



# 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. Molecular Biology

Amended upto BOM- 51/2017, Dated 28/08/2017

## **Amended History**

1. Approved as per BOM- 29/2013 Dated 15/06/2013.
2. As amended in BOM- 43/2015, [Resolution No. 3.6(a)], Dated 06/11/2015.
3. As amended in BOM- 48/2017, [Resolution No. 5.11(g)], [Resolution No.5.25], Dated 24/01/2017.
4. As amended in BOM- 51/2017, [Resolution No.1.3.14.3], [Resolution No.1.3.14.10], [Resolution No.1.3.14.13], [Resolution No.1.3.7.11(i)], [Resolution No.1.3.23] Dated 28/08/2017.

## **M.Sc. Molecular Biology Syllabus**

### **Course Description**

Diagnosis of cervical cancer by testing for Human Papilloma Virus (HPV) using diagnostic kits based on simple DNA hybridization has become a reality. Purchasing cardiomyocytes as an OTC product from a pharmacist may not be anymore futuristic. With gigantic developments in the area of instrumentation technology, it has now become possible to develop biosensors using nanoparticles. The lab on chip may not be so distant.

To keep pace with the worldwide research scenario on proteomics & Genomics, the MGMIHS has opened new vistas to students desirous of doing post graduate course in Molecular Biology. The course is structured from simple to higher, complex and more applied aspects of Molecular Biology.

**Eligibility:** Eligibility students with the following undergraduate degrees are eligible, B.Sc. Biotechnology, B.Sc. Biochemistry or any Life Sciences, MBBS, BHMS, BAMS.

Student should have obtained minimum 50% marks in the undergraduate degree or B grade from any recognized University.

### **Objective:**

The students of M.sc. Molecular Biology course should be able to

1. Read and analyze the primary research literature, critically assess scientific experiments and evaluate the impact of a scientific discovery.
2. Understand key implications of Proteomics and Genomics, Nanobiotechnology etc.
3. Be conversant with latest research developments in all the above areas.
4. Be primed and able to conduct quality research in latest molecular biology based research topics.

**M.Sc. Molecular Biology**  
(2 year Course)

Sr. No	Semester	Module	
1	<b>Sem I- Basic Molecular Biology I</b>	Module 1	Cell Biology
		Module 2	Molecular Enzymology
		Module 3	Molecular Immunology
		Module 4	Biostatistics & Research Methodology
2	<b>Sem II- Basic Molecular Biology II</b>	Module 1	Proteomics I
		Module 2	Genomics I
		Module 3	Outlines of metabolism with inherited disorders.
		Module 4	Analytical Instrumentation
3	<b>Sem III – Advanced Molecular Biology</b>	Module 1	Proteomics II
		Module 2	Genomics II
		Module 3	Metabolic Engineering
		Module 4	Computational Biology & Bioinformatics
4	<b>Sem IV- Applied Molecular Biology</b>	Module 1	Molecular Diagnostics & Nanobiotechnology
		Module 2	Bioethics, Biosafety, IPR & Technology transfer
		Module 3 & Module 4 PROJECT WORK: An interdisciplinary module	

M.Sc. Molecular Biology  
(2 year Course)

Sem I- Basic Molecular Biology I

Module 1- Cell Biology

Contents:

Topic No.	Topics and Details	Theory
1	Overview of Cell biology Universal features of cells Diversity of genomes Visualization of cell, its fine structure and molecules	2
2	The cell membrane and its structure Transport across membrane, Ion channels Receptor mediated endocytosis.	2
3	Cellular components and function, protein sorting Vesicular traffic inside the cells Mitochondria and chloroplast and its genetic system	2
4	Cell signalling, receptor, ligands, signalling pathways Signal transduction mechanisms Cytoskeleton of cells, cytoskeleton filaments, molecular motors	3
5	Cell cycle, regulation of cell division, cell cycle checkpoints. Cell division- Mitosis, meiosis and the mechanism of cell division	3
6	Germ cells, Stem cells, Cancer cells	1
7	Apoptosis: Mechanism, Pathways, Markers.	2
<b>Total</b>		<b>15 lect.</b>

**Practicals :**

Sr. No	Topic	No of Practical classes
1	Microscopy: i. Simple, Compound, inverted and fluorescence ii. Cell count using haemocytometer iii. WBC- Differential counting iv. RBC- Osmotic fragility v. Preparation of microbial, animal and plant cells for microscopic examination & staining by Giemsa	2
2	Genetic apparatus: i. Cell viability assay ii. Mitosis & meiosis	1
3	Buccal smear of exfoliated epithelial cells	1
4	Osmosis, exosmosis and endosmosis	1
5	Fixation of cells & different fixatives	1
6	Preparation of mononuclear cells	
<b>Total</b>		<b>6</b>

**Module 2- Molecular Enzymology**

**Contents:**

Topic No.	Topics and Details	Theory
1	Classification and nomenclature of enzyme, Extracellular and intracellular enzyme, Inducible and constitutive enzyme, properties of enzymes as catalytic power, enzyme specificity, cofactors, isoenzymes, multi enzyme complex and multi functional enzyme.	2
2	Enzyme techniques- enzyme assays, analysis of enzyme assays, Expression of the enzyme activity (International Unit), specific activity of enzyme, Coupled reaction. Isolation and purification of enzyme, concept of fold purification and yield, Importance of pure enzymes, chemical modification of enzyme, molecular techniques in enzymes, immobilization of enzymes.	2

3	Factors affecting the rate of enzymes catalyzed reactions, Study of enzyme kinetics, Plots for enzyme kinetics: Michelis-Menten, Lineweaver-Burke plot and Eddie Hofstee plot. Use of initial velocity, Determination of rate constant for enzyme catalyzed reactions, inhibition and exchange studies to differentiate between multi substrate reaction mechanisms. Methods of examining enzyme-complex, Use of substrate analogs, kinetics of various types of inhibition and kinetics of enzyme inhibition.	3
4	Allosteric enzymes, sigmoidal kinetics (Cooperativity phenomenon. Hill and Scatchard plots) and their physiological significance. Symmetric and sequential modes for action of allosteric enzymes and their significance. K class and V class allosteric enzymes.	2
5	Active site of enzymes: Basic concept, conformation of active site, mapping of active site by different methods. Lysozyme and chymotrypsin as models.	2
6	Enzyme engineering: Basic concept for designing a new enzyme in reference to therapeutic enzyme, Immobilization of enzymes, designer enzymes, biosensor enzymes, enzyme crystallization and X-ray crystallography, Flexibility & conformational mobility of enzymes.	2
7	Clinical Enzymology: End point and kinetic methods for determination of enzyme activity, SI units. Application of $K_m$ to Diagnostic enzymology serum enzymes in health and disease, Isoenzymes.	2
<b>Total</b>		<b>15 lect.</b>

