# CENTRE FOR MEDICAL BIOTECHNOLOGY
# M. D. UNIVERSITY, ROHTAK

**CBCS-SCHEME OF EXAMINATION (M.Sc. –Medical Biotechnology)-2016-17 onwards**

## SCHEME OF EXAMINATION – M.Sc. (Medical Biotechnology)

| S.No. | Course Code | Nomenclature of course | Credit L | T | P | Total credit | Hours | Maximum marks |
|---|---|---|---|---|---|---|---|---|
| **1st Semester** | | | | | | | | |
| 1 | 16MBT21 C1 | Cell and Molecular Biology | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 2 | 16MBT21 C2 | Animal Cell Culture | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 3 | 16MBT21 C3 | Essentials of Microbiology | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 4 | 16MBT21 C4 | Bio-statistics and Computer applications | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 5 | 16MBT21 C5 | Biomolecules and Metabolism | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 6 | 16MBT21 C6 | Lab course I* | **0** | **0** | **4** | 4 | 8 | 100 |
| 7 | 16MBT21 C7 | Lab course II* | **0** | **0** | **4** | 4 | 8 | 100 |
| **Total Credits** | | | **20** | **0** | **8** | **28** | | |

***** Lab course I pertains to 16MBT21C1and 16MBT21C2; Lab course II pertains to 16MBT21C3, 16MBT21C4 and 16MBT21C5.

| S.No. | Course Code | Nomenclature of course | Credit L | T | P | Total credit | Hours | Maximum marks |
|---|---|---|---|---|---|---|---|---|
| **2nd Semester** | | | | | | | | |
| 8 | 16MBT22 C1 | Genetic Engineering | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 9 | 16MBT22 C2 | Immunology | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 10 | 16MBT22 C3 | Bioinformatics | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 11 | 16MBT22D1 or 16MBT22D2 | Virology # or Biotechniques # | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 12 | Open Elective! | To be choosen from the University basket | | | | 3 | 3 | |
| 13 | Foundation course! | To be choosen from the university basket | | | | 2 | 2 | |
| 14 | 16MBT22C4 | Lab course III* | **0** | **0** | **4** | 4 | 8 | 100 |
| 15 | 16MBT22C5 | Lab course IV* | **0** | **0** | **4** | 4 | 8 | 100 |
| **Total Credits** | | | **21** | **0** | **8** | **29** | | |

**#** One course to be opted out of soft core (D1 & D2) courses.

**! Open elective & foundation courses:** To be chosen from pool of OE/FE courses of University.

***** Lab course III pertains to16MBT22C1and16MBT22C2; Lab course IV pertains to 16MBT22C3,

16MBT22D1/16MBT22D2

# CENTRE FOR MEDICAL BIOTECHNOLOGY
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**CBCS-SCHEME OF EXAMINATION (M.Sc. –Medical Biotechnology)-2016-17 onwards**

| S.No. | Course Code | Nomenclature of course | Credit L | T | P | Total credit | Hours | Maximum marks |
|---|---|---|---|---|---|---|---|---|
| **3rd Semester** | | | | | | | | |
| 16 | 16MBT23C1 | Stem cell Biology | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 17 | 16MBT23C2 | Biology of Infectious Diseases | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 18 | 16MBT23D1 or 16MBT23D2 | Diagnostics# or Essentials of Drug Designing# | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 19 | 16MBT23D3 Or 16MBT23D4 | Human Genome and Genetics# Or Human Physiology and Developmental Biology# | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 20 | Open Elective | To be choosen from the basket of open elective papers provided by the University ! | | | | 3 | 3 | |
| 21 | 16MBT23C3 | Lab Course V* | **0** | **0** | **4** | 4 | 8 | 100 |
| 22 | 16MBT23C4 | Lab Course VI* | **0** | **0** | **4** | 4 | 8 | 100 |
| **Total Credits** | | | **19** | **0** | **8** | **27** | | |

**#** Two courses to be opted out of soft core (SC) courses.
**! Open elective (OE)**: To be chosen from pool of OE courses of University
***** Lab course V pertains to 16MBT23C 1 and 16MBT23C2
*****Lab course VI pertains to 16MBT23D1/16MBT23D2/16MBT23D3/16MBT23D4

| S.No. | Course Code | Nomenclature of course | Credit L | T | P | Total credit | Hours | Maximum marks |
|---|---|---|---|---|---|---|---|---|
| **4th Semester** | | | | | | | | |
| 23 | 16MBT24C1 | Ethical, Safety and Management Issues in Medical Biotechnology | **4** | **0** | **0** | 4 | 4 | 80+20 |
| 24 | 16MBT24C2 | Public Health and | **4** | **0** | **0** | 4 | 4 | 80+20 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Vaccinology | | | | | | |
| 25 | 16MBT24C3 | Dissertation | **20** | **0** | **0** | 20 | 40 | 300 |
| **Total Credits** | | | **28** | **0** | **0** | **28** | | |
| **Cumulative program credit** | | | | | | **112** | | |

## M.Sc. Medical Biotechnology Semester -I

## Course Title: Cell & Molecular Biology

**MM. Th 80 + 20** **Course Code: 16MBT21C1** **Time: 3h**

**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

**Theory**

**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. Clark D.P and Pazdernik N.J (2012) Molecular Biology. Academic Cell; 2 edition
13. Cooper G.M. and Hausman R.E (2013). The Cell: A molecular approach. Sinnaur Associates Inc. Publisher, USA, 6th edition
14. Alberts B. and Johnson A (2014). Molecular Biology of Cell. Garland Science publisher, 6th edition
15. Harris,D(Ed.), Karp, G (1999) Cell and molecular biology-Concept and experiment . John wiley & sons, sons, New York. 2nd edn.
16. Snustad, D.P. and Simmons, M.J. (2010).Principles of Genetics. John Wiley and Sons, Inc., New York.

