

CENTRE FOR MEDICAL BIOTECHNOLOGY
MAHARSHI DAYANAND UNIVERSITY ROHTAK
Choice Based Credit System(w.e.f. 2015-16)
Scheme of examination (M.Sc. Medical Biotechnology)

Sr. No.	Title of course	Course ID	Type	Credit			Total	Hours	Total Per semester	Maximum marks
				L	T	P				
Semester I										
1	Cell Biology	MBT101	Hard Core	4	--	--	4	4	32	80 + 20 IA
2	Molecular Biology	MBT102	Hard Core	4	--	--	4	4		80 + 20 IA
3	Essentials of Microbiology	MBT103	Hard Core	4	--	--	4	4		80 + 20 IA
4	Bio-statistics and Computer applications	MBT104	Hard Core	4	--	--	4	4		80 + 20 IA
5	Biomolecules and Metabolism	MBT105	Hard Core	4	--	--	4	4		80 + 20 IA
6	Lab Course I	MBT106	Practical	--	--	6	6	12		50
7	Lab Course II	MBT107	Practical	--	--	4	4	8		50
8	Communication skills	MBT108	Foundation	--	2	--	2	2		50
Semester II										
1	Genetic Engineering	MBT201	Hard Core	4	--	--	4	4	34	80 + 20 IA
2	Immunology	MBT202	Hard Core	4	--	--	4	4		80 + 20 IA
3	Animal Cell Culture	MBT203	Hard Core	4	--	--	4	4		80 + 20 IA
4	Medico-informatics	MBT204	Hard Core	4	--	--	4	4		80 + 20 IA
5	Biotechniques *	MBT205	Soft Core	4	--	--	4	4		80 + 20 IA
6	Human Physiology*	MBT206	Soft Core	4	--	--	4	4		80 + 20 IA
7	Principles of Medical Biotechnology	MBT207	Open Elective	2	--	--	2	2		40 + 10 IA
8	Lab Course III	MBT208	Practical	--	--	6	6	12		50
9	Lab Course IV	MBT209	Practical	--	--	4	4	8		50
10	Research Seminar/Journal Club	MBT309	Foundation	-	2	-	2	2		50
* Students have to take one paper out of two soft core										
Semester III										
1	Stem cell Biology	MBT301	Hard Core	4	--	--	4	4	30	80 + 20 IA
2	Human Genome and Genetics	MBT302	Hard Core	4	--	--	4	4		80 + 20 IA
3	Diagnostics	MBT303	Hard Core	4	--	--	4	4		80 + 20 IA
4	Essentials of Drug Designing	MBT304	Hard Core	4	--	--	4	4		80 + 20 IA
5	Biology of Infectious Diseases **	MBT305	Soft Core	4	--	--	4	4		80 + 20 IA
6	Developmental Biology**	MBT306	Soft Core	4	--	--	4	4		80 + 20 IA
7	Lab Course V	MBT307	Practical	-	--	6	6	12		50
8	Lab Course VI	MBT308	Practical	-	--	4	4	8		50
** Students have to take one paper out of two soft core										
Semester IV										
1	Ethical, Safety and Management Issues in Medical Biotechnology	MBT401	Hard Core	4	--	--	4	4	28	80 + 20 IA
2	Public Health and Vaccinology	MBT402	Hard Core	4	--	--	4	4		80 + 20 IA
3	Dissertation	MBT403	Project	-	--	20	20	20		300
										Total marks = 2450

M.Sc. Medical Biotechnology Semester -I
Course Title: Cell Biology

MM. Th 80 + IA 20

Course No. MBT 101

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.

Theory

UNIT I

Diversity of cell size and shape. Cell Theory. Structure of Prokaryotic and Eukaryotic cells- Isolation and growth of cells. Microscopic techniques for study of cells. Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast. Sub-cellular fractionation and criteria of functional integrity

UNIT II

Cell membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structure and function of cytoskeleton and its role in motility. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

UNIT III

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways. Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Metabolite pathways and their regulation

UNIT IV

Apoptosis, Necrosis, Aging and Senescence. Cancer: Genetic rearrangements in progenitor cells, Oncogenes, Tumor suppressor genes. Cancer and the cell cycle, virus-induced cancer, metastasis. Interaction of cancer cells with normal cells. Therapeutic interventions of uncontrolled cell growth.