**Practicals :**

Sr. No	Topic	No of Practical classes
1	$K_m$ and $V_{max}$ value of Transaminase and Amylase.	2
2	Determination of $K_{cat}$	1
3	Determination of specific activity	1
4	Enzyme purification by gel chromatography	1
5	Enzyme immobilization	1
6	Rapid zymogram of enzyme.	
<b>Total</b>		<b>6</b>

**Module 3- Molecular Immunology****Contents:**

Topic No.	Topics and Details	Theory
1	The origin of immunology: Innate and acquired immunity; humoral and cell mediated immunity. Primary and secondary lymphoid organ: antigen, B cell, T cell subsets and macrophages.	2
2	Molecular basis of Immunology: Structure of antibody, Molecular basis of antibody diversity, polyclonal and monoclonal antibody, complement, antigen-antibody reactions.	2
3	Major Histocompatibility complex (MHC): Class I & II antigens their functions	2
4	Immune response and tolerance: Regulation of immune response, immune tolerance; hyper sensitivity, autoimmunity;	2
5	Immunity to Infection : Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity;	2
6	Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology	2
7	Primary immunodeficiency, Acquired or secondary immunodeficiencies, immunomodulators and immune enhancers	2
8	Antibody engineering	1
<b>Total</b>		<b>15 lect.</b>



**Practicals:**

Sr. No	Topic	No of Practical classes
1	Practical based on antigen – antibody interactions - Widal, VDRL, Blood grouping, CRP, Titre determination.	2
2	Radial Immunodiffusion, double diffusion	2
3	Immuno electrophoresis.	2
<b>Total</b>		<b>6</b>

**Module 4- Bio-Statistics & Research Methodology**

**Contents:**

Topic No.	Topics and Details	Theory
1	Introduction to statistics & Biostatistics & its application.	
2	Data condensation & graphical methods. - Raw data, Attributes & variables, Discrete & continuous variables, - Principles of classification - Construction of frequency distribution, discrete & continuous frequency distribution, relative frequency distribution, cumulative frequency distribution. - Graphical presentation of data using: Histogram, frequency polygon, frequency curve, ogive curves. - Diagrammatic presentation of data using :simple bar diagram, multiple bar diagram, subdivided bar diagram, pie- diagram	3

3	<p>Measures of Central Tendency:</p> <ul style="list-style-type: none"> <li>- Need &amp; features of good measure of central tendency.</li> <li>- Arithmetic mean, mode, median</li> <li>- Merits &amp; demerits of mean, mode &amp; median.</li> <li>- Graphical methods for mode &amp; median.</li> <li>- Relation between mean, mode &amp; median (Empirical Relation)</li> </ul>	2
4	<p>Measures of dispersion :</p> <ul style="list-style-type: none"> <li>- Need &amp; characteristics of good measure of dispersion</li> <li>- Range, mean deviation, standard deviation, variance, C.V.</li> <li>- Merits &amp; demerits of range, Mean deviation, Standard deviation, variance C.V.</li> </ul>	2
5	Measures of skewness & kurtosis	
6	<p>Hypothesis Testing</p> <ul style="list-style-type: none"> <li>- Sampling variability &amp; Significance, Hypothesis testing</li> <li>- Normal distribution &amp; its properties, Hypothesis, Types of hypothesis, Type I error, Type II error, level of significance, P-value, one-tailed test, two tailed test.</li> <li>- Significance of difference in Mean &amp; proportion for large samples &amp; small samples.</li> <li>- SEM (Standard Error of Mean) uses &amp; its applications</li> <li>- SEDM ( Standard Error of Differences in Means)</li> <li>- t-test –(paired t-test, unpaired t-test)</li> <li>- ANOVA</li> <li>- Chi-square test for association between attributes, chi-square test for goodness of fit</li> <li>- Standard Error of Proportion (SEP) &amp; Standard Error of Difference in Proportion (SEDP) &amp; its uses and applications.</li> <li>- Non-Parametric tests</li> </ul>	3
7	Vital Statistics	1

8	Research Design:-Correlational design, Experimental design, Internal & External validity, Threats to validity, components of research design, features of correlational & experimental design Observational studies:- Exploratory studies, Descriptive studies, Explanatory studies, cohort studies, case-control studies, Evaluative studies, Monitoring studies, Historical studies, Panel studies.	2
9	Methods of data collection: Sample survey- Stages of sample survey - Methods of survey Sampling & Non sampling errors, Interviewing for Data Collection -Types of interviews -Art of asking questions. Questionnaire construction -Considerations of questionnaire construction -Features of questionnaire Pre-test Interviews & Pilot studies	2
<b>Total</b>		<b>15 lect</b>

### Practical

Sr. No	Topic	No. of Practical Classes
1	Exercise on each of the above topic	6-8
<b>Total</b>		<b>6-8</b>

### Sem II- Basic Molecular Biology II

#### Module 1- Proteomics I

##### Contents:

Topic No.	Topics and Details	Theory
1	Introduction to Proteomics, Immunoproteomics, Nutriproteomics, Scope of proteomics.	1

2	Protein Chemistry: amino acid composition, different types of amino acids and their relation to protein structure. Solubility of proteins, Isoelectric pH and its importance in proteins.	2
3	Protein Structure: i). Overview: Primary, Secondary, Tertiary and Quarternary structure. ii) Primary structure Peptide bond conformation – Ramchandran Plot iii) Secondary Structure- Importance of alpha helix in protein structure & stability. Beta sheet structures in different proteins. iv) Bonds & forces involved in tertiary and quarternary structure Contribution of tertiary and quarternary structures to protein architecture (Fibrous & Globular proteins, silk fibroin, Myoglobin, lysozyme). v) Protein motifs and their contribution to Protein architecture.	4
4	Protein denaturation and folding. Role of molecular chaperones.	1
5	Protein purification methods: i. Column Chromatography ii. Ion-exchange chromatography iii. Size exclusion chromatography iv. Affinity chromatography v. Isoelectric focusing vi. One & Two dimensional electrophoresis	4
6	Protein Analysis: i) Peptide mapping ; Protein fingerprinting ii) Amino acids sequencing methods: Sanger's & Edman degradation; automation. iii) Protein analysis with mass spectroscopy, LC-MS, MALDI-TOF - MS, SELDI-TOF-MS	3
<b>Total</b>		<b>15 lect.</b>

