

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

Course- M.Sc. Medical Biotechnology

Program Specific Outcomes:

- PSO 1. To create postgraduates with successful career as professional or a researcher through lifelong learning in the field of biotechnology.
- PSO 2. Hands-on training and mandatory research projects will help our students by providing knowledge and technical experience of problem-solving in a research environment.
- PSO 3. Students after completing this course can become entrepreneurs in the most demanding sector of medical biotechnology such as diagnostics, drug designing, stem cell biology etc.
- PSO 4. Students will develop an ability to identify, organize and answer problems in Medical Biotechnology
- PSO 5. Students will develop an ability to use skills and modern technological tools necessary for medical biotechnological practices
- PSO 6. Perform independent as well as team work to accomplish lab based tasks.
- PSO 7. Become a part of mission-Skill India- to develop researcher and scientists to uncover advance biology problems.

CENTRE FOR MEDICAL BIOTECHNOLOGY
M. D. UNIVERSITY, ROHTAK
CBCS-SCHEME OF EXAMINATION
M.Sc. Medical Biotechnology -2016-17 onwards

S.No.	Course Code	Nomenclature of course	Credit			Total credit	Hours	Maximum marks
			L	T	P			
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 CL1	Lab course I*	0	0	4	4	8	100
7	16MBT21 CL2	Lab course II*	0	0	4	4	8	100
Total Credits			20	0	8	28		700
* Lab course I pertains to 16MBT21C1 and 16MBT21C2; Lab course II pertains to 16MBT21C3, 16MBT21C4 and 16MBT21C5.								

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

S.No.	Course Code	Nomenclature of course	Credit			Total credit	Hours	Maximum marks
			L	T	P			
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 chosen from the University basket	3	0	0	3	3	80+20
13	Foundation course!	To be chosen from the university basket	2	0	0	2	2	80+20
14	16MBT22CL 1	Lab course III*	0	0	4	4	8	100
15	16MBT22CL 2	Lab course IV*	0	0	4	4	8	100
Total Credits			21	0	8	29		800
<p># 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 to 16MBT22C1 and 16MBT22C2; Lab course IV pertains to 16MBT22C3, 16MBT22D1/16MBT22D2</p>								

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

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

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

S.No.	Course Code	Nomenclature of course	Credit			Total credit	Hours	Maximum marks
			L	T	P			
3rd Semester								
16	17MBT23C1	Stem cell Biology	4	0	0	4	4	80+20
17	17MBT23C2	Biology of Infectious Diseases	4	0	0	4	4	80+20
18	17MBT23DA 1 or 17MBT23DA 2	Diagnostics [#] or Essentials of Drug Designing [#]	4	0	0	4	4	80+20
19	17MBT23DB 1 Or 17MBT23DB 2	Human Genome and Genetics [#] Or Human Physiology and Developmental Biology [#]	4	0	0	4	4	80+20
20	Open Elective	To be chosen from the basket of open elective papers provided by the University !	3	0	0	3	3	80+20
21	17MBT23CL	Lab Course V*	0	0	4	4	8	100
22	17MBT23DL	Lab Course VI*	0	0	4	4	8	100
Total Credits			19	0	8	27		700
<p># 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 17MBT23C 1 and 17MBT23C2 *Lab course VI pertains to 16MBT23DA1/DA2 and DB1/DB2</p>								

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

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

S.N o.	Course Code	Nomenclature of course	Credit			Total credit	Hour s	Maximum marks
			L	T	P			
4th Semester								
23	17MBT24C1	Ethical, Safety and Management Issues in Medical Biotechnology	4	0	0	4	4	80+20
24	17MBT24C2	Public Health and Vaccinology	4	0	0	4	4	80+20
25	17MBT24C3	Dissertation	20	0	0	20	40	300
Total Credits			28	0	0	28		500
Cumulative program credit						112		2700

Semester and Subject-wise Program objectives with Syllabus

SCHEME OF EXAMINATION

M.Sc. (Medical Biotechnology)- 1st Semester

S.No.	Course Code	Nomenclature of course	Credit			Total credit	Hours	Maximum marks
			L	T	P			
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 CL1	Lab course I*	0	0	4	4	8	100
7	16MBT21 CL2	Lab course II*	0	0	4	4	8	100
Total Credits			20	0	8	28		700
* Lab course I pertains to 16MBT21C1 and 16MBT21C2; Lab course II pertains to 16MBT21C3, 16MBT21C4 and 16MBT21C5.								