Recommended Books

1. Cell and molecular biology-Concept and experiment. 2nd edn., Harris,D(Ed.), Karp, G.1999. John wiley & 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

M.Sc. Medical Biotechnology Semester -I
Course Title: Molecular Biology

MM. Th 80 + IA 20

Course No. MBT 102

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.

Theory

UNIT I

DNA Replication: Unit of replication, replication, enzymes and accessory proteins involved in DNA replication, replication origin and replication fork, fidelity of replication, extrachromosomal replicons

Homologous Recombination

Models for recombination, Enzymes and proteins involved in recombination, Site-specific recombination, FLP/FRT and Cre/Lox recombination

UNIT II

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis

DNA Damage: Spontaneous, deamination, alkylation, oxidation, radiations, base analogs, intercalating Agents

DNA Repair: Direct reversal, Excision repair, Translesion DNA synthesis, Recombination- repair, SOS Response

UNIT III

Transcription: Prokaryotic and Eukaryotic transcription, RNA polymerases, General and specific transcription factors, Promoters and enhancer, transcription activators and repressors, Nuclear export of mRNA, modifications in RNA-Cap formation, Polyadenylation, Splicing, Editing,

Translation: Prokaryotic and eukaryotic translation, translation machinery, initiation factors and their regulation, elongation and elongation factors, termination, translational proof-reading, translational inhibitors, post translational modifications, Genetic Code

UNIT IV

Protein Trafficking: Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes

Control of Gene Expression

Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing

Recommended books:

1. Lewin, B. (2008). Genes-IX. Jones and Barlett Publishers, Inc., USA.

2. Burton E.Tropp (2008) Molecular biology: Genes to Proteins. Jones and Barlett Publishers, Inc., USA Bartlet, 4th edition
3. Watson J.D et al (2004) Molecular biology of the gene. Pearson education, 5th edition
4. Darnell J.E, Lodish F.H and Baltimore D (1986) Molecular cell Biology. Scientific American Books
5. Freifelder, D.C. (2008). Molecular Biology. Narosa Publishing House, New Delhi, 2nd ed.
6. Brown T. A (2006) Genome 3. Garland Science; 3 edition
7. Criag N and Wolberger C (2014) Molecular Biology: Principles of Genome Function. Oxford University Press; 2 edition
8. Clark D.P and Pazdernik N.J (2012) Molecular Biology. Academic Cell; 2 edition
9. Cooper G.M. and Hausman R.E (2013). The Cell: A molecular approach. Sinaur Associates Inc. Publisher, USA, 6th edition
10. Alberts B. and Johnson A (2014). Molecular Biology of Cell. Garland Science publisher, 6th edition
11. Harris,D(Ed.), Karp, G (1999) Cell and molecular biology-Concept and experiment . John wiley & sons, sons, New York. 2nd edn.
12. 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: Essentials of Microbiology

MM. Th 80 + IA 20

Course No. MBT 103

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.

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 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 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, 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

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 + IA 20

Course No. MBT 104

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.

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. Samples and Sampling Distribution, Degrees of freedom, Tests of significance, Tests of deviations, F and Z residuals, Confidence Intervals

Unit 2

Contingency tables of (Chi square) tests of goodness of fit and homogeneity, Correlation: Simple, Partial and Multiple Correlation, Methods of averages and least squares, polynomial fitting, Regression Analysis. Analysis of variance for one and two way classification Design of experiments, randomization, replication local control, completely randomized and randomized block design

Unit 3

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, Operating systems, Antivirus and firewall, Internet and its application, Binary number system, Flow charts, Algorithm in computers.

Unit 4

Introduction to programming in reference to Q Basic and C and its functions- Key words token, identifiers, arrays control statements: if else, switch control, loops: for, while, do while, structures, file handling. Introduction to data structures and database concepts, MS-OFFICE - Word processing, Spreadsheets and presentation software.