**Practicals:-**

Module No.	Topic	No. of Practical Classes
1	Concentration of proteins through ammonium sulphate & acetone precipitation	1
2	Estimation of proteins by Bradfords method.	1
3	Molecular weight determination of proteins by SDS PAGE.	1
4	Dialysis and Native PAGE of protein.	1
5	Purification of proteins through three phase partitioning ion exchange chromatography & affinity chromatography.	1
6	Determination of proteins based biomarkers in abnormal celles.	1
<b>Total</b>		<b>6</b>

**Module 2- Genomics I**

**Contents:**

Topic No.	Topics and Details	Theory
1	The biochemical basis of inheritance, DNA as the genetic material, the central dogma	1
2	DNA structure, mRNA, tRNA	1
3	Denaturation and renaturation of DNA, Tm; GC content from Tm. Renaturation kinetics of DNA and complexity of DNA, Cot curves	1
4	Nucleotide sequence composition: unique, middle and highly repetitive DNA; Redundant DNA	1
5	Nuclear organization: Chromosomal DNA and particles, nucleosomes. Modern Concept of gene organization.	1
6	Chromosomal replication, synthesis and processing (DNA replication Enzymology of DNA replication),	1

7	Genetic code	1
8	Gene mutation: Types of mutations, Molecular mechanism of mutations Chromosomal mutations: changes in the structure of chromosome and changes in number of chromosomes, polyploidy	2
9	DNA damage and repair mechanisms.	2
10	Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, extra chromosomal DNA and its functions, regulation of gene expression.	2
11	Transcription and translation machinery in prokaryotic and eukaryotic system. Post transcriptional regulation Splicing, Alternative splicing Post-transcriptional gene silencing	2
<b>Total</b>		<b>15 lect.</b>

**Practicals:**

Sr. No.	Topic	No. of Practical Classes
1	Isolation of nuclei and analysis of chromatin	1
2	Isolation of DNA	1
3	Isolation of yeast RNA	1
4	Spectrophotometric assessment of purity (260 : 280 ratio)	1
5	Thermal melting of DNA	1
6	Electrophoresis of DNA	1
<b>Total</b>		<b>6</b>

**Module 3- Outlines of Metabolism with Inherited Disorders.**

**Contents:**

Topic No.	Topics and Details	Theory
1	<p>Carbohydrate Metabolism:</p> <p>Digestion and absorption of carbohydrates: Role of glucose transporters. EM pathway, R-L-Cycle, TCA cycle HMP shunt pathway: G-6-PD deficiency Gluconeogenesis , Cori's cycle, Glucose alanine cycle. Glycogen metabolism, Glycogen storage disease Diabetes Mellitus, Renalglycosuria Lactose intolerance, essential pentosuria, fructose intolerance. Mucopolysaccharidosis (MPS).</p>	3
2	<p>Lipid Metabolism :</p> <p>i. Digestion, absorption of lipids Malabsorption, Steatorrhea</p> <p>ii. Oxidation of fatty acids – Zellweger's syndrome, Refsum's disease Biosynthesis of fatty acids</p> <p>iii. Synthesis of triacyl glycerols and Adipose tissue metabolism, Fatty liver, lipid storage diseases, Mucolipidosis Lipoprotein metabolism and Hyperlipoproteinemia, Abeta lipoproteinemia, Tangier's disease</p> <p>iv. Cholesterol metabolism and Regulation. Hypercholesterolemia, Atherosclerosis</p>	3

3	<p>Protein metabolism :</p> <ul style="list-style-type: none"> <li>i. Digestion and Absorption of proteins Reactions of amino acid (Transamination, deamination, carboxylation, transmethylation, decarboxylation)</li> <li>ii. Ammonia Metabolism and ammonia toxicity Urea cycle, its regulation and disorders</li> <li>iii. Metabolism of aromatic amino acids and their disorders (PKU, alkaptonuria, Tyrosinemia, albinism, Hartnup disease)</li> <li>iv. Metabolism of sulphuric containing amino acids and disorders (Homocystinuria, cystinuria, cystinosis)</li> <li>v. Metabolism of Glycine, serine and specialized products formed from Glycine, Glycinuria.</li> <li>vi. Metabolism of branched chain amino acids and Maple syrup urine disease.</li> </ul>	3
4	<p>Purine and Pyrimidine Metabolism</p> <ul style="list-style-type: none"> <li>i. Denovo Synthetic of purines, Salvage pathway Catabolism of purine</li> <li>ii. Gout, Lesch nyhansyndrome</li> <li>iii. Pyrimidine metabolism, Orotic aciduria, Reye's syndrome</li> <li>iv. Adenosine deaminase deficiency</li> </ul>	2
5	<p>Hb Metabolism</p> <ul style="list-style-type: none"> <li>i. Structure of Hb, Hb variants, Thalassemia, Sickle-cell anemia</li> <li>ii. Synthesis and breakdown of Hb</li> <li>iii. Porphyria and Hemophilia, Jaundice, Crigler-Najjar syndrome I &amp; II, Gilbert's syndrome.</li> </ul>	2



6	Other Genetic disorders i. Mitochondrial DNA diseases ii. Cystic fibrosis iii. Duchene muscular dystrophy iv. Alzheimer's disease Colour blindness, Retinitis pigmentosa, Glaucoma and cataract.	1
7	Minerals, Haemochromatosis, Wilson disease, Neuroferritinopathy	1
<b>Total</b>		<b>15 lect</b>

**Practicals :**

Sr. No.	Topic	No. of Practical Classes
1	Estimation of glucose	1
2	Determination of lipid profile	1
3	Estimation of Urea	1
4	Estimation Creatinine	1
5	Estimation Uric acid	1
6	Estimation of Iron	1
7	Estimation of Hemoglobin	
<b>Total</b>		<b>6</b>

#### Module 4- Instrumentation and Molecular Diagnostics

##### Contents:

Topic No.	Topics and Details	Theory
1	<b>Basic Techniques</b> Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis; Ultrafiltration, Centrifugation, Chromatography and other membrane techniques.	1
2	<b>Spectroscopy Techniques</b> UV, Visible and Raman Spectroscopy; Theory and application of Fluorescence; MS, NMR, PMR & ESR.	2
3	<b>Radioactivity</b> Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Brief idea of radiation dosimetry; Autoradiography; Applications of isotopes: Radiotracer techniques; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.	2
4	Flow Cytometer	1
5	i. Size analysis of nucleic acids- Direct analysis of nucleic acids for diagnosis of Rotaviral diarrhea, HPV for cervical cancer, Dystrophin gene for muscular dystrophy. ii. DNA probe based diagnosis of diseases Preparation of DNA probes, labels for DNA probes, oligonucleotide probes, DNA probes assays & applications.	2
6	Detection of Genetic diseases. i. Extraction of Nucleic acid from clinical samples. ii. Prenatal diagnosis of genetic diseases iii. RFLP iv. ARMS PCR for detection of mutation	4