**M.Sc. Medical Biotechnology Semester -I**

**Course Title: Animal Cell culture**

**MM. Th 80 + 20** **Course Code: 16MBT21C2** **Time: 3h**

**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

**Theory**

**UNIT I**

Animal Cell Culture: Historical Background, importance of and progress in Animal Cell Culture Technology, Application of animal cell culture. Equipments, materials, culture vessels for animal cell culture technology. Primary and established cell line cultures, Culturing and Sub-Culturing of Animal Cells.

**UNIT II**

Introduction to the balanced salt solutions and simple growth medium. Chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon dioxide, Role of serum and supplements, Serum & protein free defined 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.

**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.

**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

**M.Sc. Medical Biotechnology Semester -I**

**Course Title: Essentials of Microbiology**

**MM. Th 80 + 20** **Course Code: 16MBT21C3** **Time: 3h**

**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

**Theory**

**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, Enrichment culture methods, Theory and practice of sterilization; Principles of microbial nutrition, culture media, Microbial Evolution, Systematic and Taxonomy, New approaches to bacterial taxonomy classification including ribotypeing, Ribosomal RNA sequencing, Nomenclature and Bergey's Manual

**UNIT II**

Prokaryotic Cells: Structure-function Cell walls of eubacteria (peptidoglycan) and related molecules; Outer-membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like end spores, gas vesicles

Prokaryotic Diversity Bacteria: 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, Chlamydies and Mycoplasma. Archaea: Archaea as earliest Life forms: Halophiles; Methanogens;' Hyperthermophilic urchaea; Thermoplasma

Bacterial Genetic System Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons, Bacterial genetics map with reference to E.coli

**UNIT III**

Viruses: Bacterial, Plant, Animal and Tumor viruses; Discovery, classification and structure of viruses

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

**UNIT IV**

Overview of Basic Metabolism & Microbial Nutrition Metabolic Diversity among Microorganisms, Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy; Hydrogen - iron - nitrite - oxidizing bacteria; Nitrate and sulfate reduction; 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 text book 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 Collier Edward 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: Biostatistics and computer applications**

**MM. Th 80 + 20** **Course Code: 16MBT21C4**

**Time: 3h**

**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

**Theory**

**Unit 1**

Concepts in statistics, Types of Data, presentation of data, types of graphics, relative frequency, cumulative frequency, Measurement of central tendency, Measures of variation, coefficient of variation, Measures of Skewness and Kurtosis, Probability, Random Variables and Distributions. Binomial, Poisson, Exponential and Normal Distributions

**Unit 2**

Samples and Sampling Distribution; Degrees of freedom, Tests of significance, Tests of deviations, F and Z residuals, Confidence Intervals; Contingency tables of (Chi square) tests of goodness of fit and homogeneity, Analysis of variance for one and two way classification

**Unit 3**

Correlation: Simple, Partial and Multiple Correlation, Methods of averages and least squares, polynomial fitting, Regression Analysis; Design of experiments, randomization, replication local control, completely randomized and randomized block design

**Unit 4**

Introduction of computers, Computer classification and structural organization- input, output and central processing devices; Low and High-level languages and their salient features, Software

types and applications, Introduction to Coral Draw, MS-Office: Microsoft word, powerpoint & spreadsheet

**Recommended Books**


1. Biostatistics: A foundation for analysis in the health sciences (2004) by Wayne W. Daniel (John Wiley).
2. Introductory statistics (2006) by Prem S. Mann (John Wiley)
3. Biostatistics (1996) P.N. Arora, P.K. Malhotra, Himalaya Publishing House, Mumbai.
4. Introduction to Biostatistics (1972) Sokal & Rohit - Toppan Co. Japan
5. Rastogi V.B (2009) Fundamentals of Biostatistics. ANE Books Publishers
6. Pagano M and Gauvreau K(2001) Principles of Biostatistics. Duxbury Pr; 2 Stu Sol edition
7. Glantz S. A (2005) Primer of Biostatistics. McGraw-Hill Medical; 6 edition
8. Jyoti Kumar (2010) Biostatistics. A.I.T.B.S Publisher, India
9. Joshi R (2006) Introduction to Computers. Gyan Books Publishers
10. Brand G (2013) Introduction to Computer Science: A Textbook for Beginners in Informatics.
11. Compute fundamentals (2002) by P.K. Sinha, BPB Publications.