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. Xavier C (2008) Introduction to Computers and Basic programming. NEW AGE Publishers
11. Brand G (2013) Introduction to Computer Science: A Textbook for Beginners in Informatics.
12. Compute fundamentals (2002) by P.K. Sinha, BPB Publications.
13. “Programming with C” (1997) by Venugopal K R and Sudeep R Prasad (Tata McGraw Hill).
14. “The C Programming Language” (2007) by Brian W. Kernighan and Dennis M. Ritchie (Prentice Hall of India).

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

MM. Th 80 + IA 20

Course No. MBT 105

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.

Theory

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. Glycol proteins and proteoglycans.

Carbohydrate Metabolism: Reactions and energetics of glycolysis. Alcoholic and lactic fermentations, entry of fructose, mannose and galactose. Reactions and energetics of TCA cycle, gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of HMP pathway, Regulation of blood glucose.

UNIT II

Lipid: Classification, structure, occurrence and biological functions of lipids. Nomenclature and properties of fatty acids and triglycerides, saponification number, acid number, Reichert- Meissel number, rancidity of fats. Bile acids, isoprenoids, terpenes, isoprene rule, carotenoids

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 and cholesterol. Regulation of cholesterol metabolism. Metabolism of lipoproteins. Biosynthesis of 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. Protein denaturation, renaturation. Amino acid sequencing techniques, Chemical synthesis of polypeptides

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

UNIT IV

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

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

Porphyrin Metabolism: Biosynthesis and degradation of porphyrins.

Recommended Books

1. Biochemical calculations (1976) by Irwin H. Seghal (John Wiley and Sons Inc.).
2. Biochemistry (2004) by Voet Donald Voet, Judith G. (J Wiley and Sons.).
3. Physical biochemistry (1982) by D. Freifelder (W.H. Freeman and Company).
4. Lehninger's principles of biochemistry by D. L. Nelson and M. M. 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).
11. Introductory practical biochemistry (2005) by S. K. Sawhney, Randhir Singh (Alpha Science International).

M.Sc. Medical Biotechnology Semester--I

Course Title: Lab Course I

MM. 50

Course No. MBT 106

1. Introduction to different type of Microscopy- Bright field, phase contrast & Fluorescence Microscopy.
2. To study the different stages of Mitosis/Meiosis through slides
3. Cell counting and cell viability using trypan blue dye exclusion assay
4. To perform subcellular fractionation by density gradient centrifugation
5. To prepare and examine the cheek squamous epithelial cells of mouth of Human Beings, unstained and stained using light microscopy.
6. To measure Osmotic fragility of RBC's
7. To identify the blood cell types in human blood smear.
8. Isolation of DNA from Tissue/Whole Blood
9. Quantification of DNA using UV spectrophotometer/Nano Drop
10. Extraction of Plasmid DNA using Alkaline Lyses/ Miniprep method
11. Isolation of RNA by Trizol method
12. Electrophoresis of DNA/RNA/Plasmid
13. Determination of Melting Temperature (T_m) of DNA
- 14.** Extraction of DNA from gel
15. To learn the use of microscope and observe the motility of the bacteria
16. To perform and learn the process of sterilization
17. To visualize bacteria by simple and negative staining procedure
18. To differentiate between Gram Positive and gram negative bacteria
19. To perform the capsule staining and differentiate between capsule and artifact
20. To perform and interpret endospore staining
21. To perform and learn the process of various media preparation
22. To perform and learn the techniques for isolation of bacteria in pure culture
- 23.** To evaluate the antimicrobial activity of various antibiotics
- 24.** To perform and interpret Lacto-phenol blue staining for the fungal cell
- 25.** To compare the effectiveness of disinfectant like dettol.