7	Detection of Genetic variance.	
	i. SNP detection by different methods (simple and high throughput methods)- RFLP, Taqman Assay, Mass spectroscopy.	
	ii. Temperature Gradient Capillary electrophoresis (TGCE)	
	iii. Single Stranded Conformational Polymorphism (SSCP)	
<b>Total</b>		<b>15 lect</b>

### Practicals

Sr. No.	Topic	No. of Practical Classes
1	Centrifugation	1
2	Estimation of proteins by spectrophotometry (at 280 nm)	1
3	Column chromatography	1
4	Demonstration of HPLC	1
5	Flow cytometry demonstration	1
6	Demonstration of SNP analysis by RFLP and Taqman assay.	2
<b>Total</b>		<b>6</b>

Semester III:- Advanced Molecular Biology

Module 1- Proteomics II

Contents:

Topic No.	Topics and Details	Theory
1	Introduction to structural and functional proteomics, protein interactions underlying cell function.	1
2	Structure- function relationship of proteins.  i. Protein domains within a protein with independent function ; eg : IgG, Leucine Zipper, Zinc finger DNA binding motif.  ii. Protein binding sites & protein subunits in large protein molecules; eg: - Troponin, Hemoglobin, Immunoglobulin, Prokaryotic RNA polymerase.  iii. Effect of protein modification & cleavage eg: Caspases, fibrinogen, Prothrombin, histones, mammalian cytochrome C.  iv. Importance of 3D- structure of proteins on its functions; eg: Aquaporins, HIV reverse transcriptase.	3
3	Protein – Ligand interactions:  i. Protein binding to small molecules & ions : Oxygen eg: Myoglobin, Hemoglobin, Calcium activation of troponin, modification of enzymes by binding to cofactors and coenzymes.  ii. Protein- receptor; Protein- Nucleic acid interaction : --G protein receptor interaction and activation -Histone binding to DNA, Prions  iii. Allosteric changes in protein conformation due to ligand binding (eg : in metabolic pathways)  iv. Structural and functional changes in proteins driven by phosphorylation. eg : Tyrosine kinase, Protein kinase.	2

4	Complementary interactions between proteins and ligands eg : Immune system  i. Antigen - Antibody ii. T cell – T cell Receptor iii. Interaction with MHC class I & II antigens.	2
5	Protein interactions modulated by chemical energy: Actin, Myosin.	2
6	Protein engineering: basic concepts for designing a new protein, Energy status of protein molecule, , protein crystallization, X-Ray Crystallography for determination of protein structure,	2
7	SPDBV & Docking study using ArgusLab.	2
8	Application of Proteomics: Protein expression profiling, protein chips, application of Proteome analysis to drugs, Ab-Microarray, Tissue – Microarray	1
<b>Total</b>		<b>15 lect</b>

**Practicals:**

Sr. No.	Topic	No. of Practical Classes
1	Protein crystallization.	1
2	2- D gel electrophoresis of proteins	1
3	Measurement of glycosylation in glycosylated protein	1
4	Chemical modification of proteins <i>in vitro</i> & functional studies.	1
5	Immobilization of proteins.	1
6	Demonstration of Antibody Microarray.	1
<b>Total</b>		<b>6</b>

## Module 2- Genomics II

### Contents:

Topic No.	Topics and Details	Theory
1	Introduction to recombinant DNA technology Enzymes used in recombinant technology Bacteriophage derived vectors in recombinant DNA: Lambda vectors, cosmids, Phagemids/M13 vectors- Principle/strategies of construction and applications. Yeast vectors and cloning in yeast	3
2	Restriction modification systems in Bacteria; F factor and conjugation Transformation; Viruses: Generalized and Specialized transduction	2
3	Transposable elements; expression vectors; shuttle vectors	1
4	Design of Cloning and expression vectors The construction of cDNA and genomic libraries	1
5	The labeling of DNA with radionucleotides The screening of libraries: Oligonucleotide, cDNA and antibody probes	1
6	Restriction mapping; Chromosome walking and chromosomal localization of genes RFLP and other uses of cloned sequences micro cloning; DNA fingerprinting	2
7	Site-directed mutagenesis and molecular chimeras	1
8	Gene therapy for human diseases-molecular	1
9	Recombinant DNA products applications: Insulin, hepatitis B antigen vaccine, growth hormones	2
10	DNA Microarray, Blotting techniques SAGE.	1
<b>Total</b>		<b>15 lect</b>

**Practicals:**

Sr. No	Topic	No of Practical classes
1	Endonuclease digestion of nuclei, (RFLP) and	1
2	Analysis of DNA fragments by agarose gel electrophoresis	1
3	DNA Isolation from peripheral blood lymphocytes,	1
4	Polymerase Chain Recation (PCR)	1
5	Demonstration on Northern & Southern blotting & Microbiology	2
<b>Total</b>		<b>6</b>

**Module 3- Metabolic Engineering**

**Contents:**

Topic No.	Topics and Details	Theory
1	Introduction to metabolic engineering, Coordination of metabolic reactions: Feedback inhibition, Multigene networks, methods for metabolic characterization: Genome, Transcriptome, Proteome, Metabolome, Fluxome.	3
2	Different model of cellular reaction, Stoichiometry of cellular reactions, Reaction rates, Dynamic mass balance. Regulation of metabolic pathways: Regulation of Enzymatic Activity, Regulation of Enzyme concentration, metabolic pathway manipulation.	3

3	Metabolic flux analysis: Over determined and undetermined systems, Sensitivity analysis, Metabolite Balancing, Tracer Experiments, MS and NMR in labelling measurement, Applications of metabolic flux analysis.	3
4	Metabolic control analysis (MCA): Determination of Flux control coefficients, MCA of Linear and Branched pathways. Metabolic design: Gene amplification, Gene-disruption, Randomized and targeted strain development.	3
5	Metabolic Engineering in Practice: Actual examples from research and industrial biotechnology	3
<b>Total</b>		<b>15 lect.</b>

#### Practicals

Sr. No	Topic	No of Practical classes
1	Modulation of metabolic enzyme	2
2	Statin inhibition of HMG CoA reductase & its interpretation	2
3	Modification of metabolic network	1
4	Demonstration of cell signalling	1
<b>Total</b>		<b>6</b>

#### Module 4- Bioinformatics & Computational Biology

Contents:



Topic No.	Topics and Details	Theory
1	Introduction to Genomic data and Data Organization: Sequence Data Banks – Introduction to sequence data banks – Protein sequence data bank. NBRF-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank – GenBank, EMBL nucleotide sequence data bank, AIDS virus sequence data bank, Structural databanks – protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank – Metabolic pathway data : Microbial and Cellular Data Banks.	2
2	Sequence analysis: 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.	1
3	Secondary Structure prediction (Proteins)s; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. Tertiary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking	2
4	Cluster analysis; Phylogenetic clustering by simple matching coefficients; Sequence Comparison; Sequence pattern; Regular expression based pattern; Theory of profiles and their use in sequence analysis; Markov models; Concept of HMMS; Baum-Welch algorithm; Use of profile HMM for protein family classification; Pattern recognition methods, Neighbor Joining	2
5	Applications in Biotechnology:Primer Designing, Phylogenetic Tree Analysis with Mammalian and Bacterial 9-10 specific genes, development of specific case studies of that	2
6	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	2

7	Goals of a Microarray experiment; Normalization of Microarray data; Detecting differential gene expression; Principal component analysis; Clustering of microarray data; Structure determination by X-ray crystallography; NMR spectroscopy; PDB (Protein Data Bank) and NDB (Nucleic Acid Data Bank); File formats for storage and dissemination of molecular structure	2
8	Probabilistic models and machine learning; Gene annotation and evolution	1
9	Horizons The Future: Protein Structure, The Future: Haplotype Mapping	1
<b>Total</b>		<b>15 lect.</b>

**Practicals:**

<b>Sr. No</b>	<b>Topic</b>	<b>No of Practical classes</b>
1	Demonstration of protein Data Bank	2
2	NCBI and other sites for nucleic acids data bank.	
3	Docking studies using ArgusLab.	2
3	Programmes related to graphics and animation, RASMOL, MOLMOL, MX VRML etc.	2
<b>Total</b>		<b>6</b>

Semester IV :- Applied Molecular Biology

Module 1- Molecular Diagnostics & Nanobiotechnology

Contents:

Topic No.	Topics and Details	Theory
1	Introduction: Application of Nucleic acid analysis techniques in Diagnostics.	1
2	iii. Size analysis of nucleic acids- Direct analysis of nucleic acids for diagnosis of Rotaviral diarrhea, HPV for cervical cancer, Dystrophin gene for muscular dystrophy. iv. DNA probe based diagnosis of diseases Preparation of DNA probes, labels for DNA probes, oligonucleotide probes, DNA probes assays & applications.	2
3	Detection of Genetic diseases. v. Extraction of Nucleic acid from clinical samples. vi. Prenatal diagnosis of genetic diseases vii. RFLP viii. ARMS PCR for detection of mutation	2
4	Detection of Genetic variance. iv. SNP detection by different methods (simple and high throughput methods)- RFLP, Taqman Assay, Mass spectroscopy. v. Temperature Gradient Capillary electrophoresis (TGCE) vi. Single Stranded Conformational Polymorphism (SSCP) vii. Multiplex PCR	4
5	Introduction to Nanotechnology and nanobiotechnology Characteristic scale for quantum phenomena, nanoparticles, nano-clusters, nanotubes, nanowires and nanodots. Nano-biointerface issues in the functionalization of devices.	2

6	Various biological systems for synthesis of nanoparticles, Mechanism of synthesis of Nanoparticles in biological system. Purification of nanoparticles, Interaction between nanomaterials & biological system, protein and DNA based nano structure, nanoself assembly.	2
7	Nanofabrication as material characterization, study of size, shape, & stability of nanoparticle, Nanolithography, X-ray, diffractions, UV-Spectrum, SEM/TEM, AFM, Scanning tunneling microscope. Applications of Nanotechnology to Medicine and Diagnostics. Nanotoxicology and ethics of nanotechnology and nanobiotechnology	2
<b>Total</b>		<b>15 lect</b>

**Practicals:**

Sr. No	Topic	No of Practical classes
1	Demonstration on use of DNA probes for diagnosis of diseases	1
2	Demonstration of SNP analysis by RFLP	1
3	Demonstration of SNP analysis by Taqman assay.	1
4	Synthesis of Nanoparticles, using biological system and others	1
5	Toxicity study of silver nanoparticle	1
6.	Anti bacterial activity of nanoparticle	1
<b>Total</b>		<b>6</b>

Module 2- Bioethics, Biosafety, IPR & Technology transfer

Contents:

Topic No.	Topics and Details	Theory
1	Introduction to bioethics - Development of an interdisciplinary field, Medical ethics, Purpose and scope.	1
2	Biosafety 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	3
3	History and Evolution of IPR, basic Principles and Acquisition of Intellectual Property Rights, Basic Principles of Patent Law, Patent Application procedure, drafting of a Patent specification, understanding Copyright Law, Trade Mark, Design, Rights, International Background of Intellectual Property.	3
4	Requirement of patentable novelty, invention step and prior art, Budapest treaty, biodiversity, biotechnology and the Law-Objective, Structure of Gene/molecular Techniques, Commercial Potential of Biotech Inventions, Patenting Biotechnology Inventions-Objective, Microorganisms, Moral Issues in Patenting Biotechnological inventions. Traditional Knowledge, Plant Varieties Protection, Bio-Propecting and Bio-Piracy, need for a Sui-Generis regime, Digital Library, Indian patent system as POST Trips effect.	3

5	Patent Protection. Database and Data Protection-Objective, International conventions on IPR, WIPO Treaty, disputes under Intellectual Property Rights, Jurisdictional Issues, and Right & protection , infringement and violation, remedies against infringement, Case studies.	3
6	Discovery and bioprocess innovation, Patent claims and rights, and patent transfer, Introduction to technology transfer, transfer process and law.	2
<b>Total</b>		<b>15 lect.</b>

**Practicals:**

Sr. No	Topic	No of Practical classes
1	Dissertation Thesis / Appropriate case studies in IPR	

**Module 3 & 4 : PROJECT CONDUCTION**

The M.Sc. student is required to register for project /dissertation 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. Molecular Biology

### 1. Theory

Didactic Lectures + Seminars should be **120 Hours**

### 2. Practicals/s

Experimental Laboratory +Tutorial+ Demonstration should be **80 Hours**

### Examination Pattern (For first 03 semesters)

1. There should be two papers in Each Semester.
2. Module 1 & 2 should be covered in Paper I. Module 3 & 4 should be covered in Paper II.
3. Paper pattern should be the same as what was decided in the last Board of Studies meeting. Which is as follows:-

**Existing 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

### 4. Theory Marks Distribution

#### A. Theory Marks - 120 Marks

Paper I	60 Marks
Paper II	60 Marks
<b>Total Marks</b>	<b>120 Marks</b>

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04/03/2017

### B. Theory Internal Assessment Marks - 20 Marks

Attendance (T+P)	10 Marks
Prefinal or Midterm (T+P)	5 Marks
Seminar	5 Marks
Total Marks	20 Marks

- Total A (Theory Marks) + B (Theory Internal Assessment Marks) = 140 Marks  
i.e. Internal Assessment of Theory should be added to total Theory Paper Marks.

