hematopoiesis and differentiation B-Lymphocytes, T-Lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine -activated killer cells, Eosinophils, Neutrophils and Mast Cells; Organization and structure of lymphoid organs, Nature and Biology of antigens and superantigens.

UNIT II

Antibody structure and function, generation of diversity; Antigen - antibody interactions; Complement system; Major histocompatibility complex Regulation of immune response:Antigen processing and presentation

UNIT III

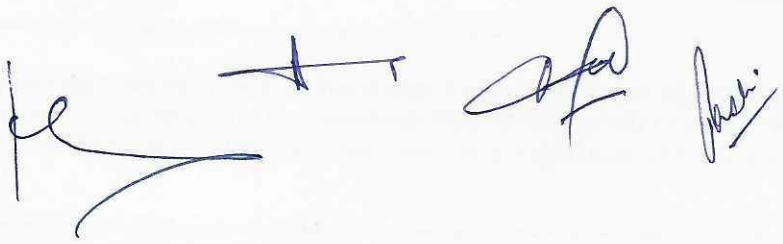
BCR & TCR,. Activation of B- and T. Lymphocytes. T-cell regulation, MHC restriction; Immunological tolerance. Generation of humoral and cell mediated immune responses: Lymphocyte trafficking.

UNIT IV

Cytokines. Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity Hypersensitivity, Autoimmunity,Transplantation, Tumor Immunology, AIDS and other Immunodeficiency.

Recommended Books

1. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York
2. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York
3. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London
4. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, Philadelphia Saunders College press.
5. Gupta P.K. (2003), Biotechnology and Genomics, Rastogi Publications Meerut
6. Anant Narayan, Text Book of Immunology,
7. Pommerville et al (2004), Alcamo's Fundamentals of Microbiology, Jones and Barteett Publishers.
8. Richard Coico (2009) Immunology - A short course, Geoffrey Sunshine (Wiley Blackwell).
9. William Paul (1999) Fundamentals of immunology , (Lippincott Williams & Wilkins).



M.Sc. Medical Biotechnology Semester - II
Course Title: Biotechniques

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT202DS03 **Time: 3h**

Learning Objectives:

1. To impart details of principles of histochemical and immunotechniques.
2. Understanding the principle and design of electrophoretic apparatus.
3. Basic principles of chromatography and centrifugation.
4. Familiarization with microscopic and radiolabeling technique.

Learning Outcomes:

1. Students will be able to explain the basic concept of ELISA, RIA, Western blotting and flow cytometry.
2. Students get familiarity with AGE, PAGE, SDS-PAGE, 2-D, Pulse-field, Capillary and Isoelectrofocussing.
3. Students will be able to appreciate the functioning and applications of Gas liquid chromatography, High pressure liquid chromatography (HPLC).
4. Students having familiarization with UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Enzyme Linked Immunosorbent Assay (ELISA), Radial Immuno Assay (RIA), Immunofluorescence microscopy, Immunoelectrophoresis; Blotting techniques: Northern, Southern and Western blotting

Electrophoresis: Principle and design of electrophoretic apparatus; Types of electrophoresis - AGE, PAGE, SDS-PAGE, 2-D, Pulse-field, Capillary

UNIT II

Chromatography:Principles and applications of Paper, Thin layer, Gel-filtration, Ion-exchange, Affinity chromatography, Hydrophobic interaction chromatography, Gas liquid chromatography, High pressure liquid chromatography (HPLC)

Centrifugation: Types of centrifuges and centrifugation, rotors and applications, differential centrifugation, density gradient, Ultracentrifuge-analytical and preparative.

UNIT III

Microscopic techniques: Bright field microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence microscopy; Electron microscopy, Atomic absorption microscopy, Scanning probe microscopy

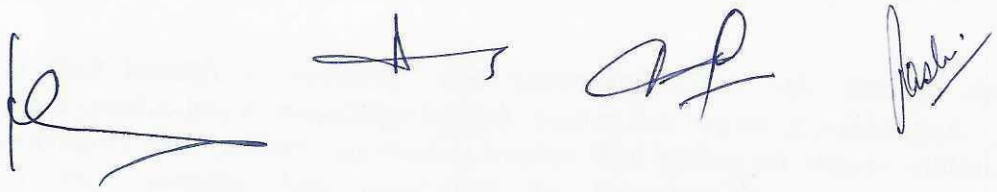
Biophysical techniques: Fluorescence spectroscopy, UV spectroscopy, Mass spectroscopy, Infrared spectroscopy, X-ray crystallography, Nucleic magnetic resonance (NMR) techniques.

UNIT IV

Cell and molecular biology techniques: Flow Cytometry, Polymerase Chain Reaction (PCR) and its variations; DNA: Protein and Protein:Protein interactions methods. Genome Sequencing techniques; Serial Analysis of Gene Expression (SAGE), DNA Microarray; Biochemical techniques: Biosensors: structure, types and applications.