M.Sc. Medical Biotechnology Semester--I

Course Title: Lab Course II

MM. 50

Course No. MBT 107

1. Introduction to various software and online servers for statistical analysis
2. Data representation using SPSS/ Microsoft Excel
3. Measurement of Skewness and Kurtosis using SPSS
4. Measurement of Central tendency (Mean, Mode and Median) and Standard Error/ Standard Deviation by SPSS/ Microsoft Excel
5. One and Two way Analysis of variance (ANOVA) of biological data using SPSS/ Microsoft Excel
6. Correlation and Regression Analysis of biological data using SPSS/ Microsoft Excel
7. Demonstration of Microsoft office software packages
8. Demonstration of Essential components of C/ QBasic language
9. Demonstration of CORAL DRAW for making posters/presentations
10. To plot the calibration curve for protein estimation by Lowry method
11. To plot standard curve for estimation of carbohydrate by anthrone method
12. Estimation of creatinine in blood
13. Separation and identification of amino acids by paper chromatography
14. To perform protein estimation test with the help of Bradford method
15. Estimation of DNA by diphenylamine reaction
16. Determination of RNA by orcinol method
17. To investigate the effect of temperature on enzyme catalyzed reaction
18. To investigate the effect of varying pH on the activity of salivary amylase
19. To determine the T_m of the DNA sample

M.Sc. Medical Biotechnology Semester -I
Course Title: Communication Skills

Foundation Course

Course No. MBT 108

MM. 50

Time: 30 min

NOTE: The students has to delivered Seminars/Presentations on from below mentioned topics

Lectures: preparation, objective/s, concepts, contents, sequence, formal proof, interrelationships, logic, conclusions, time management, using audiovisual aids. Giving a talk: body language: extempore and prepared talks. Preparing for interviews, CV/biodata.

Vocabulary: word power, pronunciations, guessing the meaning of words from the context and body language and using a dictionary

Review of basic and grammar Punctuation marks: comma, colon, semicolon, full stop, inverted comma.

Avoiding repetitious statements, double positives, double negatives, circular arguments.

Dealing with questions: avoiding circumvention and circular arguments; answering after breaking down long questions into parts.

MS power point-based presentations. Analysis of formal presentations in the course 3a in terms of actual presentations.

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

MM. Th 80 + IA 20

Course No. MBT 201

Time: 3 hours

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.

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), Benjamin Lewin, Pearson education international.
3. Genome-3 (2007) T.A Brown. Garland science, Taylor & Francis, New York.
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.

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

MM. Th 80+ IA 20

Course Code: MBT 202

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.

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, 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).
10. Peter John Wood, Dorling KInderseley (2007) Understanding immunology, (Pearson Education, India)

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

MM. Th 80 + IA 20

Course No. MBT 203

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.

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 - II
Course Title: Medico-informatics

MM. Th 80 + IA 20

Course No. MBT 204

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.

Theory

UNIT I

Biological Sequence Databases

Basic structure of database, classification of databases, Introduction to of 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: Sequence retrieval tools, sequence submission tools, Sequence analysis tools, Prediction tool, genome analysis and gene expression 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, 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

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

MM. Th 80 + IA 20

Course No. MBT 205

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.

Theory

UNIT I

Histochemical and immunotechniques: Antibody generation, ELISA, RIA, Western blot, Immunoprecipitation, Immunofluorescence microscopy, Immunoelectrophoresis,

Methods in cell and molecular biology: Flow Cytometry, Microfiltration, Ultrafiltration, Diafiltration, High pressure Homogenisation, Reverse osmosis, Lyophilisation, DNA-Protein interaction methods

UNIT II

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

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

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy analysis using light scattering, different types of mass spectrometry, Atomic absorption and Atomic emission spectroscopy and surface plasma resonance methods

Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy

UNIT IV

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

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), 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

M.Sc. Medical Biotechnology Semester - II
Course Title: Human Physiology

MM. Th 80+ IA 20

Course No: MBT 206

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.