Cell and Molecular Biology: 16MBT21C1

MM. Th 80 + 20 , Time: 3h

Course Outcomes:

- CO1. Students will be able to differentiate between meiosis and mitosis and will be able to learn about different factors control cell cycle progression.
- CO2. Students will be able to explain role of different protein/ enzymes involved in cell signalling.
- CO3. They will be able to understand mechanism of genetic damage caused by mutation and role of various repair system in neglecting the effect of these mutation.
- CO4. Students will be able to explain mechanism of DNA replication, transcription , translation and other related processes

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

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

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. Sinaur 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.

Animal Cell Culture : 16MBT21C2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to examine and analyze the theoretical and practical principles of cell culture.
- CO 2. Students will be able to take out primary cells from animal or human tissues and can grow them in outside environments for long period of time and perform various experiments on these cells
- CO 3. Students get practical skills in the field of manipulation of animal cell and tissue cultures.
- CO 4. Students will be able to explain the main advantages and disadvantages of cell and tissue culture in biomedical research and its applications.

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.

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

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

Essentials of Microbiology : 16MBT21C3

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to explain the basic concept of aseptic microbiological procedures.
- CO2. Students get familiarity with the diverse types of microbes, methods to classify them and their food habits.
- CO3. Students will be able to appreciate the functioning and applications of various techniques to growth microbes in laboratory & industry.
- CO4. Students having familiarization with the structural details of bacteria and viruses as well as with the metabolic diversity.

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 ribotyping, 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 endospores, 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, Chlamydiae and Mycoplasma. Archaea: Archaea as earliest Life forms: Halophiles; Methanogens; Hyperthermophilic archaea; 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

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

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

Biostatistics and Computer applications : 16MBT21C4

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to learn about basic concept of statistics.
- CO2. Students will be able to interpret the scientific results.
- CO3. Students will be able to explain concept of hypothesis testing.
- CO4. Students will be able to make use of appropriate test statistics according to need of data.

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

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

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; 2nd Edition
7. Glantz S. A (2005) Primer of Biostatistics. McGraw-Hill Medical; 6th 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.

Biomolecules & Metabolism : 16MBT21C5

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. By the end of the course the students will be able understand the role of Thermodynamics in Biochemistry.
- CO2. They will be able to understand role of Physiological buffers in maintaining homeostasis.
- CO3. They will be to quantify the different biomolecules.
- CO4. To understand the role of various metabolic pathways and their importance.
- CO5. To identify the presence different biomolecules in given samples.

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 II

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.

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

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).

Lab Course I: 16MBT21CL1

MM. 100

Course Outcomes:

- CO1. Practical learning of modern techniques like molecular biology and animal cell culture.
- CO2. Effective documentation and to analyze experimental results
- CO3. Hands on expertise in using modern tools in area of medical biotechnology.
- CO4. Applying theoretical knowledge in doing experimentation.
- CO5. Analyze, plan and implement knowledge in doing research in different areas of life sciences.

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

Lab Course II :16MBT21CL2

MM. 100

Course Outcomes:

- CO1. Practical learning of modern techniques like microbiology and bioinformatics.
- CO2. Develop ability to design and conduct experiments, as well as to analyze and interpret results.

- CO3. Hands on expertise in using modern tools in area of medical biotechnology.
- CO4. Applying theoretical knowledge in doing experimentation.
- CO5. Analyze, plan and implement knowledge in doing research in different areas of life sciences.

