



MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

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Curriculum for M.Sc. Medical Biotechnology

Amended upto BOM - 55/2018, Dated 27/11/2018

Amended History

1. Approved as per BOM-23/2012, item No 4, Dated 30/03/2012.
2. Approved as per BOM - 55/2018 [Resolution No.4.13]; Dated 27/11/2018.

Syllabus for Two-Year

MASTER OF SCIENCE (M. Sc.) MEDICAL BIOTECHNOLOGY SYLLABUS

Module/Semester	Module-1 Theory/Practical	Module-2 Theory/Practical	Module-3 Theory/Practical	Module-4 Theory/Practical
I semester	Molecular Cell Biology	Basic Biochemistry	Immunology, Immunotechnology & Immunogenetics	Biostatistics & Research Methodology & Scientific Writing
II Semester	Analytical Instrumentation	Bioinformatics,	Molecular Biology	Recombinant DNA Technology
III Semester	Human Genetics	Medical Microbiology	Plant Biotechnology	Animal Biotechnology
IV Semester	Biosafety, Introduction to quality assurance, accreditation & SOP writing		PROJECT	

INTRODUCTION TO THE CURRICULUM

This curriculum is developed for the course leading to the award of M.Sc degree in Medical Biotechnology. This manual is provided to assist you in integrating important elements of the content with the selection of effective teaching strategies.

The curriculum is presented in three main sections:

CORE CURRICULUM: These modules are defined as essential base information about Biotechnology that all post graduate professionals need to know

SEMESTER-1		Lecturers (Hrs)	Practicals (Hrs)
Module-1	Molecular Cell Biology (Theory & Practical)	30	50
Module-2	Basic Biochemistry (Theory and Practical)	40	60
Module-3	Immunology, Immunotechnology & Immunogenetics (Theory and Practical)	30	50
Module-4	Biostatistics & Research Methodology (Theory & Practical)	40	30
	Evaluation	30	30
	Seminars : LCD, tutorial, Group discussion	190	-
	Semester total hours	360	220
SEMESTER II			
Module-5	Analytical Instrumentation (Theory & Practical)	30	35
Module-6	Bioinformatics (Theory & Practical)	30	35
Module-7	Molecular Biology	45	80
Module-8	Recombinant DNA Technology (Theory & Practical)	40	80
	Evaluation	30	30
	Seminars : LCD, tutorial, Group discussion	190	
	Semester total hours	365	260
SEMESTER III			
Module-9	Human Genetics (Theory & Practical)	50	80
Module-10	Medical Microbiology (Theory & Practical)	50	80
Module-11	Plant Biotechnology (Theory & Practical)	60	100
Module-12	Animal Biotechnology (Theory & Practical)	50	40
	Evaluation	30	30

	Seminars : LCD, tutorial, Group discussion	100	
	Semester total hours	340	330
SEMESTER IV			
Module-14	Biosafety, Introduction to quality assurance, accreditation & SOP writing	40	
Module-13	PROJECT CONDUCTION An interdisciplinary module has been developed for selection of relevant dissertation work.	400	
		440	

TABLE OF CONTENTS**MODULE 1: MOLECULAR CELL BIOLOGY: THEORY**

UNIT	TOPIC
1	<i>Cytology</i> : Development history of cytology. Cell – basic unit of life: Structure and function of cell, Prokaryotic & Eukaryotic cell, Structure and function of various cells such as Viruses, Bacteria, Animals, Pancreatic islets, Neurons, Muscle cells, Tissues & their composition
2	<i>Concept of Cyto-receptors</i> : Function of membrane receptors. Methods of introduction of substances to cells: endo and exocytosis, pinocytosis, phagocytosis. Mechanism of transport substances through membrane: diffusion, osmosis, ion channels, active and passive transport, ion pumps.
3	<i>Structural organization and mechanism of sorting and regulation</i> of intracellular transport, electrical properties of membranes: Cell wall, nucleus, Mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, structure & function of cytoskeleton and its role in motility.
4	<i>Cell signaling</i> : Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, and regulation of signaling pathways
5.	<i>Cellular communication</i> : General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, desmosomes, tight junction, extracellular matrix, integrins, neurotransmission and its regulation
6.	<i>Pathogenicity of cell</i> : Living cells Vs dead cell, Necrotic Vs pycnotic death, Programmed cell death, Regeneration of cell
7.	<i>Differentiating Cells</i> : Sperms, Oocytes, Blood cells
8.	<i>Stem cells (Basics)</i> : Adult stem cell, Umbilical stem cell (UCB). Embryonic stem cell

CELL BIOLOGY PRACTICAL

SESSION	TOPIC
1	Sterilization techniques (Wet and Dry Sterilization, Chemical sterilization and Ultrafiltration.
2	Microscopy
3	Cell counting (using Haemocytometer) a) WBC- Differential Staining b) Total Count

4	RBC osmotic fragility
5	Cell Viability Assay- (using Typhan blue Stain)
6	Preparation of monolayer cell
7	Preparation of microbial, animal for microscopic observation (anucleated and nucleated cells)
8	Osmosis , exosmosis and endosmosis
9	Fixation of cells & different fixatives
10	Microtomy