**M.Sc. Medical Biotechnology Semester -I**

**Course Title: Biomolecules and Metabolism**

**MM. Th 80 + 20** **Course Code: 16MBT21C5**

**Time: 3h**

**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

## Theory

### UNIT I

Principles of biophysical chemistry (pH, buffer, Principles of thermodynamics, Water as biological solvent) Stablizing 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 intransport 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. Freifilder (W.H. Freeman and Company).
4. Lehninger's principles of biochemistry by D. L. Nelson and M. M. Cox (W. H. Freeman).
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. A biologist's guide to principles and techniques in practical biochemistry (1986) by Keith Wilson, Kenneth H. Goulding (ELBS).
10. 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: Lab Course I**

**Course Code: 16MBT21C6** **MM. 100**

1. To study the different stages of Mitosis/Meiosis through slides
2. Cell counting and cell viability using trypan blue dye exclusion assay
3. Isolation of DNA from Tissue/Blood/Microorganism
4. Quantification of DNA using UV spectrophotometer/Nano Drop
5. Extraction of Plasmid DNA using Alkaline Lyses/ Miniprep method
6. Electrophoresis of DNA/RNA/Plasmid
7. Extraction of DNA from gel
8. Introduction to aseptic technique in animal cell culture
9. Preparation and sterilization of animal cell culture medium

10. Microscopy Slide Set for Mammalian Cell lines
11. Seeding, culture and splitting of cell lines
12. Seeding, culture and splitting of Adherent cell lines
13. Cryopreservation of cell lines.
14. Cell proliferation and cytotoxicity assay by MTT.
15. Maintenance and culture of Adherent and Suspension cell lines for long term

**M.Sc. Medical Biotechnology Semester--I**

**Course Title: Lab Course II**

**Course Code: 16MBT21C7** **MM. 100**

1. To learn the use of microscope and observe the motility of the bacteria
2. To perform and learn the process of sterilization
3. To visualize bacteria by simple and negative staining procedure
4. To differentiate between Gram Positive and gram negative bacteria
5. To perform the capsule staining and differentiate between capsule and artifact
6. To perform and interpret endospore staining
7. To perform and learn the process of various media preparation
8. To perform and learn the techniques for isolation of bacteria in pure culture
9. To evaluate the antimicrobial activity of various antibiotics
10. To perform and interpret Lacto-phenol blue staining for the fungal cell
11. To compare the effectiveness of disinfectant like dettol.
12. Introduction to various software and online severs for statistical analysis
13. Data representation using SPSS/ Microsoft Excel
14. Measurement of Skewness and Kurtosis using SPSS
15. Measurement of Central tendency (Mean, Mode and Median) and Standard Error/ Standard Deviation by SPSS/ Microsoft Excel
16. One and Two way Analysis of variance (ANOVA) of biological data using SPSS/ Microsoft Excel
17. Correlation and Regression Analysis of biological data using SPSS/ Microsoft Excel
18. Demonstration of Microsoft office software packages

19. Demonstration of CORAL DRAW for making posters/presentations
20. To plot the calibration curve for protein estimation by Lowry method
21. To plot standard curve for estimation of carbohydrate by anthrone method
22. Estimation of creatinine in blood
23. Separation and identification of amino acids by paper chromatography
24. To perform protein estimation test with the help of Bradford method
25. Estimation of DNA by diphenylamine reaction
26. Determination of RNA by orcinol method
27. To investigate the effect of temperature on enzyme catalyzed reaction
28. To investigate the effect of varying pH on the activity of salivary amylase
29. To determine the Tm of the DNA sample

**M.Sc. Medical Biotechnology Semester -II**

**Course Title: Genetic Engineering**

**MM. Th 80 + 20** **Course Code: 16MBT22C1** **Time: 3h**

**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

**Theory**

**UNIT I**

Scope of Genetic Engineering. Molecular Tools and Their Applications, Restriction enzymes, modification enzymes, DNA and RNA markers . Nucleic Acid Purification, Yield Analysis, Nucleic Acid Amplification and its Applications, Gene Cloning Vectors, Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing, cDNA Synthesis and Cloning mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening, Alternative Strategies of Gene Cloning

**UNIT II**

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

**Unit-III**

Expression strategies for heterologous genes, Vector engineering and codon optimization, host engineering, in vitro transcription and translation, expression in bacteria expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

**UNIT IV**

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins. Phage Display, T-DNA and

Transposon Tagging. Transgenic and gene knockout technologies. Targeted gene replacement, chromosome engineering.

Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

**Recommended Books**


1. Gene cloning and DNA analysis - An Introduction (2006) 5th edition, T.A Brown, Blackwell publisher.
2. Essential genes (2006), Benzamin 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 Primose 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

11. DNA Cloning : A Practical Approach (1995) , D.M. Glover and B.D. Hames, IRL Press, Oxford,
12. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes (1998), S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.

**M.Sc. Medical Biotechnology Semester -II**

**Course Title: Immunology**

**MM. Th 80+20** **Course Code: 16MBT22C2**

**Time: 3h**

**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

**Theory**

**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 super antigens.

**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, Philadephia Sauders 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: Bioinformatics**

**MM. Th 80 + 20** **Course Code: 16MBT22C3** **Time: 3h**

**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

**Theory**

**UNIT I**

**Biological Sequence Databases**

Basic structure of database, classification of databases, Introduction to sequence and molecular file format

**Nucleic Acid Databases:** GenBank, EMBL, DDBJ, UniGene, SCOR, STACK

**Protein Databases:** TrEMBL, UniProt, Swiss Prot, PIR, PDB, PROSITE, PRINTS, SCOP, CATH

Overview of specialized databases for structure, literature, disease, pathway, enzyme, genome, taxonomy, expression, chemical, proteome, micro-array etc.