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 servers 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 T_m of the DNA sample

SCHEME OF EXAMINATION

M.Sc. (Medical Biotechnology)- 2nd Semester

S.No.	Course Code	Nomenclature of course	Credit			Total credit	Hours	Maximum marks
			L	T	P			
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	Principles of Medical Biotechnology-I	3	0	0	3	3	80+20
13	Foundation course!	To be chosen from the university basket	2	0	0	2	2	80+20
14	16MBT22CL1	Lab course III*	0	0	4	4	8	100
15	16MBT22CL2	Lab course IV*	0	0	4	4	8	100
Total Credits			21	0	8	29		800
<p># One course to be opted out of soft core (D1 & D2) courses.</p> <p>! Open elective & foundation courses: To be chosen from pool of OE/FE courses of University.</p> <p>* Lab course III pertains to 16MBT22C1 and 16MBT22C2; Lab course IV pertains to 16MBT22C3, 16MBT22D1/16MBT22D2</p>								

Genetic Engineering : 16MBT22C1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to describe how transgenic bacteria, plants, and animals may be used to generate products useful to humans.
- CO2. Students get practical skills in the field of manipulation of genetic material.
- CO3. Students will be able to explain how genes can be removed from chromosomes and inserted into different chromosomes.
- CO4. Students will be able to explain how to screen for clones that contain a desired gene fragment.

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.

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

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 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-Appling 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.

Immunology : 16MBT22C2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

CO1. By the end of the course the students will be able understand role of importance

of Innate and Adaptive Immunity.

- CO2. Students will be able to understand role on antigen antibody interactions in various immunotechniques.
- CO3. They will be able to explain the mechanisms generating diversity and specificity in Immune System.
- CO4. They will be able to understand the behavior of body towards complex disorders.

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.

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

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 Bartlett Publishers.
8. Richard Coico (2009) Immunology - A short course, Geoffrey Sunshine (Wiley Blackwell).
9. William Paul (1999) Fundamentals of immunology , (Lippincott Williams & Wilkins).

Bioinformatics : 16MBT22C3

MM. Th 80 + 20, Time: 3h

Course Outcomes :

- CO1. Students will be able to know about important bioinformatics databases.
- CO2. Students will get knowledge about important bioinformatics tools such as BLAST, FASTA, clustal - w etc.
- CO3. Students will be able to understand concept of alignment and importance of scoring matrices.
- CO4. Student will be able to learn about application of important phylogenetic tools based searches using BLAST and FASTA tools.

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

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

Recommended books:

1. Jin Xiong (2006) Essential Bioinformatics. Cambridge publisher
2. Zhumur Ghosh and Bibekanand Mallick (2008) Bioinformatics: 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, Michael 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

Virology: 16MBT22D1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. By the end of the course the students will be able to Handle and care of the laboratory animals – Mice, Rat, Rabbit.
- CO2. Design an ideal virology laboratory.
- CO3. Perform the experiments for diagnosis of virus infection.
- CO4. Design strategy for screening of new antiviral drugs.
- CO5. Have knowledge about hemorrhagic, encephalitic and enteric viruses.

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 immuno-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 Noncytotoxic 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

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

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

Biotechniques : 16MBT22D2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to explain the basic concept of ELISA, RIA, Western blotting and flow cytometry.
- CO2. Students get familiarity with AGE, PAGE, SDS-PAGE, 2-D, Pulse-field, Capillary and Isoelectrofocussing.
- CO3. Students will be able to appreciate the functioning and applications of Gas liquid chromatography, High pressure liquid chromatography (HPLC).
- CO4. Students having familiarization with UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy.

UNIT I

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, Western blot, Immunoprecipitation, 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: Visualization 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

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

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), Principles 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. Upadhyay, A ; Upadhyay, 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

Open Elective : Principles of Medical Biotechnology-I

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to explain the basic concept of ELISA, RIA and Western

blot.

- CO2. Students get familiarity with Hemoglobin – Structure, biosynthesis and catabolism.
- CO3. Students will be able to appreciate the collection and transport of specimens for diagnosis.
- CO4. Students having familiarization with tools of epidemiology.