Reference Books:

1. Cell and Molecular biology, Gerald Karp, John Wiley and sons Inc
2. Cell Biology by C.B. Powar.
3. Cell and Molecular Biology; DeRobertis; Lippincott Williams & Wilkins 8th Edition (2001)
4. Molecular Biology of the Cell and the Hypercell with CDROM; Alberts, Bray; Garland Publishing 1st Edition (1999)
5. Molecular Biology of the Cell with CDROM Alberts, Bruce; Johnson, Alexander; Lewis, Julian 4th Edition (2005).
6. Molecular Cell Biology, H. Lodish, A. Berk, S. L. Zipursky, W. H. Preeman and Company

MODULE 2: BASIC BIOCHEMISTRY

UNIT	TOPIC
1	<i>Chemistry of carbohydrates:</i> Biomedical importance, Classification, chemistry and functions, Monosaccharide, Disaccharides, Polysaccharides including glucosamine glycans, Glycoproteins
2	<i>Chemistry of Lipids:</i> Biomedical importance, classification, Chemistry and functions of tri-acylglycerol Phospholipids glycolipids, Fatty acids, Prostaglandins, Steroids and lipoproteins
3.	<i>Chemistry of proteins:</i> Biomedical importance, General nature of amino acids, Various ways of classification of amino acids, Biologically important peptides, Classification, properties and biological importance of proteins, Structural organization of proteins, Plasma proteins-functions, clinical significance of various fractions, Methods of separation of proteins
4.	<i>Enzymes:</i> Nomenclature and classification, General properties, Factors affecting enzyme activity, Enzyme kinetics, Michaelis-Menten equation, L-B plot, Mechanism of action: Concept of Vmax, turnover number, Enzyme inhibition, Regulation of enzyme activity
5.	<i>Chemistry of Hemoglobin:</i> Chemistry and functions of Hb and MyoHb, Types of normal and abnormal Hbs, HbM, Thalassemias, Hemoglobin derivatives
6.	<i>Hormones:</i> Characteristics and classification of hormones, Mechanism of action of peptide and steroid hormones, Hormone receptors and diseases
7	<i>Biological Oxidation:</i> Bioenergetics, Biological oxidation, Electron transport chain, Oxidative phosphorylation

BASICS BIOCHEMISTRY PRACTICALS

SESSION	TOPICS
1	Tests for monosaccharide
2	Test for Disaccharides
3	Test for polysaccharides and osazone formation
4	Color reaction of proteins
5	Precipitation reactions of proteins
6.	Chemistry of Milk

7	Chemistry of bile
8	Urine Physical characteristics and normal constituents
9	Urine report; Physical characteristics and abnormal constituents
10	Estimation of blood glucose
11	Estimation of blood urea

Reference Books:

1. Biochemistry- Stryer, Berg, 6th Edition, W.H. Freeman and Co., 2007.
2. Biochemistry- Metzler; DE, 2nd Edn., Academic press, 2001.
3. Lehninger' Principles of biochemistry- Nelson, Cox, 4th Edn., W.H. Freeman and Co., 2005.
4. Biochemistry – Voet; D, Voet; J, 3rd Edn. John Wiley and sons Inc. 2004.
5. Outlines of Biochemistry- Conn; E, Stumpf, 5th Edn. Tata-McGraw Hill, 1988.
6. Harper's Principles of Biochemistry- Murray, Gardener, Mayes, Rodwell, 27th Edn. McGraw Hill Education, 2006
7. Biochemistry- Rawn, D, Pamina publications, 2004
8. Textbook of biochemistry- West, Todd, Mason, VanBergen, 4th edn. Oxford & IBH, 1966.
9. Biochemistry- Satyanarayan. U, Books & Allied (P) Ltd., 2003.
10. Biochemistry- Champe; P, 3rd Edn. Lippincott Williams & Wilkins, 2005.
11. Biochemistry- Zubay; G, 3rd Edn. Pearson Education P. Ltd, 2003

MODULE 3: IMMUNOLOGY, IMMUNOTECHNOLOGY & IMMUNOGENETICS

UNIT	TOPIC
1	<i>Introduction to immune system</i> Innate and adaptive immunity; Cells and organs of the immune system; Primary and secondary immune responses; Antigens; Antibodies and T cell receptors: Antigen, Structure and function of immunoglobulins, Monoclonal antibodies, B and T cell receptors and co-receptors
2	<i>Generation and regulation of immune responses</i> Antigen processing and presentation; MHC-restriction; Cytokines; T Cell Maturation, activation and differentiation; B Cell Generation, activation and differentiation; Clonal selection and immunological memory; Complement system; Leukocyte activation and migration; Cell mediated cytotoxic responses; Regulation of immune responses; Immunological tolerance
3	<i>Antigen-antibody Reactions</i> Strength of Antigen-Antibody Reactions (Antibody Affinity, Avidity and Cross Reactivity), In Vivo Antigen-Antibody Reactions, In Vitro Antigen-Antibody Reactions <ul style="list-style-type: none"> ➤ Precipitation (In Fluid and In Gel Immuno-electrophoresis), ➤ Agglutination (Heamagglutination, Bacterial agglutination, Passive agglutination and Agglutination Inhibition). ➤ Radioimmuno Assay (RIA) ➤ Enzyme Linked Immunosorbant Assay (ELISA), ➤ Western Blot ➤ Immuno Fluorescence
4	<i>Disorders of Human Immune System</i> Primary and secondary immunodeficiencies; Autoimmune disorders; Hypersensitive reactions; Cytokinerelateddiseases