UNIT I

Introduction to brain and neurobiology: Structure, classification and functions of neurons and neuroglia. Cytoskeletal elements and axoplasmic flow. The resting membrane potential. The action potential. Electrotonic potentials. Propagation of nerve impulse in different types of nerve fibers. Properties of nerve fibers : excitability, conductivity, all or none law, accommodation, adaptation, summation, refractory period. Chronaxie, rheobase and utilization time. Synapses : types, structure, synaptic transmission of the impulse, synaptic potentials, neurotransmitters, cotransmitters, neuromodulators. The neuromuscular junction : structure, transmission, end-plate potential, post-tetanic potentiation. Motor unit. Nerve growth factors. Sight and perception, hearing and balance, smell, taste, touch, pain, analgesics.

UNIT II

Blood: Formed elements of blood—origin, formation, functions. Haemoglobin – Structure, reactions, biosynthesis and catabolism. Foetal haemoglobin. Abnormal haemoglobins- Sickle-cell anemia and Thalassemia. Different types of anaemia and their causes. Hemostasis – factors, mechanism, anticoagulants, procoagulants. Disorders of hemostasis-Hemophilia, Thrombosis and Embolism. Blood group – ABO and Rh. . Blood transfusion and its hazards.

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. Electrocardiography – the normal electrocardiogram, Cardiac Arrhythmias – Normal cardiac rate. Myocardial Infarctions. Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels. Cardiac and vasomotor centers, baroreceptors and chemoreceptors, innervation of the heart and blood vessels

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 : Excitation-contraction coupling. Dihydropyridine receptors & Ryanodine receptors. Isometric and isotonic contraction

UNIT III

Digestive system: Anatomy and histology of alimentary canal. Deglutition. Movements of alimentary canal and their regulations. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Synthesis of Bile acids. Enterohepatic circulation. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Defecation. Feces. GALT. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones.

Respiratory system: Mechanics of breathing -- role of respiratory muscles, glottis. Lung volumes and capacity. alveolar surface tension and surfactant, work of breathing. Transport of gases in body - Partial

pressure and composition of normal atmospheric gases in inspired, expired, alveolar air and blood. Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve.

UNIT IV

Regulation of respiration -- neural and chemical, respiratory centers Hypoxia – types, effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Body fluids, fluid balance, parenteral solutions, renal physiology, Hormones and homeostasis. Reproductive biology and Contraception.

Recommended Books

1. John E. Hall, Medical Physiology by Guyton, Saunders, 12th edition
2. Indu Khurana, Medical Physiology, Elsevier India, 1st edition
3. Gerard J. Tortora, Bryan H. Derrickson, Principles of Anatomy and Physiology, Wiley; 13th edition.
4. Human Physiology Illustrated by B. Jain

M.Sc. Medical Biotechnology Semester -II
Course Title: Principles of Medical Biotechnology

MM. Th 40 + IA 10

Course No. MBT 207

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.

Theory

UNIT I

Haemostasis – disorders and regulation – Types of Anaemia, Deficiency of iron, B12 and folic acid, hemolytic, aplastic and genetic disorders), Bleeding disorders of man. General inflammatory marks and specific therapeutic bioindicators. CRP (C reactive protein), RA (Rheumatoid Arthritis), ASO(Anti Streptolysin O), Chronic inflammatory cells and mediators, Lymphatics and lymph nodes in inflammation, systemic effect of inflammation, Genetic counselling. Introduction to pharmacogenomics

UNIT II

Safety in diagnostic lab, Collection and submission of diagnostic specimen, Bacterial pathogens: Microscopy, Culture and Identification, Diagnostic applications of immunological tests, Isolation and identification of viral pathogens, Tests to demonstrate antiviral antibody, Antimicrobial drug interactions, Adverse reaction of antimicrobial agents

UNIT III

Molecular basis of disease, Virulence factors of different pathogenic bacteria and gene associated with, Gene Hunting, Using genetic information for vaccine designing, Zoonoses and control of zoonotic diseases: *Taenia sagginata* infection, Toxocariasis, Cryptosporidiasis, Orf disease, Leptospirosis, Toxoplasmosis, Rabies

UNIT IV

Stem cells: Adult, Embryonic and Hematopoietic and iPSC stem cells and their applications; Tissue engineering, Gene therapy: Somatic and Germ line; Transgene and gene knockout technology; Recombinant vaccines and proteins; Antiviral therapy, Epigenetics and genome imprinting