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, Hypersensitivity. 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

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.

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, Philadelphia Saunders College press.

Lab Course III : 16MBT22CL1

MM. 100

Course Outcomes:

- CO1. Practical learning of modern techniques like genetic engineering and immunology.
 - CO2. Develop ability to design and conduct experiments, as well as to analyze and interpret results.
 - CO3. Hands on expertise in using modern tools in area of medical biotechnology.
 - CO4. Applying theoretical knowledge in doing experimentation.
 - CO5. Analyze, plan and implement knowledge in doing research experiments
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 Immunodiffusion
 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

Lab Course IV : 16MBT22CL2

MM. 100

Course Outcomes:

- CO1. Practical learning of modern techniques like bioinformatics, biotechniques and virology.
- CO2. Develop ability to design and conduct experiments, as well as to analyze and interpret results.
- CO3. Hands on expertise in using modern tools in area of medical biotechnology.
- CO4. Analyze, plan and implement knowledge in doing research experiments

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

SCHEME OF EXAMINATION

M.Sc. Medical Biotechnology- 3rd Semester

S.N o.	Course Code	Nomenclature of course	Credit			Total credit	Hour s	Maximu m marks
			L	T	P			
3rd Semester								
16	17MBT23C1	Stem cell Biology	4	0	0	4	4	80+20
17	17MBT23C2	Biology of Infectious Diseases	4	0	0	4	4	80+20
18	17MBT23DA1 or 17MBT23DA2	Diagnostics [#] or Essentials of Drug Designing [#]	4	0	0	4	4	80+20
19	17MBT23DB1 Or17MBT23D B2	Human Genome and Genetics [#] OrHuman Physiology and Developmental Biology [#]	4	0	0	4	4	80+20
20	Open Elective	Principles of Medical Biotechnology-II	3	0	0	3	3	80+20
21	17MBT23CL	Lab Course V*	0	0	4	4	8	100
22	17MBT23DL	Lab Course VI*	0	0	4	4	8	100
Total Credits			19	0	8	27		700

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 17MBT23C 1 and 17MBT23C2

*Lab course VI pertains to 16MBT23DA1/DA2 and DB1/DB2

Stem cell Biology: 17MBT23C1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to describe different types of stem cells, how they are derived and the extent of their plasticity.
- CO2. 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.
- CO3. Students will be able to isolate stem cells from various tissues and grow them in culture
- CO 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.

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

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

Recommended Books

1. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two Volume, 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 Engineering & Regenerative Medicine" 2008, Artech House, INC Publications.
4. Naggy N. Habib, M.Y. Levicar, L.G. Jiao and N. Fisk: Stem Cell Repair and Regeneration. Volume-2, 2007, Imperial College Press

Biology of Infectious Diseases : 17MBT23 C2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to explain the etiological agent, pathogenesis of different bacterial, viral, fungal and protozoal disease.
- CO2. Students get familiarity with the economic impact of disease burden.
- CO3. Students will be able the steps in outbreak investigation.
- CO4. Students having familiarization with vaccines and antimicrobial drugs.

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: 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) 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

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

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

Diagnostics : 16MBT22DA1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

CO1. Students will become aware about the Good Laboratory Practices and their importance.

- CO2. Students will be able to understand about in- born errors of metabolism along with various other congenital and developmental disorders and their implications.
- CO3. They will be able to understand the etiology, pathophysiology and treatment prescribed for such disorders.
- CO4. They will become aware of Personalized medicines and its needs current scenario.

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.

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

Recommended Books

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

Essentials of Drug Designing : 17MBT23DA2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to know different methods for molecular structure prediction.
- CO2. Students get to know how molecules in a structure stabilize themselves.
- CO3. Students will be able to understand the various methods for protein prediction.
- CO4. Students will get to know how drugs are designed by computational means.