### 5. Practical Marks Distribution

#### C. Practical Experiments - 50 Marks

Experiment No.1	20 Marks
Experiment No.2 or Station Exercise	20 Marks
Viva	10 Marks(5+5)
Total	50 Marks

#### D. Practical Internal Assessment - 10 Marks

Journal	5 Marks
Prefinal or Midterm	5 Marks
Total	10 Marks

- Total C (Practical Marks) + D (Practical Internal Assessment Marks) = 60 Mark  
i.e. Internal Assessment of Practical should be added to total Practical Paper Marks.
- **Grand Total:** A (Theory Marks) + B (Theory Internal Assessment Marks) + C (Practical Marks) + D (Practical Internal Assessment Marks) = 200 Marks

### Examination Pattern (For 04th semester)

1. There should be one paper (Paper I) and Project/Dissertation work in 4<sup>th</sup> Semester.
2. Module 1 & 2 should be covered in Paper I.
3. No Paper II in 4<sup>th</sup> Semester. Instead of that Module 3 & 4 will be Project/Dissertation work.
4. Paper pattern should be the same as what was decided in the last Board of Studies meeting.  
Which is as follows:-

**Existing 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

## 5. Theory Marks Distribution

### A. Theory Marks - 60 Marks

Paper I	60 Marks
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### B. Theory Internal Assessment Marks - 10 Marks

Attendance (T+P)	5 Marks
Prefinal or Midterm (T+P)	2.5 Marks
Seminar	2.5 Marks
Total Marks	10 Marks

- Total A (Theory Marks) + B (Theory Internal Assessment Marks) = 70 Marks  
i.e. Internal Assessment of Theory should be added to total Theory Paper Marks.

## 6. Practical Marks Distribution

### C. Practical Experiments - 25 Marks

Experiment No.1	10 Marks
Experiment No.2 or Station Exercise	10 Marks
Viva	5 Marks
Total	25 Marks

#### D. Practical Internal Assessment – 05 Marks

Journal	2.5 Marks
Prefinal or Midterm	2.5 Marks
Total	05 Marks

- Total C (Practical Marks) + D (Practical Internal Assessment Marks) = 30 Mark  
i.e. Internal Assessment of Practical should be added to total Practical Paper Marks.
- No Paper II in 4<sup>th</sup> Semester. Instead of that Module 3 & 4 will be Project/Dissertation work of 100 marks.
- **Grand Total:** A (Theory Marks) + B (Theory Internal Assessment Marks) + C (Practical Marks) + D (Practical Internal Assessment Marks) + Project/Dissertation work = 200 Marks
- **Project/Dissertation work:-**  
M.Sc. Molecular biology student should submit a suitable project/dissertation topic forwarded by the guide to the School of Biomedical Sciences by 16<sup>th</sup> September in III Semester of the course. Following approval of ethics & scientific committee, work should be carried out in IV Semester. Completed project/dissertation should be submitted in IV semester as per the norm of university. Project//dissertation will be total of 100 marks.
- **EACH CANDIDATE APPEARS FOR 200 MARKS IN EACH SEMESTER.**
- **Passing Criteria :** As per MGMIHS Rules.
- **Infrastructure required :** Facility available with OMICS laboratory & Central Research Laboratory will be utilized.
- **Teaching staff from following departments**
- **Visiting Faculty needed.**

*Handwritten signature and date:*  
16/03/2017

**Resolution passed in BOM – 48/2017, dated 24/01/2017**

**Resolution No. 5.25:** Resolved to institute 6 monthly progress Report for PG Students of all Courses from the batches admitted in 2016-17. **[Annexure-XVII of BOM-48/2017]**

All M.Sc. medical  
courses

**Resolution No. 1.3.14.13 of BOM-51/2017:** Resolved to include "IPR and Bioethics" module in all B.Sc. (AHS) courses based on annual pattern in 1<sup>st</sup> year, M.Sc. (2 yr courses) in 4<sup>th</sup> semester and M.Sc. (3 yr courses) in 6<sup>th</sup> semester as an elective subject from batch admitted in 2017-18 onwards. **Annexure-XXXV**

Annexure 10.1

MSc Elective Module - Bioethics, IPR & Technology transfer

Contents:

Topic No.	Topics and Details	Theory
1	<b>Bioethics:</b> Bioethical issues related to Healthcare & medicine Food & agriculture Genetic engineering, Disposal of investigative material, integrity, Internet ethics, Human dignity, Privacy and confidentiality, Risk minimization, Drug information services, Animal ethics	6
2	<b>Introduction to Intellectual Property:</b> Concept of Intellectual Property Kinds of Intellectual Property Patents, Copyrights, Designs, Trademarks, Geographical Indication, Infringement of IPR, Its protection and Remedies Licensing and its types	3
3	<b>International Scenario:</b> Introduction to the leading international instruments concerning intellectual property rights, The Berne Convention, GATT, WTO, Indian Patent Act, Universal Copyright Convention, The Paris Convention, TRIPS, The World Intellectual Property Rights Organization (WIPO), Budapest treaty.	3
4	<b>Patents:</b> Requirement of patentable novelty, Inventive step, Prior art Classifying products as patentable and non-patentable Procedure for applying for patent, Patent Infringement and related case studies, Biological Patentability	3
<b>Total</b>		<b>15 lect.</b>

Reference books:

1. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
2. Intellectual Property Right- Wattal- Oxford Publication House.(1997) ISBN:0195905024.
3. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10. 0028657748
4. Contemporary issues in bioethics – Beauchamp & Walters (B&W ) 4<sup>th</sup> edition.
5. Classic philosophical questions by Gloude (8<sup>th</sup> Edition)
6. Case book series and booklets by UNESCO Bioethics Core curriculum 2008

BSc Elective Module – Bioethics & IPR

Contents:

Topic No.	Topics and Details	Theory
1	<b>Introduction to Bioethics</b> Bioethical issues related to Healthcare & medicine .	1
	<b>Anatomy</b> - Cadaver ethics. Human dignity, PNDT, Disposal of cadaver	1
	<b>Physiology</b> - Animal ethics. Health policy privacy	2
	<b>Biochemistry &amp; Pathology</b> - Prudence of investigation confidentiality, Patients bill of rights. Disposal of investigative material, Integrity, Blood transfusion	3
	<b>Pharmacology</b> - Rational drug prescribing, Clinical trials, Risk minimization, Animal ethics	3
	<b>Microbiology</b> - Hand wash, Drug resistance minimization, Prudence of investigation confidentiality, Sterilization procedure, Biosafety and bio hazard	2
2	<b>Introduction to Intellectual Property:</b> Concept of Intellectual Property Kinds of Intellectual Property Patents Copyrights Designs Trademarks Geographical Indication Infringement of IPR Its protection and Remedies Licensing and its types	3
<b>Total</b>		<b>15 lect.</b>

Reference books

1. Contemporary issues in bioethics – Beauchamp & Walters (B&W) 4th edition.
2. Classic philosophical questions by Glou (8<sup>th</sup> Edition)
3. Case book series and booklets by UNESCO Bioethics Core curriculum 2008
4. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748
5. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
6. Intellectual Property Right- Wattal- Oxford Publication House.(1997) ISBN:0195905024.