Recommended Books

1. Molecular Cloning : a Laboratory Manual, J. Sambrook, E.F. Fritsch and T.Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000
2. Richard E. Venn (2003), Principal and Practice of Bioanalysis. Taylor and Francis.
3. Walker J. and Wilson K (2000), Principles and Techniques-Practical Biochemistry, 5th Edition, Cambridge University Press, London.
4. Freifelder D. (1982), Physical Biochemistry – Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman and Company, San Francisco
5. Slater R.J. (1990), Radioisotopes in Biology-A Practical Approach, Oxford University Press, New York
6. Switzer R.L. and Garrity L.F. (1999), Experimental Biochemistry, W.H. Freeman and Company, New York
7. Sawhney, S.K. and Singh R (2000), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi
8. Upadhayaye, A ; Upadhyaye, K and Nath N. (2002), Biophysical Chemistry : Principles & Techniques, Himalaya Publication House, New Delhi
9. David Sheehan, Physical Biochemistry; Principles and applications (2000):Wiley Press
10. Simon Roe, Protein purification techniques –A practical approach, Oxford University Press



M.Sc. Medical Biotechnology Semester -II
Course Title: Animal Cell culture

MM. Th 70 (EA) + 30 (IA) Course Code: 24MBT202DS04 **Time: 3h**

Learning Objectives:

1. To provide knowledge about animal cell culture that has become an essential laboratory technique for the study of biochemical and physiological processes.
2. To discriminate between the different types of cell culture technologies.
3. The subject provides the necessary basic information about the conditions of cell culture manipulation,
4. Keeping cells in culture, passage and using of cell culture and tissues.

Learning Outcomes:

1. Students will be able to examine and analyze the theoretical principles of cell culture.
2. Students will be able to examine and analyze the practical principles of cell culture.
3. Students get practical skills in the field of manipulation of animal cell and tissue cultures.
4. Students will be able to explain the main advantages and disadvantages of cell and tissue culture in biomedical research and its applications.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Animal Cell Culture: Historical Background and progress in Animal Cell Culture Technology, Application of animal cell culture. Aseptic techniques in cell culture, Equipment, materials, culture vessels for animal cell culture technology, Primary and established cell cultures, Culturing and Subculturing of suspension and adherent cell culture, Cryopreservation and cell banking.

UNIT II

Introduction to the balanced salt solutions and simple growth medium, Type of cell culture media, Chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon dioxide, Role of serum and supplements, Serum free media and their application, Measurement of viability, cytotoxicity and apoptosis in cell culture.

UNIT III

Biology and characterization of cultured cells - Cell adhesion, proliferation, differentiation, morphology of cells and identification, Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells, Types of cell lines, maintenance of cell lines, Measuring parameters of growth, Prevention and management of Contamination.

UNIT IV

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture, Scale up in monolayer. Cell synchronization of cell cultures and cell division, Cell cloning and micromanipulation, Invitro Transformation of Animal Cells, Scaffolds and 3D printing of Organs.

Recommended Books

1. Culture of Animal Cells- A manual of basic techniques by R.I. Freshney
2. Animal Cells Culture and Media, D.C.Darling and S.J.Morgan, 1994. BIOS Scientific Publishers Limited.
3. Methods in Cell Biology, Volume 57, Jennie P.Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
4. Animal Biotechnology, M.M. Ranga, 2000. Agrobios, India. 5. Biotechnology, Satyanarayana, U., 2006. Books and Allied (P) Ltd.
5. Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, OXFORD.
6. Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
7. Animal Cell Culture Techniques. Ed. Martin Clynes, springer
8. Cell Culture Lab Fax. Eds. M Butler & M. Dawson, Bios Scientific Publications Ltd. Oxford.
9. Biotechnology, Vol. 7b 1993 Rehm. H.J. and Reed, G.(eds) VCH Publications
10. Cell Growth and Division: a Practical Approach. Ed. R. Basega, IRL Press

Course Title: Lab Course II

Course Code: 24MBT202DS05 **MM. 100**

Learning objectives

1. Students will learn about various antigen antibody interaction experiments
2. Students will learn about various bioinformatics databases and also will learn about data analysis methods
3. Students will learn about the methods to cultivate bacteriophage
4. Students

Learning outcomes

1. Students will be able to interpret antigen-antibody interaction patterns
2. Students will be able to retrieve the biological information from databases
3. Students will be able to analyze the data using parametric and nonparametric statistics
4. Students will be able to cultivate viruses and grow it in embryonated eggs

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List of Practicals

1. To test the pattern of antigen-antibody interaction through Ouchterlony double diffusion assay.
2. To perform the Rocket electrophoresis
3. To perform the Widal test
4. To screen the environmental samples for bacteriophage
5. To determine Plaque forming Units (PFU) by double agar method
6. To perform Chromatography: Paper, Thin Layer
7. To perform Electrophoresis: PAGE, AGE,
8. Spectrophotometry: UV/Visible, Nanodrop
9. To perform PCR: Multiplex and Real-Time
10. To perform Sonication
11. Animal Cell culture media preparation and sterilization
12. Culture and passaging of adherent cells
13. Establishment of primary cell culture
14. To determine total erythrocyte count
15. To determine Differential leucocyte count

Course Title: Viral Immunology

Course Code: 24MBT202SE01 **MM. 100**

Learning objectives

Students will:

1. learn the basics of viral immunology
2. learn about various antigen antibody interaction experiments
3. explore the structure of embryonated egg and technique to cultivate virus in it
4. learn the principle of Real Time PCR to determine viral copy number

Learning outcomes

Students will be able to:

1. perform Isolation and Cultivation of NewCastle Disease virus in embryonated eggs.
2. interpret antigen-antibody interaction patterns by ELISA and western blotting
3. perform viral genomic RNA extraction by PCI and Trizol method
4. clone and express recombinant viral proteins