**UNIT II**

**Tools in Bioinformatics:** Submission tools for nucleotide and protein, Data analysis tools, gene prediction tools, Modelling tools

**Database Search Algorithms**:

Algorithm and its classification, Heuristic and exhaustive algorithm, Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST and FASTA results

**UNIT III**

**Sequence Comparison Methods:**

Theory of scoring matrices and their use for sequence comparison Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch & SmithWaterman algorithms, Multiple sequence alignment

**Profile and Hidden Markow Model:** Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to psiBLAST. Markov chains and Markov models and their use in gene finding. Concept of HMMS, the Forward, backward and the Viterbi algorithm

**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. Jin Xiong (2006) Essential Bioinformatics. Cambridge publisher
2. Zhumur Ghosh and Bibekanand Mallick (2008) Bionformatics: Principles and Applications. Oxford University Press publisher
3. Orpita Bosu and Simminder Kaur Thukral (2007). Bioinformatics. Oxford University Press publisher
4. M.Lesk (2002) Introduction to Bioinformatics. Oxford University Press publisher
5. Fundamental Concepts of Bioinformatics, Dan E. Krane, Michael L. Raymer, Michaeel L. Raymer, Elaine Nicpon Marieb, 2002, Benjamin/Cummings
6. P. Rastogi and N. Mendiritta (2013) Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revised edition
7. Mount and David W (2004) Bioinformatics: sequence and genome analysis. Cshl Press, 2nd edition
8. Harisha S (2007) Fundamentals of Bioinformatics. I K International Publishing House Pvt. Ltd
9. Dan E. Krane (2003) Fundamentals concepts of bioinformatics. Dorling Kindersley (RS); First edition
10. David Edwards and Jason Stajich (2009) Bioinformatics: Tools and Applications. Published by Springer

**M.Sc. Medical Biotechnology Semester - II**

**Course Title: Virology**

**MM. Th 80 + 20** **Course Code: 16MBT22D1** **Time: 3h**

**Theory**

**UNIT I**

**Introduction**: History and principles of virology, Structure and morphology of animal and plant viruses, Infrastructure for virology research: Principles of bio-safety, 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: Immnuodiagnosis, 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 Noncytocidal 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. Field's Virology
2. A manual of basic virological techniques; Grace C. Rovozzo
3. An Introduction to Virology; Clyde R., Goodheart
4. Animal Virology; D. Baltimore
5. Veterinary Virology by Murphy

**M.Sc. Medical Biotechnology Semester - II**

**Course Title: Biotechniques**

**MM. Th 80 + 20** **Course Code: 16MBT22D2** **Time: 3h**

**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

**Theory**

**UNIT I**

**Histochemical and immunotechniques:** Antibody generation, detection of molecules using ELISA, RIA, Western blot,Iimmunoprecipitation, Immunofluorescence microscopy, Immunoelectrophoresis, Flow Cytometry

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

**UNIT II**

**Chromatography:** Principles and applications of Paper, Thin layer, Gel-filtration, ion-exchange, Affinity chromatography, Gas liquid chromatography, High pressure liquid chromatography (HPLC); Reversed Phase chromatography ,Hydrophobic interaction chromatography.

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

**UNIT III**

**Microscopic techniques:** Visulization of cells and subcellular components by light microscopy; Resolving powers of different microscopes, Microscopy of living cells; Scanning and Transmission microscopes, Fixation and staining techniques for EM; Freeze-etch and freeze-fracture methods for EM

**Methods in cell and molecular biology**: Microfiltration, Ultrafiltration, Diafiltration, Homogenisation, Lyophilisation, DNA-Protein /Protein-Protein interaction methods

**UNIT IV**

**Biophysical methods:** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy; Mass spectrometry, Atomic absorption and emission spectroscopy

**Radiolabeling techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines

## 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 Fransisco
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
11. Shrivastva S (2010) Molecular Techniques in Biochemistry and Biotechnology, New Central Book Agency Ltd

**M.Sc. Medical Biotechnology Semester -II**

**Course Title: Principles of Medical Biotechnology-I**

**Course Code: Open Elective**

**NOTE:** The examiner is required to set seven questions in all. Question No. 1 will be compulsory and short answer type covering the entire syllabus. The remaining six questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting at-least one from each unit.

## Theory

### Unit -I

Innate and acquired immunity. Nature and Biology of antigens and super antigens. Antibody structure and function. Antigen - antibody interactions, ELISA, RIA, Western blot, Immunoprecipitation, Inflammation- Acute and chronic inflammation, Hypersenstivity. Blood group – ABO and Rh. Haemoglobin – Structure, biosynthesis and catabolism.

### Unit -II

Different types of anaemia and their causes (Deficiency of iron, B12 and folic acid, hemolytic, aplastic and genetic disorders). Homeostasis – factors, mechanism, anticoagulants, procoagulants. Host microbe interactions, entry of pathogens, growth and multiplication of the pathogens, Endotoxins, Collection and transport of specimens for diagnosis

### Unit -III

Methods of antimicrobial activity determination, types of epidemiology, tools of epidemiology, Recognition of an infectious disease in a population, types of epidemics, control of epidemics. General properties of viruses, viral multiplication, viral hemagglutination, Cultivation of viruses, Classification and nomenclature of viruses, host response to virus infection

**Recommended Books**


1. John E. Hall, Medical Physiology by Guyton, Saunders, 12th edition
2. Mims' Medical Microbiology By (author) Richard Goering, By (author) Hazel Dockrell, By (author) Mark Zuckerman, By (author)Ivan M. Roitt, By (author) Peter L. Chiodini Saunders (W.B.) Co Ltd.
3. Benjamin E. (1996), Immunology - A short course 3rd Edition, John Wiley, New York
4. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York
5. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London
6. Tizard I.R. (1995), Immunology - An introduction, 4th Edition, Philadephia Sauders College press.