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

1. Genomic DNA isolation and purification from the nuclei and quantitation of DNA by spectrophotometer.
2. Plasmid Isolation
3. Restriction digestion of Lambda DNA with different restriction enzymes
4. Ligation Reaction of Eco R1 Digest
5. PCR
6. Preparation of complement cells
7. Transformation
8. To test the pattern of antigen-antibody interaction through Ouchterlony double diffusion assay.
9. Rocket electrophoresis
10. Radial Immunodiffusion
11. ELISA
12. Western Blotting
13. Blood group typing using haemagglutination tests.
14. To perform Immunoelectrophoresis
15. To perform Countercurrent Immunoelectrophoresis
16. Ig G Isolation
17. Introduction to aseptic technique in stem cell biology
18. Preparation and sterilization of animal cell culture medium
19. Microscopy Slide Set for Mammalian Cell lines
20. Seeding, culture and splitting of cell lines
21. Seeding, culture and splitting of Adherent cell lines
22. Cryopreservation of cell lines.
23. Cell proliferation and cytotoxicity assay by MTT.
24. Maintenance and culture of Adherent and Suspension cell lines for long term

1. Study of NCBI homepage using Entrez
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. Chromatography: Paper, Thin Layer, Gel Filtration, HPLC
11. Electrophoresis: PAGE, AGE, 2.D
12. Microscopy: Bright Field, Fluorescence, Electron
13. Centrifugation: Differential and Ultracentrifugation
14. Spectrophotometry: UV/Visible, Mass-Spectroscopy
15. PCR: Multiplex and Real-Time
16. Flow Cytometry
17. Western blotting
18. Sonication
19. Lypholization
20. Determination of hemoglobin by Sahli's method
21. Determination of total erythrocyte count by hemocytometer method
22. Determination of total leucocyte count by hemocytometer method
23. Differential leucocyte count
24. Determination of bleeding time and blood clotting time
25. Microscopy slide set for different organs of body
26. Urine physiology

M.Sc. Medical Biotechnology Semester -III
Course Title: Stem Cell Biology

MM. Th 80 + IA 20

Course No. MBT 301

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.

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 *in vitro* 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, 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

M.Sc. Medical Biotechnology Semester - III
Course Title: Human Genome and Genetics

MM. Th 80 + IA 20

Course No. MBT 302

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.

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, STR, STS, microsatellite, SNP and their detection techniques - RFLP, genotyping, RAPD, AFLP

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

Books Recommended

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: Diagnostics

MM. Th 80 + IA 20

Course No. MBT 303

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.

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 man – 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

Pastemak, An Introduction to Molecular Human Genetics, 2nd Edition, Fritzsche, 2005. Mange and Mange, Basic Human Genetics, 2nd Edition, Sinauer Assoc, 1999.
Lewis, Human Genetics, 7th Edition, WCB & McGraw, 2007.
Vogel and Motulsky, Human Genetics, 3rd Edition, Springer Verlag, 1997.
Strachan and Read, Human Molecular Genetics, 3rd Edition, Garland Sci. Publishing, 2004.
Maroni, Molecular and Genetic Analysis of Human Traits, 1st Edition, Wiley-Blackwell, 2001.
Howley and Mori, The Human Genome, Academic Press, 1999.
Strickberger, Genetics, 3rd edition, McMillan, 1985.
Snustad & Simmons, Principles of Genetics, 4th Edition, Wiley, 2005.
Griffiths et al, Modern genetic analysis, 2nd Edition, Freeman, 2002.
Hartl and Jones, Genetics-Principles and Analysis, 4th Edition, Jones & Bartlett, 1998.
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 + IA 20

Course No. MBT 304

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.

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 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: Biology of Infectious Diseases

MM. Th 80 + IA 20

Course No. MBT 305

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.

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: 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

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: Developmental Biology

MM. Th 80 + IA 20

Course No. MBT 306

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.