**Resolution passed in BOM – 48/2017, dated 24/01/2017**

**Item No. 5.11: BOS (Biomedical Sciences) dated 16.09.2016**

**Resolution No. 5.11**

- g) Regarding induction of project/dissertation work in the 4<sup>th</sup> semester of ongoing M.Sc. Molecular Biology programme, it was recommended to start project/ dissertation work during the end of 3<sup>rd</sup> semester, so that students can finish their dissertation work in the 4<sup>th</sup> Semester. It was further recommended to follow the same pattern in Biotechnology and Genetics courses.

**Resolution No. 5.11(g):**

- (i) It is resolved to incorporate project work during the 3<sup>rd</sup> semester of M.Sc., (Molecular Biology), so that students can finish their project in the 4<sup>th</sup> Semester of the 2 years M.Sc. (Molecular Biology) course. [Annexure-XXX of BOM-48/2017].
- (ii) It is resolved that the submission of “project synopsis” and “final project” will be as per MGMIHS Timeline & fees chargeable for submission of dissertation/thesis/project. [Annexure-VI of BOM-48/2017].
- (iii) It is resolved to approve the IV semester M.Sc. (Molecular Biology) examination heads with marks distribution [Annexure-VII of BOM-48/2017].

## ANNEXURE - VII

## MGM Institute of Health Sciences, Navi Mumbai

Department of Molecular Biology  
MGM Institute's University Department of Biomedical Sciences  
IV<sup>th</sup> Semester M.Sc. Molecular Biology Exam Result Format (Proposed)

	Paper -I		Project/ Dissertation Work (100)	Total (200)
	Theory + IA (60+10 = 70)	Practical + IA (25+05 = 30)		
Passing Head	35	15	50	-

Where,  
IA- Internal Assesement

Yadav  
01/02/2019

(Dr. RAMAN B. YADAV)

D



**Resolution No. 1.3.7.11 (i) of BOM-51/2017:** Resolved that the following Bioethics topics in PG Curriculum are to be included for PG students of all specialization and a sensitization of these topics can be done during PG Induction programme:

- Concept of Autonomy
- Informed Consent
- Confidentiality
- Communication Skills
- Patient rights
- Withholding / Withdrawing life-saving treatment
- Palliative Care
- Issues related to Organ Transplantation
- Surgical Research and Surgical Innovation
- Hospital Ethics Committee
- Doctor-Patient relationship

**Resolution No. 1.3.14.10 of BOM-51/2017:** Resolved to undertake Industrial visits as Career Provision for all students pursuing M.Sc.(2 yr & 3 yr) courses. [Annexure-XXXIV]

Annexure 7.3

Industrial visits/hospital visit for M.Sc Medical approved by the BOS members and to be included in the existing syllabus and should be implemented in the new academic year.

Industrial visit	
Course	Criteria
MSc - 2 year/3 year Medical MSc courses	<ul style="list-style-type: none"><li>• Final year students</li><li>• 1 week program</li><li>• Visit to 2/3 Govt. recognized research institutes / Industries / hospitals.</li><li>• Within or out of state</li><li>• Cost to be borne by the students</li><li>• Two faculty to accompany students</li></ul>

Muller

Resolution No. 1.3.23 of BOM-51/2017: Resolved to implement a Structured Induction programme (07 days) for PG students. [Annexure-XLIV]



MGM INSTITUTE OF HEALTH SCIENCES  
Navi Mumbai

Induction Program for newly admitted Postgraduate students

Day 1	<ul style="list-style-type: none"> <li>• Address by Dean, Medical Suptd, Director (Academics)</li> <li>• Pre-test</li> <li>• Communication Skills</li> <li>• Universal Safety Precautions</li> <li>• Biomedical Waste Management</li> <li>• Infection Control Policy</li> </ul>
Day 2	<ul style="list-style-type: none"> <li>• Emergency services</li> <li>• Laboratory services</li> <li>• Blood Bank services</li> <li>• Medicolegal issues</li> <li>• Prescription writing</li> <li>• Adverse Drug Reaction</li> <li>• Handling surgical specimens</li> </ul>
Day 3	<ul style="list-style-type: none"> <li>• Principles of Ethics</li> <li>• Professionalism</li> <li>• Research Ethics</li> <li>• Informed Consent</li> <li>• Confidentiality</li> <li>• Doctor-Patient relationship</li> </ul>
Day 4	<ul style="list-style-type: none"> <li>• Research Methodology</li> </ul>
Day 5	<ul style="list-style-type: none"> <li>• Synopsis writing</li> </ul>
Day 6	<ul style="list-style-type: none"> <li>• Dissertation writing</li> <li>• Statistics</li> </ul>
Day 7	<ul style="list-style-type: none"> <li>• ATLS</li> <li>• Post-test</li> </ul>

The Induction Program will be conducted in the first week of June.  
Timing: 9.30 am to 3.30 pm

(Prof. Dr. Siddharth P. Dubhashi) -  
Director (Academics)

**Resolution No. 1.3.14.3 of BOM-51/2017:** Resolved to approve the List of Textbooks for B.Sc. Paramedical Courses / M.Sc. Molecular Biology. [~~Annexure-XXXI~~]