**M.Sc. Medical Biotechnology Semester -II**

**Course Title: Communication Skills**

**Course Code: Foundation Course**

**NOTE:** The examiner is required to set five questions in all. Question No. 1 will be compulsory and short answer type covering the entire syllabus. The remaining four questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and two more selecting one from each unit.

**Theory**

**UNIT I**

Public Speaking Skills: Defining purpose of presentation, Organizing content, Rehearsing and presentation, time management, Group discussion, Debate and Interview skills. Presentation skills: Power Point based presentations; Scientific presentations, use of web information in presentation, Ethical/copyright issues in presentation, Title, objective, methodology and result presentation. Scientific poster preparation & presentation

**UNIT II**

Writing skills: Preparing CV/Biodata. Importance of communicating Science; Problems while writing a scientific document; Process of Scientific writing: thinking, planning, rough drafts and revising context.
Plagiarism; Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts.

**Recommended Books**


1. Ashraf Rizvi M. Effective Technical Communication. Tata McGraw – Hill Publishing Company Limited; New Delhi; 2005.
2. Mohan Krishna & Raman, Meenakshi. Effective English Communication. Tata McGraw – Hill Publishing Company Limited; New Delhi; 2000.
3. Technical Writing and Professional Communication- Thomas Huckin and Lesle Oleson London William Collins and Sons.
4. Communication Skills and Soft Skills: An Integrated Approach by E Suresh Kumar et al. (Pearson Publications)
5. Developing Communication Skills by Krishna Mohan &Meera Banerjee (Macmillan)


## M.Sc. Medical Biotechnology Semester--II

### Course Title: Lab Course III

**Course Code: 16MBT22HC4** **MM. 100**

1. Genomic DNA isolation and purification from the nuclei and quantification of DNA by UV spectrophotometer
2. Isolation of RNA by Trizol method
3. Restriction digestion of Lambda DNA with different restriction enzymes
4. Ligation Reaction of Eco R1 Digest PCR
5. Preparation of complement cells
6. Transformation

7. To test the pattern of antigen-antibody interaction through Ouchterlony double diffusion assay.
8. Rocket electrophoresis
9. Radial Immunoduffision
10. ELISA
11. Western Blotting
12. Blood group typing using haemagglutination tests.
13. To perform Immunoelectrophoresis
14. To perform Countercurrent Immunoelectrophoresis
15. Ig G Isolation

**M.Sc. Medical Biotechnology Semester--II**

**Course Title: Lab Course IV**

**Course Code: 16MBT22HC5** **MM. 100**

1. Study of NCBI homepage using Entrez retrieval system
2. Comparative study of different Sequence and Structural file formats
3. To retrieve out nucleotide/ protein sequences information from GenBank and PDB
4. To perform similarity searches on nucleotide/amino acid sequences using BLAST
5. To perform Pairwise alignment of given sequence using Dotlet server
6. Building a Multiple Sequence Alignment of given sequence using ClustalW
7. Study of Phylogentic relationships using PHYLIP Packages
8. To find out the conserved domain present in proteins
9. Demonstration of Primer designing using Primer3
10. Extraction of viral genomic RNA by PCI method and its analysis by nanodrop.
11. Determination of electropherotype of segmented double stranded RNA virus by RNA-PAGE and silver staining.
12. Reverse transcription PCR of genomic viral RNA.
13. Extraction of viral genomic DNA by Chelax method.
14. Introduction to different parts of embryonated eggs.
15. Inoculation of virus in embryonated eggs
16. Chromatography: Paper, Thin Layer, Gel Filtration, HPLC
17. Electrophoresis: PAGE, AGE, 2.D
18. Microscopy: Bright Field, Fluorescence, Electron
19. Centrifugation: Differential and Ultracentrifugation
20. Spectrophotometry: UV/Visible, Mass-Spectroscopy
21. PCR: Multiplex and Real-Time
22. Flow Cytometry

23. Western blotting
24. Sonication
25. Lypholization

**M.Sc. Medical Biotechnology Semester -III**

**Course Title: Stem Cell Biology**

**MM. Th 80 + 20** **Course Code: 16MBT23C1** **Time: 3h**

**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

**Theory**

**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: haematopoietic and Mesenchymal stem cells. Organ Derived Stem cells, Cancer stem cells, Induced pluripotent stem cells, Stem cell banking.

**UNIT II**

Stem cell characterizations: Bone Marrow Mesenchymal Stem Cells , Hematopoietic Stem Cells isolation & characterizations, markers & their identification. Blood cell formation from Bone marrow stem cell. Growth factor requirement and 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.

**UNIT IV**

Therapeutic application of stem cells: Current State and Future Perspectives, Neurodegenerative diseases, Spinal cord injury, Heart disease, Diabetes, Burns and Skin ulcers, Muscular Dystrophy, Orthopaedic applications, Eye diseases, Stem cells and gene therapy. 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 80 + 20** **Course Code: 16MBT23 C2** **Time: 3h**