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

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

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

Human Genetics and Genomics : 16MBT23DB1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to explain about internal architecture of nuclear and mitochondrial genome.
- CO2. Students will be able to explain repetition in genome affects its functioning and stability.
- CO3. Students will be able to explain markers like SNP, EST, and microsatellite contributes towards genome diversity and assists in mapping of genes.
- CO4. 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.

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

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

Recommended Books

1. Brooker, R.J. (1999). Genetics, Principles and Analysis. Addison Wesley Longman, California.
2. Cummings, M.R. (2009). Human Genetics. Cengage 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

Human Physiology and Developmental Biology : 17MBT23DB2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to working of heart and respiratory system.
- CO2. Students get familiarity with the digestion of carbohydrates, fat and protein.
- CO3. Students will be able the understand the mechanism of muscle contraction.
- CO4. Students having familiarization with the developmental process of mammals.

UNIT I

Blood-Composition and functions of plasma, hemopoiesis, erythrocytes including Hb, leuckocytes 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

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

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 Hershhal 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

Open Elective : Principle of medical biotechnology II

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Student will learn what exactly genetic engineering is and how enzymes are used in this field.
- CO2. Students will be able to explain about different technique and its implication in creating genetically engineered organisms.
- CO3. Students will be able to explain the basic requirement and method of animal cell culture.
- CO4. Student will be able to understand basic concept of stem cells and its uses in therapeutic applications.

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.

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.

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.

Lab Course V: 16MBT23CL

MM. 100

Course Outcomes:

- CO1. Practical learning of modern techniques like stem cell biology and infectious diseases.
- CO2. Grow aptitude to design and carry out experiments, to analyze and Interpret results.

CO3. Proficiency in using modern tools in area of medical biotechnology.

CO4. Applying theoretical knowledge in doing experimentation.

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 adipogenic 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

Lab Course VI : 16MBT23DL

MM. 100

Course Outcomes:

CO1. Practical learning of modern techniques like diagnostics and drug designing.

CO2. Learning genomics and genetics along with physiology and developmental

biology

- CO3. Design experiments, analyze and interpret results.
- CO4. Proficiency in using modern tools in area of medical biotechnology.
- CO5. Applying theoretical knowledge in doing experimentation.

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

SCHEME OF EXAMINATION

M.Sc. (Medical Biotechnology)- 4th Semester

S.N o.	Course Code	Nomenclature of course	Credit			Total credit	Hour s	Maximum marks
			L	T	P			
4th Semester								
23	17MBT24C1	Ethical, Safety and Management Issues in Medical Biotechnology	4	0	0	4	4	80+20
24	17MBT24C2	Public Health and Vaccinology	4	0	0	4	4	80+20
25	17MBT24C3	Dissertation	20	0	0	20	40	300
Total Credits			28	0	0	28		
Cumulative program credit						112		2700

Social, Ethical and management issues in Medical Biotechnology: 17MBT24C1

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. Students will be able to identify basic differences between different forms of IPR like patent, copyright, trademarks etc.
- CO2. Students will understand influence of ethical and other related issues on research related to biological system.
- CO3. Students will be able to explain about the different types of types of bio safety levels, their set up and need.
- CO4. Student will be able to describe how management concept can be applied to biotechnology.

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

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

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.

Public Health and Vaccinology: 17MBT24C2

MM. Th 80 + 20, Time: 3h

Course Outcomes:

- CO1. 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.
- CO2. Students will be able to explain the underlying science of human health and disease including opportunities for promoting and protecting health across the life course.
- CO3. Students will be able to explain the different types of vaccines and guidelines for current vaccination practices.
- CO 4. Students will be able to describe modern techniques used in production of new vaccines.

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

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

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.

Dissertation: 17MBT24C3

MM. 3000

Course Outcomes:

- CO1. Students will be able to identify and define research problem.
- CO2. Students will be able to generate research questions and hypothesis and can apply appropriate research methods for to prove same.
- CO3. Students will be able to conduct research responsibly and ethically.
- CO4. Students will be able collect data and will learn to interpret their results.
- CO5. Students will be able to discuss and present their findings.