IMMUNOLOGY & IMMUNOTECHNOLOGY PRACTICALS

SESSION	TOPIC
1	Blood film preparation and identification of cells
2	Lymphoid organs and their microscopic organization
3	Immunization, Collection of Serum
4	To test the pattern of antigen-antibody interaction through Ouchterlony double diffusion assay

5	Radio Immune diffusion
6	Purification of IgG from serum
7	Separation of mononuclear cells by Ficoll-Hypaque
8	Western-blotting
9	To detect the presence of antigen/antibody using Enzyme Linked ImmunoSorbent Assay (ELISA).
10	VDRL test
11	Immunodiagnosics (demonstration using commercial kits)
12	Blood group typing using haemagglutination tests.
13	Estimation of hemoglobin content in blood
14	Isolation, purification and identification of immunoglobulin from blood

Reference Books:

1. Essential Immunology: Ivan Roitt.
2. Kuby Immunology: Gold by, Kindt and Osborne.
3. Immunology: Roitt, Brostoff, Mole.
4. Introductory Immunology : Huw Davies

MODULE 4: BIOSTATISTICS & COMPUTER APPLICATIONS (THEORY)

UNIT	TOPIC
1	<i>Definitions and scope of Biostatistics</i> : Variable in biology, collection, classification and tabulation of data. Graphical and diagrammatic representation, histogram, frequency polygon, frequency curve.
2	<i>Descriptive statistics</i> : Measures of central tendency – Mean (arithmetic, harmonic and Geometric), Median and Mode. Measures of dispersion – Standard deviation and Standard errors
3.	<i>Basic idea of significance test.</i> Statistical hypotheses, types of errors, level of Significance, Student's t, chi-square, goodness of fit and F tests. Correlation and Regression Analysis- concepts and applications. Probability : Basic concepts, Basic theorems of probability- addition and multiplication theorems Conditional probability, Probability distribution-definition & applications
4.	Computational Techniques for understating above three units like Met Lab, SPSS and SAS
5	Research Methodology & Scientific Writing: Building the foundation of research, Choosing appropriate subject, Narrowing subject into topic, Writing thesis statements Managing the project; How to allow time efficiently, Creating a Schedule Researching the material (Making bibliography cards), Summarizing research material, Documentation style (DPA & MS), Preparing "Works Cited", "References" pages, Writing thesis Writing a research paper

BIOSTATISTICS PRACTICALS

1	Use of INTERNET and WWW
2	Medline, Medline Search
3	Usage of statistics for data analysis
4	To develop and design case studies according to Medical Cases with the help of statistical methods. (Minimum 10)

Reference Books:

1. D. H. Sanders Computers Today. Mc. Graw-Hill. Book Company.
2. J. Peek, G. Todino & J. Straug Learning the unix operating system. O'Reilly Associates.
3. S. C. Gupta. Fundamentals of Statistics. Himalaya Pub. House.
4. J. Medhi. Statistical Methods An introductory text. New Age International (P) Ltd. Publishers.
5. P. S. S. SudarRao & J. Richard. An introduction to biostatistics. Prentice Hall of India. N. Delhi.
6. Fundamentals of mathematical Statistics.
7. Fundamentals of Applied I Statistics.
8. Statistical Method.

MODULE 5: ANALYTICAL TECHNIQUES: PRINCIPLES AND INSTRUMENTATION

UNIT	TOPIC
1	<p><i>Chromatography</i>: Basic Principles <i>Types</i> : Adsorption chromatography, Partition chromatography , Liquid chromatography, Gas-liquid chromatography, Ion-exchange chromatography, Affinity chromatography, HPLC <i>Applications of chromatographic techniques in biology</i></p>
2	<p><i>Spectroscopy</i>: Interaction of radiation with matter, absorption of radiation, emission of radiation Beer-Lambert relationship, Components of spectrophotometer, Types of detectors <i>Types</i>: UV-Vis Spectrophotometry, Fluorimetric methods, Atomic absorption spectroscopy Flame photometry, Magnetic resonance spectroscopy <i>Applications of different spectroscopic techniques</i></p>
3	<p><i>Electrophoresis</i> :Factors affecting electrophoresis <i>Types</i>:Vertical, submarine and gradient electrophoresis , Isoelectric focusing, Capillary electrophoresis, Immuno-electrophoresis <i>Applications of electrophoresis in biology</i> <i>Centrifugation</i>: Preparative and analytical centrifuges; RCF, zonal, equilibrium and density gradients</p>
4	<p><i>Radioisotopes</i>: Nature of radioactivity, types of radioactive decay, unit of radioactivity.Detection and measurement of radioactivity.Geiger counter, scintillation counters, autoradiography <i>Applications of isotopes in biology (tracers, radio immunoassay)</i></p>
5	Flow cytometry, DNA sequencing; PCR, DNA microarray, Proteomics, Nanotechnology