**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

**Theory**

## UNIT I

**Bacteria**: Representative diseases to be studied in detail are - tetanus, diphtheria, cholera, typhoid, tuberculosis, leprosy, plague, and syphilis. Infections caused by anaerobic bacteria, 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: Ascariais, 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) Anti-viral chemotherapy. Anti-fungal chemotherapy. Hospital-acquired infections (nosocomial), immune compromised 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 (Lange Basic Science) by Geo. F.Brooks, Janet S. Butel, Stephen A. Morse McGraw-Hill Medical; 23 edition
2. Medical Microbiology: with Student Consult by Patrick R. Murray PhD (Author), Ken S. Rosenthal PhD Saunders; 7 edition
3. Mims' Medical Microbiology By (author) Richard Goering, By (author) Hazel Dockrell, By (author) Mark Zuckerman, By (author)Ivan M. Roitt, By (author) Peter L. Chiodini Saunders (W.B.) Co Ltd

**M.Sc. Medical Biotechnology Semester - III**

**Course Title: Diagnostics**

**MM. Th 80 + 20** **Course Code: 16MBT23D1**

**Time: 3h**

**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

**Theory**

**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 counselling. 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. How1ey and Mori, The Human Genome, Academic Press, 1999.
7. Strickberger, Genetics, 3rd edition, McMillan, 1985.
8. Snustad & Simmons, Principles of Genetics, 4th Edition, Wiley, 2005.
9. Griffiths et al, Modern genetic analysis, 2nd Edition, Freeman, 2002.
10. Hartl and Jones, Genetics-Principles and Analysis, 4th Edition, Jones & Bartlett, 1998.

11.Alberts et al, Molecular Biology of The Cell, 2nd Edition , Garland 2007

**M.Sc. Medical Biotechnology Semester - III**

**Course Title: Essentials of Drug Designing**

**MM. Th 80 + 20** **Course Code: 16MBT23D2**

**Time: 3h**

**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

**Theory**

**UNIT I**

**Experimental Methods for Molecular Structure Determination**: Brief account of structure determination by X-ray crystallography and NMR spectroscopy. Validation of experimentally obtained NMR structures. The Protein Data Bank (PDB) and the Nucleic Acid Data Bank (NDB). The PDB and the mmCIF file formats for the storage and dissemination of molecular structures.

**UNIT II**

**Conformational Analysis**: Concept of free energy of molecules. Introduction to various force fields and their relative merits and demerits. Techniques for Molecular energy minimization, Monte Carlo and Molecular Dynamics simulation.

**UNIT III**

**Molecular Modelling:** Methods of molecular modeling including homology modeling, threading and ab initio protein structure prediction together with their relative merits and demerits. Methods for structure structure comparison of macromolecules with special reference to proteins.

## UNIT IV

**Drug Design**:

General ideas of drug designing, 2D and 3D QASR, concept of a pharmacophore and pharmacophore based searches of ligand databases. Concepts of COMFA. Methods for simulated docking

## Recommended Books


1. Leach A.R (1996) Molecular Modelling: Principles and Applications. Pearson Education publisher, 2nd edition
2. Zhumur Ghosh and Bibekanand Mallick (2008) Bionformatics: Principles and Applications. Oxford University Press publisher
3. Susan Peters and Prema Latha Mallipeddi (2011) Application of in Silico Techniques for Drug Designing. Proquest, Umi Dissertation Publishing
4. Narendra Singh Lodhi and Pushpendra Kumar Vishwakarma (2011) New Drug Designing and Development. VDM Verlag publishers
5. Aubhishek Zaman (2012) Drug Designing Approaches Using In Silico Techniques. LAP Lambert Academic Publishing
6. Kamlesh Dashora and Darshan Dubey (2012) Drug Designing. Discovery Publishing House
7. K, Anand Solomon (2015) Molecular Modelling and Drug Design. MJP Publishers
8. Mohammed and Dr Shaik Jameel (2015) Computational Drug Discovery: Drug Discovery Process and Methods
9. V. Kothekar (2005) Essentials Of Drug Designing. Dhruv publications

10. James Devillers (1996) Genetic Algorithms in Molecular Modeling. Academic Press Inc

**M.Sc. Medical Biotechnology Semester - III**

**Course Title: Human Genome and Genetics**

**MM. Th 80 + IA 20** **Course Code: 16MBT23D3**

**Time: 3h**

**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

**Theory**

**UNIT I**

**Human genome**

Nuclear and mitochondrial genome, Protein coding genes, RNA genes, Repetitive DNA in human genome, LINE and SINE Repeats, Cot analysis, Human Genome Project- Salient features and importance

**Genes and chromosome:** ORF, Initiation and termination signals, Chromatin architecture and

packaging of human genome, Centromere and Centrosome, Telomers and Telomerases, DNA topology and its functional importance

**UNIT II**

**Genome variation and analysis:** VNTR (Variable number of tandem repeats), STS (Sequence tagged sites), SNP (Single nucleotide polymorphism) and their detection techniques (Genotyping RFLP, RAPD etc).

**Genome mapping:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell and radiation hybrids, LOD score for linkage testing,

**UNIT III**

**Mendelian principles:** concept of dominance, segregation, independent assortment

**Allelic and non-allelic interactions:** Concept of alleles, multiple alleles, lethal alleles, pseudoallele types of dominance, Epistasis

**Extensions of Mendelian principles:** linkage and crossing over, pleiotropy, genomic imprinting, sex linkage, sex limited sex influenced traits, mechanism of sex determination. penetrance and expressivity, phenocopy, cytoplasmic inheritance

**UNIT IV**

**Cytogenetics:** Karyotype, Spectral karyotyping, Chromosome banding, in *situ* hybridization, comparative genomic hybridization (CGH), Structural and numerical alterations of chromosomes and their genetic implications.