Theory

UNIT I

History and basic concepts: the origin of developmental biology- cell theory, mosaic and regulative development, discovery of induction, genetics and development; basic concepts of developmental biology- cell division, cell differentiation, signaling, patterning; model systems: vertebrates model organism- *Xenopus laevis*, chicken, mammals, zebrafish; invertebrate model organism- *Drosophila melanogaster*, *Caenorhabditis elegans*, Structure, chemistry, dynamics and regulation of sperm locomotion, capacitation and egg-surface targeting

UNIT II

Molecular biology, cytology and biochemistry of oogenesis: Synthesis and storage of maternal transcripts, proteins and cell organelles. ovulation and hormonal control in mammals. Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity. Egg activation, early cleavages and blastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

UNIT III

Implantation and formation of the placenta in mammals Gastrulation in mammals-formation of primitive streak, morphogenetic movements and neural induction. Ectoderm-eye development, epidermis, hair development, neural crest, tooth development and axon guidance, Mesoderm- somites, development of muscle, bone, kidney, heart and vessels, formation of limbs

UNIT IV

Pattern forming genes and expression in *Drosophila* and mammalian embryos, Development of the mammalian brain-cerebral cortex-cell lineages Lens development-fibre differentiation, programmed morphogenetic histogenetic cell, death (apoptosis). Erythropoiesis, myelopoiesis. Ageing

Recommended Books

1. Developmental biology by Scott Gilbert
2. Essential Developmental Biology Second Edition by J M W Slack
3. Principles of Development by Cheryll Tickle, Lewis Wolpert
4. Encyclopaedia of Developmental Biology by Manju Yadav
5. Current Topics in Developmental Biology by Roger A Pedersen Roger A Pedersen

Course No. MBT 307

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. Identification of inactivated X chromosome as Barr body
10. Micronucleus assay using buccal epithelial cells
11. Metaphase chromosome preparation from whole blood/tissue
12. Visualization of different banding pattern of chromosome
13. To construct a karyotype from metaphase chromosome spreads
14. Sister Chromatid Exchange (SCE) assay using peripheral blood lymphocytes
15. Identification of inactivated X chromosome as Barr body
16. Isolation of Genomic DNA from Blood sample
17. PCR-RFLP of Cyp gene variants
18. C-peptide test for diabetes
19. Molecular weight determination by SDS-PAGE

1. Introduction to Computational softwares being used in Drug designing
2. Sketching and optimization of the structure of various chemical compounds using Chem sketch/ChemDraw
3. File format available for drug designing tools and their inter-conversion using OpenBabel
4. Retrieval of PDB file and its display using Swiss PDB viewer and Rasmol
5. Energy minimization using Swiss PDB viewer/YASARA
6. Force field analysis using Swiss PDB viewer
7. To perform Homology Modeling using Swiss-Modler
8. Gene structure prediction using GenScan/GeneMark
9. Demonstration of docking using AutoDock/Chimera
10. To perform primary and secondary test for identification and classification of bacteria
11. Isolation, characterization and identification of Klebsiella
12. Isolation, characterization and identification of Staphylococcus
13. Isolation, characterization and identification of E. coli
14. To perform and interpret standard procedure used for isolation, characterization and identification of Bacillus sp.
15. To perform and interpret standard procedure used for isolation, characterization and identification of Salmonella sp.
16. To perform and interpret standard procedure used for isolation, characterization and identification of Proteus sp.
17. Extraction of total viral RNA from given sample and estimation of its quantity and quality
18. Electrophoretic analysis of segmented RNA viruses
19. To demonstrate the process of transformation for acquiring antibiotic resistance
20. To determine the copy number of virus in the given sample
21. To determine the mass motility and initial motility of semen sample
22. Determination of total sperm count in the given semen sample
23. Determination of viable spermatozoa in semen sample
24. Microscopy set of slides for different developmental stages
25. Evaluation of ovum

M.Sc. Medical Biotechnology Semester - IV
Course Title: Ethical, Safety and Management Issues in Medical Biotechnology

MM. Th 80 + IA 20

Course No. MBT 401

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.

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 + IA 20

Course No. MBT 402

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.

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 Henry 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.