TECHNIQUES: PRINCIPLES & INSTRUMENTATION PRACTICALS

1	Practical based on Centrifugation
2	Practical based on Spectrophotometer
3	Practical based on Chromatography
4	Practical based on Electrophoresis

Reference Books:

1. Instrumental methods of chemical analysis. B.K. Sharma, Goel Publishing House, 25th edition
 2. Principles and techniques of biochemistry and molecular biology, Wilson and Walker, Cambridge University Press, 6th edition
 3. Instrumental methods of chemical analysis, Chatwal and Anand, Himalaya Publishing House, 5th Edition
 4. Tools and techniques of biotechnology, Mousumi Debnath, Pointer Publishers, 1st edition
 5. Biophysical chemistry-Principles and techniques, Upadhyay; Upadhyay and Nath, H Himalaya Publishing House, 3rd Edition
 6. Physical biochemistry- applications to biochemistry and molecular biology, David Freifelder, Freeman and Co., 2nd edition.
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MODULE 6: BIOINFORMATICS (THEORY)

UNIT	TOPIC
1	<i>Introduction to Genomic data and Data Organization:</i> <i>Sequence Data Banks</i> – Introduction to sequence data banks – <i>Protein sequence data bank</i> . NBFR-PIR, SWISSPROT, Signal peptide data bank, <i>Nucleic acid sequence data bank</i> – GenBank, EMBL nucleotide sequence data bank, AIDS virus sequence data bank, <i>Structural databanks</i> – protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank – Metabolic pathway data : Microbial and Cellular Data Banks.
2	<i>Sequence analysis:</i> Analysis Tools for Sequence Data Banks; Pair wise alignment - NEEDLEMAN and Wunsch algorithm, Smith Waterman, BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles.
3	<i>Secondary Structure prediction (Proteins)s;</i> prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. <i>Tertiary Structure predictions;</i> prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model. Neural Networking
4	<i>Applications in Biotechnology:</i> Primer Designing, Phylogenetic Tree Analysis with Mammalian and Bacterial 9-10 specific genes, development of specific case studies of that.
5	Protein classifications, Fold libraries, Protein structure prediction: Fold recognition (threading), Protein structure predictions: Comparative modeling (Homology), Advanced topics: Protein folding, Protein ligand interactions, Molecular Modeling & Dynamics, Drug Designing

BIOINFORMATICS PRACTICALS

SESSION	TOPIC
1	Searching protein sequences related to an unknown sequence
2	Finding the secondary structure of an unknown sequence
3	Using BLAST
4	Using Clustal W

5	Finding the tertiary structure of an unknown sequence
6	Programmers related to graphics and animation, RASMOL, MOLMOL, MX VRML etc
7.	Visualization, characterization and annotation of unknown gene and proteins.

Reference Books:

1. Introduction to Bioinformatics – Teresa Atwood and David J.Parry, Pearson smith publication (2003)
2. Introduction to Bioinformatics – lesk, Oxford press (2003)
3. Fundamental Concepts of Bioinformatics - Dan E. Krane, Michael L. Raymer, Pearson education (2004)
4. Sequence structure and Database— Des Higgins, Willice Taylor, oxford press (2003)
5. Bioinformatics: Sequence and Genome analysis by David W. Mount CBS Publishers & Distributors, 2004 reprint
6. Bioinformatics: Sequence, Structure and Databanks A Practical Approach, Higgins, ISBN: 0195667530, I.K. International Publishing House Pvt. Ltd
7. Bioinformatics: Theory and Practice, Chikhale NJ and GomaseVS,b ISBN:978-81-8318-831-9, Himalaya Publication House
8. Proteomics: Theory and Practice, Gomase VS and Chikhale NJ, Himalaya Publication House
9. Discovering Genomics, Proteomics and Bioinformatics, Campbell, ISBN: 9788131715598, Pearson Education
10. Bioinformatics: Databases, Tools, and Algorithms, OrpitaBosu, SimminderKaur, Thukral , ISBN: 9780195676839, Oxford University Press

MODULE7: MOLECULAR BIOLOGY (THEORY)

UNIT	TOPIC
1	<i>Structure of Nucleic Acid:</i> DNA,RNA, mRNA, tRNA, rRNA, Denaturation and Renaturation of DNA, T _m ; GC content from T _m , Renaturation kinetics of DNA and complexity of DNA, Cot curves Satellite DNA: Repetitive DNA, SNP, STR,
2	<i>DNA Replication:</i> Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication,Enzymes and accessory proteins involved in DNA replication. DNA Damage & Repair.
3	<i>Transcription</i> Prokaryotic transcription, Eukaryotic transcription, RNA polymerases, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, 5'-Cap formation, Transcription termination, 3'-end processing and polyadenylation, Post-transcriptional gene silencing
4	<i>RNA splicing</i> Nuclear splicing, splice some and small nuclear RNAs, group I and group II Introns, <i>Cis-</i> and <i>Trans-</i> splicing reactions, tRNA splicing, alternate splicing.
5	<i>Translation</i> Prokaryotic and eukaryotic translation: Synthesis of aminoacyl tRNA, aminoacyl synthetases, Mechanism of initiation, elongation and termination, Regulation of translation, co-and post-translational modifications of proteins
6	<i>Regulation of gene expression</i> Induction and repression, operon theory, lac operon, trp operon, ara operon, attenuation, positive and negative control, cataboliterepression,regulation of transcription by cAMP and CRP