List of Practicals

1. Orientation to a virology laboratory
2. Isolation and Cultivation of NewCastle Disease virus in embryonated eggs.
3. Titration of NewCastle Disease virus by hemagglutination test.
4. Haemagglutination inhibition test for detection of antibodies to newcastle disease virus
5. Extraction of viral genomic RNA by PCI method and its analysis by nanodrop.
6. Extraction of viral genomic RNA by Trizol method
7. Reverse transcription-PCR of viral gene
8. Real Time PCR analysis to determine the viral copy number
9. Cloning of HN gene of NDV virus in suitable vector
10 Standardization of expression of recombinant protein
11 Western blotting to confirm the presence of target protein in the sample
12 To perform ELISA to determine antibody titer in the given sample

SEMESTER-III

SYLLABUS

M.Sc. Medical Biotechnology Semester -III

Course Title: Stem Cell Biology

MM. Th 70 (EA) + 30 (IA) **Course Code: 25MBT203DS01** **Time: 3h**

Learning Objectives:

1. To illustrate what stem cells are and their potential applications.
2. To describe the techniques involved in creating, maintaining and studying stem cells.
3. To provide knowledge about the significance of stem cell technology
4. Applications of stem cells in medicine and public health.

Learning Outcomes:

1. Students will be able to describe different types of stem cells
2. Students will be able to learn how they are derived and the extent of their plasticity
3. Students will be able to explain how stem cells are currently being used in the clinic and what kinds of future treatments lie on the horizon.
4. Students will be able to explain how tumor stem cells give rise to metastases and treatment-resistant remnant cells that cause relapse, and how this impacts on the development of future cancer treatment strategies

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Basic biology of stem cells, Unique properties of stem cells, Types & sources of stem cells: embryonic, fetal, cord blood, placenta, adult, bone marrow, Organ Derived Stem cells, Stem Cell Niche, Cancer stem cells, Induced pluripotent stem cells, Stem cell banking.

UNIT II

Stem cell characterizations: Haematopoietic and mesenchymal stem cells isolation and characterizations, Blood cell formation from Bone marrow stem cell, Stem cell maintenance in *invitro* culture. Bone marrow transplantation versus Stem cell transplantation. Stem Cells and Cloning.

UNIT III

Molecular basis of stem cell self renewal, pluripotency and differentiation, Metaplasia and transdifferentiation. Role of signal transduction pathways in self renewal and differentiation of stem cells. Cell cycle regulators in stem cells, Epithelial to Mesenchymal transition in stem cells

UNIT IV

Therapeutic application of stem cells: Stem Cells Application in Hematological Disorders Stem Cells Application in Non- Hematological Disorders, Advances in stem cell research, Stem cells and gene therapy. Engineering stem cells for immunotherapy, Current Challenges and future prospects, Industrial approach to stem cells. Ethical and Legal issues: ICMR-DBT Guidelines in conducting human stem cell research

Recommended Books

1. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, TwoVolume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, 2012, Academic Press.
2. R. Lanza, J. Gearhart et al (Ed), Essential of Stem Cell Biology, Elsevier Academic press.
3. J. J. Mao, G. Vunjak-Novakovic et al (Ed): "Translational Approaches in Tissue
4. Engineering & Regenerative Medicine" 2008, Artech House, INC Publications. Naggy N. Habib, M.Y. Levicar, L.G. Jiao and N. Fisk: Stem Cell Repair and Regeneration. Volume-2, 2007, Imperial College Press

M.Sc. Medical Biotechnology Semester - III
Course Title: Biology of Infectious Diseases
MM. Th 70 (EA) + 30 (IA) **Course Code: 25MBT203DS02** **Time: 3h**

Learning Objectives:
1. To understand the pathogenesis and treatment of bacterial, viral and fungal disease
2. To understand the concept of disease burden and its economic impact
3. Familiarization with investigation of outbreak
4. To understand the principles of different viral vaccines

Learning Outcomes:
1. Students will be able to explain the etiological agent, pathogenesis of different bacterial, viral, fungal and protozoal diseases
2. Students get familiarity with the economic impact of disease burden
3. Students will be able to take the steps in outbreak investigation
4. Students having familiarization with vaccines and antimicrobial drugs

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Bacteria: Representative diseases to be studied in detail are - tetanus, diphtheria, cholera, typhoid, tuberculosis, leprosy, plague, and syphilis, spirochetes, chlamydia, rickettsiae.
Viruses: Representative diseases to be studied in detail are - viral hepatitis, influenza, rabies, polio and AIDS and viral cancers.
Fungi: Diseases to be taken up in following categories: superficial, subcutaneous, systemic and opportunistic mycoses.