**Quantitative and population genetics:** Continuous variations, Polygenic inheritance, heritability and its 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 Jones, E.W. (2011). Genetics: Analysis of Genes and Genomes. Jones and Barlett Publishers, USA, 7th ed.
8. Strachan, T. and Read, A. (2010). Human Molecular Genetics. Garland Publishers, London. 4th ed.
9. Hartl D. L. and Clark (1989) Principle of Population Genetics. Sinauer Associates Inc.,U.S.; 2nd Revised edition edition
10. S.D. Gangane (2012), Human Genetics. Elsevier; 4th ed
11. Brown T. A (2006) Genome 3. Garland Science; 3 edition
12. 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: Human Physiology and Developmental Biology**

**MM. Th 80+20** **Course Code: 16MBT23D4**

**Time: 3h**

**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

**Theory**

**UNIT I**

**Blood**-Composition and functions of plasma, hemopoiesis, erythrocytes including Hb, leckocytes and thrombocytes,plasma proteins and their role. Blood coagulation-mechanism, Blood group and Rh factor. **Cardiovascular System:** Anatomy of the heart. Properties of cardiac muscle. Origin and propagation of cardiac impulse. The cardiac cycle- pressure and volume changes. Heart sounds. Cardiac output , Starling's law of heart. Normal electrocardiogram **Transfers of blood gases**-oxygen and carbon dioxide. Role of 2, 3-BPG, Bohr effect and chloride shift. Regulation of respiration.

**UNIT II**

**Digestive system**-Composition, functions and regulation ofsalivary, gastric, pancreatic, intestinal and bile secretions.Digestion and absorption of

carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. Role of peristalsis andlarge intestine in digestion. **Excretory system**-Structure of nephron, formation of urine(glomerular filtration, tubular reabsorption of glucose, waterand electrolytes), tubular secretion, role of kidneys regulation of blood pressure. **Muscle Physiology :** Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. Red and white striated muscle fibers. Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period, tonicity, conductivity, extensibility and elasticity. Mechanism of skeletal and smooth muscle contraction and relaxation

## UNIT III

**Neurophysiology :** membrane potential and action potential, Types of neurms and synapses and transmission of nerve impulse across the membrane, Neurochemistry of vision, gustation, olfaction and hearing. Sensory recaptors in skin and muscles.**Endocrinology-**Secretion, mechanisms of action and of hormones of hypothalamus, pituitary, thyroid, adrenal gland
and pancreas. **Reproductive physiology**-Synthesis and functions of testosterone and ovarian hormones. Menstrual cycle and physiology of pregnancy and lactation.

## UNIT IV

**Basic concepts of development :** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients **Gametogenesis, fertilization and early development:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; axes and pattern formation in *Drosophila*, and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates

**Recommended Books:**

1. Textbook of Medical Physiology 10th Ed. By Arthur C. Guyton and John E. Hall, Harcourt Asia Pte Ltd.
2. Essential Medical Physiology 3rd Ed By Leonard R. Johnson, Elsevier Academic Press.
3. Endocrinology: An Integrated Approach By SS Nussey and SA Whitehead. BIOS Scientific Publishers
4. Physiology 3rd Ed, By Linda Costanzo, Saunders Publishers.
5. Principles of Anatomy and Physiology 10th Edition By Gerard J. Tortora and Sandra Grabowski. Publisher: John Wiley and Sons.
6. Principles of Human Physiology (Paperback) By Cindy L. Stanfield and William J. Germann. Publisher: Pearson Education.
7. Samson Wright's Applied Physiology 13th Ed. CA Keele, E Neil & N Joels. Oxford University Press.
8. Principles of Biochemistry: Mammalian Biochemistry By Emil Smith. McGraw Hill Publications.
9. Human Physiology: The Mechanisms of Body Function (Paperback) By Arthur J. Vander, James Sherman, Dorothy S. Luciano, Eric P. Widmaier, Hershel Raff and Hershal Strang. McGraw Hill Education.
10. Medical Physiology: Principles for Clinical Medicine 3rd Ed. By Rodney R. Rhoades and David R. Bell. Lippincott Williams & Wilkins.
11. Developmental biology by Scott Gilbert
12. Essential Developmental Biology Second Edition by J M W Slack

**M.Sc. Medical Biotechnology Semester -III**

**Course Title: Principles of Medical Biotechnology II**

**Course Code: Open Elective**

**NOTE:** The examiner is required to set seven questions in all. Question No. 1 will be compulsory and short answer type covering the entire syllabus. The remaining six questions will be set with two questions from each unit. The candidate will be required to attempt Question 1 and four more selecting at-least one from each unit.

## Theory

### Unit – I

Cloning vectors- Plasmid, cosmid, phagemid,phasmid, bacteriophages YAC, BAC, HAC; Shuttle vectors; Recombinant – production, identification and selection; Restriction endonucleases, Ligases; Hybridization; Linkers and adaptors; DNA Transformation and transfection methods; Cell expression system; Human genome project

### Unit – II

PCR and its variant; Blotting- Southern, northern & western; Genomic and cDNA library;; DNA Footprinting ; Gene therapy, Gene knockout, Tissue engineering.

Animal Cell Culture: Introduction and Application of animal cell culture. Equipments, materials, culture vessels for animal cell culture, Primary and established cell line cultures

### Unit – III

Basic biology of stem cells; Types & sources of stem cells, Blood cell formation from Bone marrow stem cells, Isolation & characterizations of stem cells, Cancer stem cells, Induced pluripotent stem cells, Stem cell banking, Therapeutic application of stem cells.