MOLECULAR BIOLOGY PRACTICALS

SESSION	TOPIC
1	DNA extraction from blood - Manual Method
2	Isolation of total RNA and mRNA (Oligo-dT cellulose method)

3	Purification and Concentration of the DNA/RNA- Spectrophotometer
4	Estimation of DNA by Chemical Means- Diphenyl amine method
5	Estimation of RNA by Chemical Means- Orcinol Method
6	Isolation of plasmid DNA- Kit Based Method
7	Isolation of nucleic acids from the given sample and determination of the DNA and RNA content.
8	PCR based diagnosis of diseases (Pulmonary TB)

Reference Books:

- 1) Molecular Biology; David Freifelder, Narosa Publishing House, 2nd edition (2004)
- 2) Microbial Genetics; David Freifelder, Narosa Publishing House, 2nd edition (2004)
- 3) Principles of Gene Manipulations; S. B. Primrose, R. M. Twyman, R. W. Old, Blackwell Science, 6th Edition (2003).
- 4) Gene VIII; Benjamin Lewin; Oxford Univ. Press, 8th edition (2004)
- 5) Advanced Molecular Biology; R. M. Twyman, 1st Edition, (2003)
- 6) Instant Notes on Molecular Biology; P.C. Turner, A. G. McLennan, A. D. Bates & M. R. H. White, 2nd Edition (2002)

MODULE 8: RECOMBINANT DNA TECHNOLOGY (THEORY)

UNIT	TOPIC
1	<i>Enzymes used in DNA technology:</i> Restriction and modification enzymes, Other nucleases, Polymerases, ligases, kinases and phosphatases. Cloning vectors: plasmids, phages, cosmids, artificial chromosomes, shuttle vectors, expression vectors.
2	<i>DNA transactions in Microbes:</i> Transformation, transduction and conjugation. Cloning Vectors – Plasmids, cosmids, λ , phagemids, yeast artificial chromosomes.
3	<i>Cloning Methodologies</i> Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; <i>Direct and indirect methods.</i> Probe Preparation (radiolabel ling and non radiolabel ling). Methods based on Nucleic acid homology (Southern, northern, western, southern-western, colony and plaque hybridization, chromosomal walk, etc.).
4	<i>PCR and Its Applications</i> Primer design; Fidelity of thermos table enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; PCR in gene recombination; Deletion; addition; Overlap extension; and Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)
5	<i>Sequencing methods; Enzymatic DNA sequencing;</i> Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knockout mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.

SESSION	TOPIC
1	Making the bacterial cells competent
2	Transformation of <i>E.coli</i> .
3	<i>In vitro</i> DNA ligation
4	Bacterial conjugation
5	DNA blotting technique Northern blotting technique & Southern blotting
6	RFLP technique
7	PCR analysis of DNA fragments by agarose gel electrophoresis

Reference Books:

1. Recombinant DNA: Watson et. al.
2. Genetic engineering : Sandya Mitra
3. Principles of gene manipulation : Old & Primrose
4. Molecular Biology Lab fax I & II : T. A. Brown
5. Genetic Engineering and its applications. (2004) 2/e, Joshi. P: Agrobios, India
6. Gene Cloning and DNA analysis: An introduction, (2006) 5/e . T. A. Brown, Black Well Publishing Company.
7. Principles of Gene Manipulation; S. B. Primrose, R. M. Twyman & R. W. Old; Blackwell Science, 6th Edition (2001).
8. Essential Molecular Biology (volume I) Practical Approach; Edited By T. A. Brown; Oxford University Press, 2nd Edition (2001).
9. Molecular Cloning lab manual; Joseph Sambrook, David W. Russell, Cold Spring Harbor Laboratory Press, 3rd Edition (2001)

MODULE 9: HUMAN GENETICS (THEORY)