UNIT II

Protozoa:Classification, Diseases to be discussed are - amoebiasis, toxoplasmosis, trichomoniasis & leishmaniasis. Parasitic diseases, Classification: Ascariasis, Liver fluke, Tape worms, Disease burden and its economic impact, Investigation of epidemics. Replication of DNA, RNA+ve and RNA-ve viruses, retroviruses

UNIT III

Viral vaccines: conventional; killed/attenuated; DNA; peptide; recombinant proteins. Sterilization techniques: biohazard hoods; containment facilities, BSL 2, 3, 4. Bacterial and viral vectors, Biological warfare agents

UNIT IV

Mode of action of antibiotics and antiviral: molecular mechanism of drug resistance (MDR) Antiviral chemotherapy. Antifungal chemotherapy. Hospital-acquired infections (nosocomial), immunocompromised states Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, dot hybridization and PCR assays

Recommended Books

1. "Jawetz, Melnick & Adelberg's Medical Microbiology" by Karen C. Carroll, Janet Butel, and Stephen Morse.
2. . "Medical Microbiology" by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller.
3. "Bailey & Scott's Diagnostic Microbiology" by Patricia Tille.
4. "Review of Medical Microbiology and Immunology" by Warren Levinson.
5. "Clinical Microbiology Made Ridiculously Simple" by Mark Gladwin and William Trattler.
6. "Medical Microbiology and Infection at a Glance" by Stephen H. Gillespie and Kathleen B. Bamford.
7. "Color Atlas of Medical Bacteriology" by Luis M. de la Maza, Marie T. Pezzlo, and Janet T. Shigei.
8. . "Essential Microbiology for Dentistry" by Lakshman Samaranayake and Christopher C. K. Ho.
9. "Mims' Medical Microbiology" by Richard V. Goering, Hazel Dockrell, Mark Zuckerman, and Peter L. Chiodini.
10. Medical Microbiology: With Student Consult Online Access" by Michael R. Barer and Will L. Irving.

M.Sc. Medical Biotechnology Semester - III
Course Title: Diagnostics
MM. Th 70 (EA) + 30 (IA) Course Code: 25MBT203DS03 Time: 3h

Learning Objectives:

1. To introduce students about Quality control, GMP and GLP
2. Inborn errors of metabolism, Pre-implantation diagnosis ,prenatal diagnosis Genetic counseling
3. Role of Pedigree analysis in diagnostics and complications in its analysis
4. Introducing the role of Karyotype analysis. FISH, spectral karyotyping (SKY) and comparative genomic hybridization(CGH) and Cancer cytogenetics in diagnostics.

Learning Outcomes:

1. Students will become aware about the Good Laboratory Practices and their importance.
2. Students will be able to understand about in- born errors of metabolism along with various other congenital and developmental disorders and their implications
3. They will be able to understand the etiology, pathophysiology and treatment prescribed for such disorders
4. They will become aware of Personalized medicines and its needs in the current scenario

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT –I

Quality control, GMP and GLP, records. Chromosomal anomalies and disorders : Numerical (polyploidy, aneuploidy, autosomal, sex- chromosomal), Structural (deletion, duplication, translocation, inversion, isochromosome, ring chromosome). Mitochondrial genome and disorders. Genetic Disorders: Single gene Disorders (Cystic Fibrosis, Marfan's syndrome), Multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia)

.

UNIT-II

Methods for genetic study in human – pedigree analysis, Pedigree construction & family study Complications in pedigree analysis (variable expressivity, heterogeneity, penetrance, anticipation, epigenetics, mosaicism)

Polyclonal and monoclonal antibodies, Karyotype analysis. G-banding, FISH, spectral karyotyping (SKY) and comparative genomic hybridization(CGH)

UNIT- III

Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, *In situ* PCR, Long-PCR, PCR-ELISA, Ligase Chain Reaction, genetic profiling, single nucleotide polymorphism.

Applications of PCR- PCR based microbial typing: Eubacterial identification based on 16S rRNA sequences- Amplified Ribosomal DNA Restriction analysis (ARDRA)-Culture independent analysis of bacteria- DGGE and TRFLP. Molecular diagnosis of fungal pathogens based on 18S rRNA sequences- Detection of viral pathogens through PCR. RAPD for animal and plants- PCR in forensic science-AmpFLP, STR, Multiplex PCR

UNIT- IV

Cancer cytogenetics. Dynamic mutations. Biochemical diagnostics: inborn errors of metabolism, Haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders. Pre-implantation diagnosis,pre-natal diagnosis-chorionic villus sampling, Amniocentesis. Genetic counseling. Introduction to pharmacogenomics and toxicogenomics.

Recommended Books

1. Pastemak, An Introduction to Molecular Human Genetics, 2nd Edition, Fritzgarald, 2005. Mange and Mange, Basic Human Genetics, 2nd Edition, Sinauer Assoc, 1999.
2. Lewis, Human Genetics, 7th Edition, WCB & McGraw, 2007.
3. Vogel and Motulsky, Human Genetics, 3rd Edition, Springer Verlag, 1997.
4. Strachen and Read, Human Molecular Genetics, 3rd Edition, Garland Sci. Publishing, 2004.
5. Maroni, Molecular and Genetic Analysis of Human Traits, 1st Edition, Wiley-Blackwell, 2001.
6. Strickberger, Genetics, 3rd edition, McMillan, 1985.
7. Snustad & Simmons, Principles of Genetics, 4th Edition, Wiley, 2005.
8. Griffiths et al, Modern genetic analysis, 2nd Edition, Freeman, 2002.
9. Hartl and Jones, Genetics-Principles and Analysis, 4th Edition, Jones & Bartlett, 1998.
10. Alberts et al, Molecular Biology of The Cell, 2nd Edition , Garland 2007.