**Recommended Books**


1. R. Lanza, J. Gearhart et al (Ed), Essential of Stem Cell Biology, Elsevier Academic press.
2. 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.
3. Culture of Animal Cells- A manual of basic techniques by R.I. Freshney
4. Animal Cells Culture and Media, D.C.Darling and S.J.Morgan, 1994. BIOS Scientific Publishers Limited.
5. Gene cloning and DNA analysis – An Introduction (2006) 5th edition, T.A Brown, Blackwell publisher.
6. Essential genes (2006), Benzamin Lewin, Pearson education international.
7. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, NewYork.
8. Principles of gene manipulation and Genomics (2006) 7th edition, S.B Primose and R.M Twyman, Blackwell publishing.
9. Principles of Genetic Engineering (2009), Mousumi Debnath, pointer publisher, Jaipur.
10. Molecular Biotechnology-Principles and Applications of Recombinant DNA (2003) 3rd edition, Bernard R Glick and Jack J pasternak. ASM press, Washington.

11. Human Molecular Genetics (2004) 3rd edition, Tom Strachan & Andrew P Read, Garland science.

**M.Sc. Medical Biotechnology Semester--III**

**Course Title: Lab Course V**

**Course Code: 16MBT23C3** **MM. 100**

1. Introduction to aseptic technique in stem cell biology
2. Preparation of medium for stem cell culture
3. Microscopy slide of stem cells
4. Isolation of stem cell rich mononuclear cells by density gradient centrifugation using Ficoll.
5. Isolation of hematopoietic stem and Progenitors cells by magnetic cell sorting
6. In vitro culturing of hematopoietic stem cell and Progenitors cells
7. In vitro Culture and expansion of stem cell.
8. In vitro adipogenice differentiation of stem cells and staining of adipocytes generated in culture.
9. To perform primary and secondary test for identification and classification of bacteria
10. Isolation, characterization and identification of Klebsiella
11. Isolation, characterization and identification of Staphylococcus
12. Isolation, characterization and identification of E. coli
13. To perform and interpret standard procedure used for isolation, characterization and identification of Bacillus sp.
14. To perform and interpret standard procedure used for isolation, characterization and identification of Salmonella sp.
15. To perform and interpret standard procedure used for isolation, characterization and identification of Proteus sp.
16. Extraction of total viral RNA from given sample and estimation of its quantity and quality
17. Electrophoretic analysis of segmented RNA viruses
18. To demonstrate the process of transformation for acquiring antibiotic resistance
19. To determine the copy number of virus in the given sample
20. To determine the mass motility and initial motility of semen sample

21. Determination of total sperm count in the given semen sample
22. Determination of viable spermatozoa in semen sample

**M.Sc. Medical Biotechnology Semester--III**

**Course Title: Lab Course VI**

**Course Code: 16MBT23C4** **MM. 100**

1. Isolation of Genomic DNA from Blood sample
2. PCR-RFLP for study of gene variants
3. C-peptide test for diabetes
4. Widal Test
5. C-Reactive Protein Test
6. Estimation of Blood Sugar
7. Molecular weight determination by SDS-PAGE
8. Introduction to Computational softwares being used in Drug designing
9. Sketching and optimization of the structure of various chemical compounds using Chem sketch/ChemDraw
10. File format available for drug designing tools and their inter-conversion using OpenBabel

11. Retrieval of PDB file and its display using Swiss PDB viewer and Rasmol
12. Energy minimization using Swiss PDB viewer/YASARA
13. Force field analysis using Swiss PDB viewer
14. To perform Homology Modeling using Swiss-Modler
15. Gene structure prediction using GenScan/GeneMark
16. Demonstration of docking using AutoDock/Chimera
17. Identification of inactivated X chromosome as Barr body
18. Micronucleus assay using buccal epithelial cells
19. Metaphase chromosome preparation from whole blood/tissue
20. Visualization of different banding pattern of chromosome
21. To construct a karyotype from metaphase chromosome spreads
22. Sister Chromatid Exchange (SCE) assay using peripheral blood lymphocytes
23. Determination of hemoglobin by Sahli's method
24. Determination of total erythrocyte count by hemocytometer method
25. Determination of total leucocyte count by hemocytometer method
26. Differential leucocyte count
27. Determination of bleeding time and blood clotting time
28. Microscopy slide set for different organs of body
29. Urine physiology
30. Microscopy set of slides for different developmental stages
31. Evaluation of ovum

**M.Sc. Medical Biotechnology Semester - IV**

**Course Title: Ethical, Safety and Management Issues in Medical Biotechnology**

**MM. Th 80 + 20** **Course Code: 16MBT24C1** **Time: 3h**

**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

**Theory**

**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 Ethical issues** - Introduction to ethics and ethical committee, function and responsibility of ethical committee; Social and ethical issues regarding genetic 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

**Management -** Planning, Organizing, Leading & Controlling; Concepts and characteristics of information; Importance of MIS; Communication - type, channels & barriers; Financial management, planning and control

## 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.

**M.Sc. Medical Biotechnology Semester - IV**

**Course Title: Public Health and Vaccinology**

**MM. Th 80 + 20** **Course Code: 16MBT24C2** **Time: 3h**

**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

**Theory**

**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**

History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment

**UNIT IV**

Preservation techniques to maintain good antigen quality, freeze drying, Introduction to newer vaccine approaches namely- subunit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, nanoparticles in vaccine delivery systems

**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.