UNIT	TOPIC
1	<p><i>Mendelism and its extensions</i> Law of segregation; Law of independent assortment; Chromosomal basis of segregation and independent assortment; Linkage; Crossing over; Multiple allelism; Pleiotropy; Cytoplasmic inheritance</p>
2	<p><i>Cytogenetic</i> International System for Human Chromosome Nomenclature; Mechanisms of numerical and structural chromosomal aberrations; Chromosomal basis of sex determination; Non-chromosomal basis of sex determination; Cytoplasmic inheritance</p>
3.	<p><i>Population genetics</i> Allelic and genotypic frequencies, Hardy-Weinberg Equilibrium, Changes in allelic frequencies, Inbreeding and out breeding.--</p>
4.	<p><i>History of Human Genetics:</i> Pedigrees- gathering family history; Pedigree symbols; Construction of pedigrees; Presentation of molecular genetic data in pedigrees; Pedigree analysis of monogenic traits: Autosomal inheritance-dominant, recessive; Sex-linked inheritance- X-linked recessive, dominant; Y-linked; Sex-limited and sex-influenced traits; Mitochondrial inheritance; MIM number; Complications to the basic pedigree patterns I: Non-penetrance, variable expressivity, pleiotropy, onset, dominance problem; Anticipation;</p>
5	<p><i>Historical overview of genetic counseling:</i> Models of Eugenic, Medical/Preventive, Decision making, Psychotherapeutic counseling; current definition and goals, Components of genetic counseling Indications and purpose, Information gathering and construction of pedigree, Medical Genetic evaluation, Basic components of Medical History, Past medical history, social & family history, Physical examination</p>
6	<p><i>Genetic disorders</i> Inborn errors of metabolism: Phenylketonuria; Neurogenetic disorders: Alzheimer's disease; Muscle genetic disorders: Duchenne Muscular Dystrophy; Genetic disorders of Haematopoietic systems: Sickle cell anemia; Multifactorial disorders: Diabetes mellitus; Mitochondrial syndromes; Management of genetic disorders</p>

HUMAN GENETICS PRACTICAL

SESSION	TOPIC
1	Lymphocyte culture and chromosome preparations
2	Chromosome preparations-PHA-stimulated short-term blood cultures
3	G-banding of chromosomes
4	Karyotype preparation
5	Preparation of Pedigree chart of some common phenotypic characters of human
6	Risk assessment in Pedigree
7	Study of Sex-chromatin from buccal smear
8	Facial landmarks and dermatoglyphia
9	In situ hybridization-FISH (example with centromeric and telomeric probes)
10	RT-PCR based Diagnosis

Reference Books:

1. Gardner EJ, Simmons MJ, Snustard DP, (2004). Principles of Genetics. 8th Ed, John Wiley & sons Inc
2. Jain H K, (2004), Genetics: Principles, Concepts & Implications. Oxford & IBH Publishing Co.P.Ltd
3. Robert.R.H,(2002), Principles of Genetics, 7thEd.Tata McGraw Hill PublishingCo.Ltd
4. Sambamurthy AVSS, (1999).Genetics.Narosa Publishing House
5. Winter P C, Hickey G I, Fletcher H L, (2003).Instant notes of Genetics, 2nd Ed, Viva Books Pvt Ltd
6. Verma PS, Agarwal VK.(2007).Cell Biology,Genetics,MolecularBiology ,Evolution and Ecology.S.Chand
7. Strickberger, Genetics, 3rd edition, McMillan, 1985.
8. Snustad & Simmons, Principles of Genetics, 4th Edition, Wiley, 2005.
9. Griffiths et al, Modern genetic analysis, 2nd Edition, Freeman, 2002.
10. Hartl and Jones, Genetics-Principles and Analysis, 4th Edition, Jones & Bartlett, 1998.
11. Lewin, Genes IX, 9th Edition, Jones & Bartlett, 2007.

MODULE 10: MEDICAL MICROBIOLOGY (THEORY)

UNIT	TOPIC
1	<i>Historical Introduction-</i> Definition of Medical Microbiology. Concepts of disease, Evolution of Medical Microbiology. Important scientists & their contributions, Leeuwenhoek, Louis, Lister, Robert Koch, Koch postulates.
2	<i>Classification of living beings</i> Kingdom Protista. Prokaryotic & Eukaryotic cells, Units of measurement. Microscopy –Principles & parts of light microscope. Other types of microscopes.
3.	<i>Study of bacteria</i> Wet mount, staining Methods- Grams stain, ZN stain, special stains. Size shape and arrangement of different bacteria. Classification of bacteria (GmPos&Neg) Examples of Acid fast orgs.
4.	<i>Structure of bacterial cell</i> composition, function of various parts.(I) & Same (II)
5	<i>Growth and multiplication of bacteria.</i> Bacterial growth curve, nutritional and other growth requirements.
6	<i>Need for sterilization, Definitions,</i> Classification of physical agents with e.g.s, Details of autoclave and Hot air oven. <i>Culture media , Identification of bacteria Biochemical tests</i>
7.	<i>Infection-Pathogenecity& Virulence factors,</i> Disease burden, Investigation of Epidemics
9.	<i>Bacterial Genetics:</i> Antibiotic sensitivity test& Drug resistance, Antibacterial-Mode of action, classification, Antifungal, Antiviral, Antiparasitic-Antiprotozoal &Antihelminths
10.	<i>Virology-</i> Structure, properties of viruses, Replication, Classes-DNA& RNA &List of diseases caused, Viral & Bacterial Vaccines, Vectors- Viral & Bacterial

MEDICAL MICROBIOLOGY PRACTICALS

SESSION	TOPIC
1	Glassware used in Microbiology laboratory & its cleaning.
2	Study of Microscope- Compound Microscope & its parts. Use of oil Immersion objective.
3	Study of different equipments- Bunsen burner, water bath, Autoclave, Laminar air flow, Incubator, Hot air oven, Centrifuge, and Refrigerator
4	Preparation of liquid medium -nutrients broth, sugar fermentation media.
5	Preparation of nutrient agar, agar slant.
6.	Isolation of microorganism by streak plate method.
7	Isolation of microorganism by pour plate method.
8	Isolation of microorganism by spread plate method.
9	Enumeration and cultivation of microorganisms
10	Isolation of bacteria from mixture
11	Isolation of antibiotic producers from soil and identification of the isolated culture
12	Staining Techniques
13	Haemagglutination test
14	Commercial kits-based diagnosis
15	Antibiotic sensitivity (bacterial)