M.Sc. Medical Biotechnology Semester - III
Course Title: Human Genome and Genetics
MM. Th 70 (EA) + 30 (IA) Course Code: 25MBT203DS04 **Time: 3h**

Learning Objectives:

1. To explain about organization of human genome
2. To describe the techniques involved in mapping of genes and role of different genetic markers in mapping
3. To provide knowledge about genes interaction and the underlying mechanism of their action
4. To familiarize students with cytogenetic techniques and their application in biological sciences

Learning Outcomes:

1. Students will be able to explain about internal architecture of nuclear and mitochondrial genome
2. Students will be able to explain repetition in genome affects its functioning and stability
3. Students will be able to explain markers like SNP, EST, and microsatellite contributes towards genome diversity and assists in mapping of genes
4. Student will be able to understand basic concept of genes and how do they interact with other genes and how do they affect one another

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Nuclear and mitochondrial genome, Protein coding genes, RNA genes, Repetitive DNA in human genome, Cot analysis, Human Genome Project- Salient features and importance; Structural component of gene and chromosome, Histone and non-histone proteins, Telomeres and Telomerases, DNA topology and its functional importance

UNIT II

Variable number of tandem repeats (VNTR), Sequence tagged sites (STS), Single Nucleotide polymorphisms (SNPs),
Linkage maps, tetrad analysis, Physical mapping by using somatic cell and radiation hybrids, LOD score for linkage testing,

UNIT III

Concept of dominance, segregation, independent assortment, Concept of alleles, multiple alleles, lethal alleles, pseudoalleles, Epistasis, pleiotropy, Sex limited and influenced traits, mechanism of sex determination. penetrance and expressivity, phenocopy, cytoplasmic inheritance

UNIT IV

Concept of epigenetics and genomic imprinting, Chromosome banding and Karyotype, Continuous and discontinuous variations,polygenic inheritance and its heritability and measurements, Population and gene pool, allelic frequency, Hardy Weinberg law.

Recommended Books

1. Brooker, R.J. (1999). Genetics, Principles and Analysis. Addison Wesley Longman, California.
2. Cummings, M.R. (2009). Human Genetics. Cenage Learning, USA.
3. Gardner, E.J. (2011). Human Genetics. Viva Books Pvt. Ltd., India.
4. Klug, W.S. and Cummings, M.R. (2003). Concepts of Genetics. Pearson Education, Inc., New Delhi.
5. Snustad, D.P. and Simmons, M.J. (2010).Principles of Genetics. John Wiley and Sons, Inc., New York.
6. Tamarin R.H. (2012). Principles of Genetics. Tata McGrawHill, New York.
7. Hartl D. L. and Clark (1989) Principle of Population Genetics. Sinauer Associates Inc.,U.S.; 2nd Revised edition edition
8. S.D. Gangane (2012), Human Genetics. Elsevier; 4th ed
9. Brown T. A (2006) Genome 3. Garland Science; 3 edition
10. Anthony J.F. Griffiths and Susan R. Wessler (2011) An Introduction to Genetic Analysis. W. H. Freeman; 10th edition

M.Sc. Medical Biotechnology Semester--III
Course Title: Lab Course III

Course Code: 25MBT203DS05 **MM. 100**

Learning objectives:

1. To learn about the diagnostic aspect of blood cell count
2. To learn about characterization and identification of microorganism
3. To learn about various techniques related to human genome
4. To learn about antimicrobial sensitivity testing

Learning Outcomes:

1. Students will be able to interpret blood cell count results
2. Students will be to identify and characterize unknown microbes.
3. Students will be able to perform experiments related to the human genome.
4. Students will be able to perform experiments related to hematology, liver function test, Kidney function test

List of Practicals

1. Isolation, characterization and identification of Klebsiella
2. Isolation, characterization and identification of Staphylococcus
3. Isolation, characterization and identification of E. coli
4. To perform and interpret standard procedure used for isolation, characterization and identification of Bacillus sp.
5. To demonstrate the process of transformation for acquiring antibiotic resistance
6. Determination of total leucocyte count by hemocytometer method
7. Estimation of Blood Sugar
8. Identification of inactivated X chromosome as Barr body
9. Micronucleus assay using buccal epithelial cells
10. Metaphase chromosome preparation from whole blood/tissue
11. Visualization of different banding pattern of chromosome
12. To construct a karyotype from metaphase chromosome spreads
13. Determination of hemoglobin by Sahli's method
14. Determination of bleeding time and blood clotting time

M.Sc. Medical Biotechnology Semester--III
Course Title: Essentials of Stem Cell Culture

Course Code: 25MBT203SE01 **MM. 100**

Learning objectives:

1. To develop practical skills required for the successful isolation, culture of animal/human cells.
2. To learn the animal cell culture maintenance and subculturing
3. To gain practical experience in seeding, culturing, passaging, and cryopreserving both suspension and adherent culture cell lines.
4. To develop practical skills required for the successful isolation, culture and differentiation of stem cells.

Learning Outcomes:

1. Students will develop proficiency in seeding, maintaining, and passaging animal cells from primary tissues as well as established cell lines.
2. Students will demonstrate competence in the identification, isolation and culture of hematopoietic stem cells.
3. Students will understand the specific requirements and challenges associated with culturing cells under *in vitro* conditions.
4. Students will be able to understand the techniques and considerations for maintaining stem cell pluripotency or promoting differentiation.