References Book:

1. Textbook of Microbiology ;R. Ananthnarayan, C. K. J. Panicker, Orient Longman 6th Edition (2003)
2. Immunology: Introductory textbook;NandiniShetty, New Age International pvt.Ltd. 1st Edition (2003)
3. Principles of Virology by SJ Flint, LW Enquist, RM Krug, VR Racaniello, AM
4. Skalka ASM Press Washington 1st edition (2002)
5. An introduction to genetic engineering by ST Desmond and Nicholl CambridgeUniversity Press 2nd edition(2004)
6. General Microbiology Vol. II by Powar and Daginawala Himalaya Publ. House8th edition (2004)

MODULE 11: PLANT BIOTECHNOLOGY (THEORY)

UNIT	TOPIC
1	Introduction to cell and tissue culture; Tissue culture as a Technique to produce novel plants and hybrids. <i>Tissue culture media</i> (Composition and Preparation). Sterilization and agents of Sterilization used in tissue culture labs. <i>Initiation and maintenance of callus and suspension cultures</i> ; Single cell clones. Organogenesis; Somatic embryogenesis; Transfer and establishment of whole plants in soil. Shoot tip culture; Rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue.
2	<i>Protoplast isolation, culture and fusion</i> ; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Anther, pollen and ovary culture for production of haploid plants and homozygous lines.
3	CHEMISTRY OF NATURAL PRODUCTS (1): General Pharmacognosy-Cultivation of medicinal plants.-Selection & breeding of medicinal plants.-Factors affecting plant growth -Preparation of drugs from, plants to pharmaceuticals.- Adulteration.- Secondary plant metabolites.-Dusting powder.-Hairs & Fabrics.
4	CHEMISTRY OF NATURAL PRODUCTS(1): Alkaloids, General reactions, Phenylalkyl amine alkaloids, Pyridine alkaloids, Pyrrolizidine alkaloids, Piperine alkaloids, Quinoline alkaloids, Isoquinoline alkaloids, Quinolizidine alkaloids, Tropolone alkaloids, Purine alkaloids, Tropane alkaloids, Volatile oils, Terpenes, Oxygenated terpenes, Lipids & Fixed oil, Fats & Waxes, Vitamins & minerals
5	Quality control of herbal products, Validation of methods, Tissue culture, Gas chromatography (basis, instrumental, applications, Q.C. by finger print by GLC analysis of natural products), HPLC (basis, , instrumental, applications, Q.C. by finger print by HPLC analysis of natural products), Structural elucidation of natural products (UV, IR, 1D & 2D NMR and Mass spectrometry)

PLANT BIOTECHNOLOGY PRACTICALS

SESSION	TOPIC
1	Preparation of plant cell culture media
2	Surface sterilization
3	Organ Culture

4	Callus propagation, Anther culture, production of Haploids
5	Development of seed powder extract and assay with different cell lines
6	Development of different assays with liquid extract from herbal plant
8	Purification of herbal extract with HPLC, GC and also traditional method

MODULE 12: ANIMAL BIOTECHNOLOGY (THEORY)

UNIT	TOPIC
1	Structure and organization of animal cell. Equipments and materials for animal cell culture technology.
2	Introduction to the balanced salt solutions and simple growth medium.
3	Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum and Protein free defined media and their application.
4	Primary and established cell line cultures. Measurement of viability and cytotoxicity. Biology and characterization of the cultured cells, measuring parameters of growth.
5	Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary Culture; maintenance of cell culture; Cell cloning and cell separation. Cell synchronization. Cell transformation. Scaling up of animal cell culture. Stem cell cultures, embryonic stem cells and their Applications, embryo technology
6	<i>Applications of animal biotechnology:</i> Use of cell culture for production of a regulatory protein, Use of cell culture for production of a hormone (e.g. Insulin), Use of cell culture for production of vaccines, Cell hybridization and human hybridization. Use of cell culture in drug targeting and drug toxicity analysis. Transplantation of cultured cells.

ANIMAL BIOTECHNOLOGY PRACTICALS

SESSION	TOPIC
1	Sterilization and preparation of animal cell culture media
2	Isolation and culture of lymphocytes
3	Cell counting and cell viability
4	Trypsinization of monolayer and sub culturing

MODULE 13: BIOSAFETY, INTRODUCTION TO QUALITY ASSURANCE & SOP WRITING (THEORY)

UNIT	TOPIC
1	<i>Biosafety</i> Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs
2	<i>Introduction to quality assurance, accreditation & SOP writing</i> :Concept of ISO standards and certification , National regulatory body for accreditation, Quality parameters, GMP & GLP, Standard operating procedures, Application of QA in field of genetics, Data management of clonal and testing laboratory

5	Cryopreservation and thawing.
6	Measurement of doubling time
7	Role of serum in cell culture.

MODULE 14: PROJECT CONDUCTION: LIST OF TOPICS

The M.Sc. student is required to register for Research work that will be compiled into a thesis. The thesis must be supervised by the Supervisor appointed by the Faculty of Medicine upon the recommendation by Head of the Department or Course Director.