List of Practicals

1. Preparation and sterilization of animal cell culture medium
2. Microscopy Slide Set for Mammalian Cell lines
3. Preparation of cell pellet and cell counting using hemocytometer.
4. Cell viability assay using trypan blue dye exclusion method.
5. Isolation of cells from primary source- Blood/tissue and establish primary cell culture.
6. Seeding, culture and passaging of suspension culture cell lines.
7. Seeding, culture and passaging of adherent culture cell lines.
8. Thawing and cryopreservation of cell lines in cryoprotective cell culture medium.
9. Microscopy slide of stem cells
10. Isolation of stem cell rich mononuclear cells by density gradient centrifugation using Ficoll.
11. Isolation of stem and progenitor cells by magnetic cell sorting.
12. Preparation of medium for stem cell culture.
13. *In vitro* culturing of stem cell and progenitors cells
14. In vitro differentiation of stem cells
15. Characterization of *in vitro* differentiated cells.

SEMESTER-IV

SYLLABUS

M.Sc. Medical Biotechnology Semester - IV
Course Title: Bioethics, Biosafety and IPR
MM. Th 70 (EA) + 30 (IA) **Course Code: 25MBT204DS01** **Time: 3h**

Learning Objectives:

1. To describe the concept of intellectual property rights and how it works.
2. To address students about social, ethical, moral and legal issues associated with biotechnology and related areas.
3. To provide knowledge about concerns associated with laboratory and manufacturing practices.
4. To apprise about the biosafety issues in human health

Learning Outcomes:

1. Students will be able to identify basic differences between different forms of IPR like patent, copyright, trademarks etc.
2. Students will understand the influence of ethical and other related issues on research related to the biological system.
3. Students will be able to explain about the different types of types of biosafety levels, their set up and need.
4. Students will be able to learn ethical issue associated with human genome.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

IPR – Introduction to IPR and its types covering detail about Patent and Copyright; Patent Cooperation Treaty (PCT), General Agreement on Tariffs and Trade (GATT), patents and copyrights. Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances. Human genome and IPR

UNIT II

Social and Ethicalissues – Introduction to ethics and ethical committee, function and responsibility of ethical committee; Social and ethical issues regardinggenetic discrimination, cloning, sex determination, gene therapy, clinical trials, stem cell research; Religious and regulatory considerations in stem cell research

UNIT III

Biosafety - Definition, Requirement, Biosafety containment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA.

UNIT IV

Ethical, legal and social implications of human genome project, ethical concerns involved in genetic research, handling and disposal of hazardous materials used in biotechnology, concerns related to transgenic organisms, Bioethics in Biodiversity and resource management

Recommended Books

1. Encyclopedia of Ethical, Legal and Policy Issues in Biotechnology, Wiley and Sons, Inc.
2. Bioethics and Biosafety Paperback by M.K. Sateesh. I K International Publishing House Pvt. Ltd
3. Bioethics In A Liberal Society: The Political Framework Of Bioethics Decision Making by Thomas May
4. Bioethics: Christian Approach In A Pluralistic World (Critical Issues In Bioethics) by Paul Cox,Scott B. Rae, Published by Wm. B. Eerdmans Publishing Co.
5. "Biosafety in Microbiological and Biomedical Laboratories" by U.S. Centers for Disease Control and Prevention (CDC).
6. "Biotechnology and the Human Good" by C. Ben Mitchell and Edmund D. Pellegrino.
7. "Ethics of Biotechnology" by Kristin Shrader-Frechette.
8. "Biosafety: Guidelines for Handling Pathogenic Microorganisms and Biological Toxins" by World Health Organization (WHO).
9. "Bioethics: An Introduction" by Marianne Talbot.
10. "Biotechnology and Intellectual Property Rights: Legal and Social Implications" by Kshitij Kumar Singh and Shamnad Basheer.

M.Sc. Medical Biotechnology Semester - IV
Course Title: Public Health and Vaccinology

MM. Th 70 (EA) + 30 (IA) Course Code: 25MBT204DS02 **Time: 3h**

Learning Objectives:

1. To describe public health as a system, including its unique and important features and their role within it
2. To apply measures of population health and illness, including risk factors, to community health improvement initiatives
3. To provide knowledge about how social science-based knowledge and tools combine with biological
4. To understand and address public health problems

Learning Outcomes:

1. Students will be able to describe and articulate the potential impact of essential services that public health programs provide to protect and improve the health of populations
2. Students will be able to explain the underlying science of human health and disease
3. Students will be able to explain the different types of vaccines and guidelines for current vaccination practices
4. Students will learn about the opportunities for promoting and protecting health across the life course

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NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Definition and Concept of Public Health, Historical aspects of Public Health, Changing Concepts of Public Health, Public Health versus Medical Care, Unique Features of Public Health, Public Health as a System, Determinants of Health (Social, Economic, Cultural, Environmental, Education, Genetics, Food and Nutrition). Indicators of health, Burden of disease, Health promotion, Concept of Prevention, Intervention, Role of different disciplines in Public Health, Scope of Public Health

UNIT II

Historical aspects of epidemiology, Basic concepts, definition and significance, aims of epidemiology, Clinical versus epidemiological approach, Applications and uses of epidemiology, Concept of diseases, Natural history of disease, spectrum of disease, Concept of control, frequency, distribution of disease, Measurements of mortality Measurements of morbidity (prevalence and incidence), Methods of descriptive epidemiology, analytical epidemiology, experimental epidemiology

UNIT III

Vaccinology: History of development of vaccines, concept of vaccines, conventional approaches to vaccine development, live, attenuated and killed vaccines, Role and properties of adjuvants, stabilizers, preservatives and vehicles.Introduction to newer vaccine approaches namely- subunit vaccines, synthetic vaccines, DNA vaccines, virus like particles,

recombinant vaccines, edible vaccines, nanoparticles in vaccine delivery systems, Reverse Vaccinology.

UNIT IV

Vaccine development: stages of development, clinical trials and regulatory requirements. Methods of construction of traditional vaccines, seed lot systems, Modern methods of vaccine construction: methods based on synthetic chemistry and rDNA technology, Vaccine formulation, Vaccine stability and preservation: cold chain.

Recommended Books

1. Mary -Jane Schneider and Henrey Schneider, 2006 (2nd edition), Introduction to Public Health, Jones and Bartlett Publishers.
2. Kirch, Wilhelm, 2008, Encyclopedia of Public Health, Volume 1 & 2, Kluwer Academic Publishers.
3. Barry R Bloom, Paul-Henri Lambert 2002. The Vaccine Book. Academic Press
4. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. The new generation vaccines. 3rd Ed. Informa Healthcare.
5. Lowrie DB & Whalen R. 2000. DNA Vaccines. Humana Press.
6. R Bonita, R Beaglehole, T Kjellstrom, 2006 (2nd edition), Basic epidemiology, World Health Organization.
7. John Yarnell, 2007, Epidemiology and Prevention- A system Based Approach, Oxford.

M.Sc. Medical Biotechnology Semester -IV
Course Title: Biostatistics and Bioinformatics

MM. Th 70 (EA) + 30 (IA) Course Code: 25MBT204DS03 **Time: 3h**

Learning Objectives:

1. To learn about dataset, their types & presentation methods
2. To learn about various sampling techniques & experimental design
3. To learn about parametric and nonparametric statistical methods.
4. To learn about bioinformatic sequence, structure and specialized databases

Learning Outcomes:

1. Students will be able to learn about the basic concept of statistics.
2. Students will be able to explain the concept of hypothesis testing.
3. Students will be able to make use of appropriate test statistics according to the need of data.
4. Students will be able to extract information from biological databases.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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Unit I

Data sources, types & its graphical presentation; Measurement of central tendency (Mean, Mode & Median); Measures of variations (Range, Quartile deviation, standard deviation and variance) ; Measures of Shape (Skewness and Kurtosis). Experimental design and its principle and types; Sampling technique: random and non random.

Unit II

Degree of freedom; confidence Interval; Hypothesis testing, student 't' test; Analysis of variance (ANOVA); Chi-square: Test for goodness of fit and independence); Correlation: Simple, Partial and Multiple Correlation; Regression and its types.

Unit III

Introduction to NCBI; Bioinformatics Databases: Sequence databases (GenBank, DDBJ, EMBL, PIR, Swiss-Prot, UniProt); Structure databases (PDB, SCOP, CATH); Overview of specialized databases: diseases, literature, pathway, genome, expression etc. Pairwise and multiple sequence alignment methods.

Unit IV

Phylogenetics Basis: Molecular Evolution and Molecular Phylogenetics, Gene Phylogeny versus Species Phylogeny, Forms of Tree Representation; Phylogenetic Tree Construction Methods: Distance-based methods, Character-based methods, Phylogenetic Tree Evaluation

Recommended Books

1. Introductory statistics (2006) by Prem S. Mann (John Wiley)
2. Biostatistics (1996) P.N. Arora, P.K. Malhotra, Himalaya Publishing House, Mumbai.
3. Introduction to Biostatistics (1972) Sokal & Rohit – Toppan Co. Japan
4. Rastogi V.B (2009) Fundamentals of Biostatistics. ANE Books Publishers

5. Jin Xiong (2006) Essential Bioinformatics. Cambridge publisher
6. Zhumur Ghosh and Bibekanand Mallick (2008) Bioinformatics: Principles and
7. Applications. Oxford University Press publisher
8. Orpita Bosu and Simminder Kaur Thukral (2007). Bioinformatics. Oxford UniversityPress publisher

SYLLABUS

M.Sc. Medical Biotechnology Semester - IV

Course Title: Environmental Toxicology and Health

MM. Th 70 (EA) + 30 (IA) **Course Code: 25MBT204DS04** **Time: 3h**

Learning Objectives:

1. To introduce the student to the various types of environmental pollutants.
2. T them about potential health impacts of these pollutants.
3. To introduce them to various methods of toxicity testing and biomonitoring.
4. To inform them about laws and regulations concerning environmental toxicology.

Learning Outcomes:

1. It will enhance the understanding of students about the impact of environmental pollution on human health..
2. Might lay down the framework for diagnosis of environmental exposure related health risks.
3. Inform, educate, and empower people about the potential hazards of toxic substances.
4. Educate the person in regards to laws and regulations that protect health and ensure their safety.

NOTE: In all Nine questions will be set, Question No. 1, which will be a short answer type covering the entire syllabus, will be compulsory. Out of the remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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UNIT I

Principles of Environmental Toxicology. Xenobiotics and their biotransformation; Fate and Behavior of contaminants in the Air, Soil and Water; Adsorption, distribution, metabolism and excretion (ADME) of pollutants; Relationships between exposure and toxicity.

UNIT II

Concept of Environmental Health; Role of Epidemiology in Environmental Health Research; Classes of environmental contaminants; Analytical techniques for toxicity testing in human; Biomarkers: of effect, exposure and susceptibility; Biomonitoring of environmental contaminants associated with toxicity.