Progress in research and thesis work will be evaluated at the end of each semester by Head of the department /Course Director as satisfactory or unsatisfactory.

At the end of his/her study, the student must defend his/her thesis in an oral examination administered by the board of examiners, ~~consists of at least four members, appointed by the~~ examination committee of the MGM University of Health Sciences, Navi Mumbai.

M.Sc. Medical Biotechnology

Exam Pattern

The new suggested exam pattern which is common for all subjects is as follows.

- There will **one final university exam** at the end of every semester.
- **Internal exam** will be conducted at the college level for 1st and 2nd semesters with a common time table and for 3rd, 4th, 5th and 6th semesters at the departmental level. The marks scored will be used for calculating the internal assessment as described on page 4, 5.

Marks scheme for the University exam:

Final theory marks will be **80 marks (60marks University Theory exam + 20 Marks Internal assessment)**.

The existing University Theory exam pattern should be modified.as follows:

Existing Scheme:

Question	Mark distribution	Total marks (60)
Sec:A:MCQ	20X0.5M	10
Sec:B: SAQ	10/11 x 4M	40
Sec C: LAQ	1/2 x 10 M	10
		Total= 60 M

Modified scheme: (This gives equal weightage to sec B and Sec C)

Question		Mark distribution	Marks allotted per section	Marks
Sec:A	MCQ	10X 1 M =10	10	10
Sec:B	SAQ	3/ 4 x 5 M =15	15	25
	LAQ	1/ 2 x 10 M =10	10	
Sec : C	SAQ	3/ 4 x 5 M =15	15	25
	LAQ	1/ 2 x 10 M =10	10	
				Total= 60 M

Final practical marks will be **70M.(50 marks University practical exam + 20 Marks Internal assessment)**

Practical exam pattern : Total 50 marks with following break up.

Exercise	Description	Marks
Q No 1.	Practical exercise	15 M
Q No 2	Station exercise	5x 5M =25 M
Q No 3	VIVA	10 M
		Total= 50 M

Calculation of Internal assessment: there will be 20 marks each towards internal assessment in theory and practicals. This should be submitted by respective departments atleast 15 days before university exam to the university (exam section)

Break up of Theory IA calculation for 20marks

Internal exam(at department)	10 marks
Attendance	5 marks
Seminar	5marks
	Total= 20 M

Break up of Practical IA calculation:

Internal exam(at department)	10 marks
Attendance	5 marks
Journal	5marks
	Total= 20 M

Exam pattern for Internal exam Theory: (30 marks) to be converted to 10 marks.

Question	Mark distribution	Total marks (30)
Sec:A:MCQ	10 x1M	10
Sec:B: SAQ	2 /3 x 5M	10
Sec C: LAQ	1/ 2 x 10 M	10
		Total= 30 M

Exam pattern for Internal exam Practical (30 marks) to be converted to 10 marks.

Exercise	Description	Marks
Q No 1.	Practical exercise	10 M
Q No 2	Station exercise	10 M
Q No 3	VIVA	10 M
		Total= 30 M

5 marks allocated for Attendance in theory and 5 marks for attendance in practicals.

It was decided that weightage be given to attendance as per following scheme:

Attendance percentage	Marks
<75	Zero
75	2.5
76-80	3.0
81-85	3.5
86-90	4.0
91-95	4.5
96-100	5.0

5marks for Seminar presentations (to be added to theory internal assessment) and 5marks for Journal (to be added to Practical Internal assessment).

Regarding exam marks distribution in VI Semester (3 year courses)

It was proposed that for the final semester ie 6th Sem in 3 year courses, the same mark distribution should be kept for practical exams.

Out of 50 marks practicals, break up will be as follows:

Exercise	Description	Marks
Q No 1.	Practical exercise	15 M
Q No 2	Dissertation presentation	25
Q No 3	VIVA	10 M
		Total= 50 M

- However, Dr. Harke & Dr. Mansi opined that for 2 year courses, evaluation project including viva may be carried out, out of 100 marks.

Dissertation:-

M.Sc. (Biotechnology & Genetics Courses) student should submit a suitable dissertation topic forwarded by the guide to the School of Biomedical Sciences by 16th September in III Semester of the course. Following approval of ethics & scientific committee, work should be carried out.

Completed dissertation should be submitted by 31st march in IV Semester.

Resolution No. 4.13 of BOM-55/2018: Resolved as follows:-

- (i) Slow learners must be re-designated as potential learners.
- (ii) Students scoring less than 35% marks in a particular subjects/course in the 1st formative exam are to be listed as potential learners. These learners must be constantly encouraged to perform better with the help of various remedial measures.
- (iii) Students scoring more than 75% marks in a particular subjects/course in the 1st formative exam are to be listed as advanced learners. These learners must be constantly encouraged to participate in various scholarly activities.



MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

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