UNIT III

Environmental pollutants and Cancers; Environmental exposure and cardiovascular diseases; Impact of environmental contaminants on nervous system; Environmental exposure and reproductive health; Environmental pollutant and kidney diseases; Environmental exposure and lung diseases.

UNIT IV

Role of lifestyle (Diet, smoking, alcohol intake etc.) and genetic factors in the development of environment toxicology. Laws and regulations governing environmental toxicants; Risk assessment and management strategies for environmental toxicity; Assessment of cumulative and aggregate risk exposure.

Recommended Books

1. Casarett, L. J., Doull, J., Klaassen, C. D., & Watkins, J. B. (2021). Essentials of toxicology.McGraw Hill
2. Laws, E. A. (Ed.). (2012). Environmental toxicology: selected entries from the encyclopedia of sustainability science and technology. Springer Science & Business Media.
3. Walker, C. H., Sibly, R. M., Hopkin, S. P., & Peakall, D. B. (2012). *Principles of ecotoxicology*. CRC press.
4. Koren, H., & Bisesi, M. S. (2016). Handbook of environmental health, volume II: pollutant interactions in air, water, and soil. CRC Press.
5. Kumar M & Tiwari R.R. (2019) Recent Trends and Advances in Environmental Health: Environmental remediation technologies, regulations and safety. Nova Publishers, USA.
6. Risk Assessment for Environmental Health. (2022). United States: CRC Press.

M.Sc. Medical Biotechnology Semester - IV
Course Title: Scientific Communication Skill
MM. Th 70 (EA) + 30 (IA) **Course Code: 25MBT204DS05** **Time: 3h**

Learning Objectives:

1. To develop an understanding of effective communication and conveying scientific information.
2. To learn about structure and organization of research papers and review articles, proper formatting and citations.
3. To learn about different career paths in science writing, including roles in journalism, technical writing, and communication
4. To develop effective verbal and non-verbal communication skills for impactful presentations

Learning Outcomes:

1. Students will be able to define science communication clearly and explain how it connects scientists with varied audiences
2. Students will learn to produce research articles, reviews, and funding proposals explaining study aims clearly and persuasively
3. Students will improve scientific presentations by learning verbal and nonverbal communication skills
4. Students will learn to ethically deliver scientific knowledge by ensuring accuracy, transparency, and accountability

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NOTE: In all Nine questions will be set, Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. Out of remaining eight questions, two questions will be set from each unit. Students are required to attempt four questions i.e. any one from each unit. Each Question will carry equal marks

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Unit I

Introduction to Science Communication: Definition and Importance of Science Communication, Target Audiences in Science Communication, Public-science engagement, Effective communication, Importance of visual Communication, Graphic design fundamentals and data visualization. Use of multimedia in science communication. Strategies for simplifying complex scientific concepts.

Unit II

Science Writing: Introduction of Science Writing, Formal and informal writing in science, Structure and organization of Research papers and Review writing, Essential grammar rules, Importance of revision and self-editing. Publication and Peer Review Process, Writing for Grants and Proposals. Different career paths in science writing.

Unit III

Public Speaking and Presentation Skills: Fundamentals of Public Speaking, Presentation of scientific information to diverse audiences, Verbal and non-verbal communication skills, Engaging presentations for clarity and impact, Visuals and multimedia effects in communication, Overcoming stage fear and building confidence. Strategies for managing questions from the audience.

Unit IV

Ethics and Responsible Science Communication: Ethical Issues in Science Communication, Responsible dissemination of scientific information, Responsible use of online platforms, Biases in science communication, Impact on public perception and consequences of miscommunication, Scientific transparency and accountability.

Recommended books:

1. "The Art of Communicating Science" by William Isaac and Robert Finnerty
2. "The Chicago Guide to Communicating Science" by Scott L. Montgomery
3. "Science Communication an introduction" by Frans Van Dam And Liesbeth De Bakker, World Scientific India
4. "The science of effective communication: Improve Your Social Skills and Small Talk, Develop Charisma and Learn How to Talk to Anyone" by Ian Tuhovsky
5. "Complete Science Communication" by Ryan C Fortenberry, Publisher: Royal Society of Chemistry
6. The Hands-On Guide For Science Communicators by Lars Lindberg Christensen, Springer

M.Sc. Medical Biotechnology Semester - IV
Course Title: Disease Diagnostics
MM. 100 Course Code: 25MBT204SE01 Time: 3h

Learning Objectives:
1. Learn to Isolate Genomic DNA from Blood sample
2. Learn to design Primer and optimize conditions for gene amplification
3. To learn identification of restriction sites and restriction enzymes for PCR-RFLP analysis
4. To analysis and present data by statistical method

Learning Outcomes:
1. Students will be able to isolate DNA from blood samples
2. Students will learn design Primers and use tools like webcutter
3. Students will be able to Perform PCR-RFLP
4. Students will learn to analysis and present data by statistical method

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List of Practicals

1.Isolation of Genomic DNA from blood sample
2.Quantification of Isolated DNA by DPA method
3.Testing the purity of isolated DNA with Nano Spectrophotometer
4.Gel Electrophoresis of extracted DNA
5.Retrieval of sequence of gene/Protein of interest
6.Designing the Primer for gene of interest
7.Identifying the restriction site and restriction enzyme with webcutter
8.Optimization of PCR conditions for designed Primer
9.Amplification of gene of interest with PCR
10.Restriction digestion for the study of gene variants
11.Calculation of Allelic frequency using Chi square
12.Data analysis and presentation of Data