## Annexure 5.3

<b>B.Sc First Year</b>		
<b>Subject</b>	<b>Book Name</b>	<b>Author</b>
<u>Anatomy</u>	Manipal Manual of Anatomy for Allied Health	Sampath Madhyastha
<u>Physiology</u>	<u>Basics of Medical Physilogy</u>	D. Venkatesh,HH Sudhakar
<u>Biochemistry</u>	<u>Essentials of biochemisrty</u>	Mr.Pankaj Kamble
<u>Microbiology</u>	<u>Text book of microbiology for Nurses</u>	<u>Anand Narayan Panikar</u>
	<u>Medical Microbiology</u>	<u>P.v-Bhaveja</u>
<b>CARDIAC TECHNOLOGY Seond Year</b>		
<b>Subject</b>	<b>Book Name</b>	<b>Author</b>
anatomy Physiology & Pathology	Anatomy& Physiology	rose& wilson
	anatomy& Physiology	Singh
	Cardiovascular Physiology	AchillesJ. Papano Gil Wier
	Human anatomy	Chaurasia
	Manipal Manual of Anatomy for Allied Health	
Cardiac Diseases & Its management	Practical Cardiology-Evaluation and Treatment of Common Cardiovascular Diseases	Raghavendra A. Baleja, Kim A Eagle
Investigations & Equipments in Cardiology	Cardiac Nursing	Elaine Coady
	Introduction to Medical Surgical Nursing	Black & Joys
	Text Book of Medical Surgical Nyrsing	Brunner & Siddharth
	The ECG in Practice	Hampton
<b>CARDIAC TECHNOLOGY Third Year</b>		
<b>Subject</b>	<b>Book Name</b>	<b>Author</b>
Cardiac invasive care and emergencies	Procedure Manuel For Critical Care	Dabra Lynn; Mchale Wiegenc
Cardiac diseases and invasive management	Pocket Companion of Critical care Nursing	Shaila malander
Investigations and equipments in invasive cardiology	Principles of Critical Care	Udwalia

	Cardiovascular Nursing - Management for Positive Outcomes	Mary Lucila & Aleyamma Eapen
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Perfusion Technology		
Second Year		
Applied Pharmacology	Pharmacology for Physiotherapy	Padmaja Uday Kumar
	Pharmacology for Nurses	Padmaja Uday Kumar
Applied Anatomy	Anatomy & Physiology	rose & wilson
Applied Physiology & Biochemistry	anatomy & Physiology	Singh
	Cardiovascular Physiology	Achilles J. Papano Gil Wier
	Human anatomy	Chaurasia
Perfusion Technology-Part I	quick Review , Clinical Perfusion Book	Stephen Bhore
	Cardio pulmonary Bypass - Surgical and Clinical Orientation	Dr. Anil G. Tendolkar
Third Year		
Subject	Book Name	Author
Perfusion Technology-Clinical	Cardiovascular Nursing - Management for Positive Outcomes	Mary Lucila & Aleyamma Eapen
Perfusion Technology-Applied	Mechanical Ventillation - Clinical applications	Vijay Deshpande T.R. Chandrashekhar
Perfusion Technology-Advanced	Cardiopulmonary Bypass , Principles and Practices , 3rd Edition	Glenn, Richerd, Alfred Ross

<b>Dialysis technology</b>		
<b>Second Year</b>		
Subject	Title	Auther
Applied Pathology	Text Book of pathology	Dr. Preeti Gupta
Conceptof Renal Discases	Introduction to Medical Surgical Nursing	Black & Joys
	Text Book of Medical Surgical Nursing	Brunner & Siddharth
	Urology Nursing , 3rd edn	lillingham Dirglar
Applied Pharmacology	Pharmacology for Physiotheray	Padmaja Uday Kumar
	Pharmacology for Nurses	Padmaja Uday Kumar
<b>Third Year</b>		
Subject	Title	Auther
Dialysis tcchliques , Paper I&II	Principles of Dialysis for Nurses&Dialysis Personnels	Zudith Z. Kallanbach
	Urology Nursing , 3rd edn	lillingham Dirglar



<u>Optometry Technology</u>		
<u>Second Year</u>		
Ocular Anatomy, Physiology Biochemistry & Pharmacology	Ocular Anatomy Physiology	basakh
	Pharmacology for Physiotherapy	Padmaja Uday Kumar
	Pharmacology for Nurses	Padmaja Uday Kumar
Optics-Physical & Physiological	Mnual of optics and Refraction	P.K. Mukherjee
	Clinical Examination in Ophthalmology	P.K. Mukherjee
	Theory & Practices of Optics and Refraction	A.K. Khurana
Common eye diseases and Ocular Pharmacology	Introduction to Medical Surgical Nursing	Black & Joys
	Text Book of Medical Surgical Nyrsing	Brunner & Siddharth
Clinical Optometry Visual & Dispensing	The Contact lense Manual - A Practical Guide to Fitting , 4th edn	Andrew Gasson, Judith Morris
	Ophthalmic Lenses and Dispensing	Mo Jolie
<u>Third Year</u>		
Subject	Book Name	Author
Community Eye health & Eye Banking	Comprehensive Ophthalmology	A.k.Khurana
Clinical Optometry- Orthoptics	Modern System of Ophthalmomlgy, Theory and Practices of Squint and Orthoptics	A.k.Khurana
Clinical Ophthalmic Techniques and dispensing optics	System For Ophthalmic Dispensing ,2nd edn	Borish
	Binocular Vision and Orthoptics - Investigations and Management	Bruce Evans & Sandip Dodhi

A Practical Approach to Obstetric Anesthesia	Curtis, Devid & Brenda Bucklin
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<u>Medical Imaging Technology</u>		
Second Year & Third Year		
For The Subjects in Second & Third Year	Basic radiological Physics	K. Thayalan
	Clarks Positioning In Radiography	steavert whitley,charls sloane,graham, adrian,chrissie
	merrills atlas of radiographic Positioning and Procedures( Vol-I,II,III)	EugeneFrank,Bruce Long,barbara Smith
	MRI /CT Protocol	Dr. Sunil Bhagwat
	Fundamentals of Radiological Physics	K. Thayalan
	Film Processing and Dark Room Practices	K. Thayalan

<u>Medical Laboratory Technology</u>		
Second Year & Third Year		
Biochemistry	Essentials of Biochemistry	Pankaja Naik
	Biochemistry for Physiotherapy& Allied Health Sciences Students	Beena shetty, Nandini M. Vinitha Ramanath Pai
	Practices of Biochemistry	Varley
Pathology	Clinical pathology Heamatology& Blood Banking for DMLT Students ,	Nanda Maheshwari
MicroBiology		
Third Year		
Third Year	Medical Laboratory technology	Mukherjee

Investigative Orthoptics	Essentials of Ophthalmology	Pradeep Sharma
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<u>OT/AT Technology</u>		
<u>Second Year</u>		
Anatomy, Physiology & pharmacology	Physics, Pharmacology and Physiology for Anaesthetists: Key Concepts for the FRCA	Mathew & Emma
	Anatomy for Anaesthetists, 8th Edition	Harold Ellis, Stanley Feldman, William Harrop-Griffiths
Medicine Applied to Anesthesia Technology	Introduction to Medical Surgical Nursing	Black & Joys
	Text Book of Medical Surgical Nursing	Brunner & Siddharth
	Medicine, Prep manual for Undergraduates	George Mathew & Praveen Aggarwal
At/Pt -Part -I	Accidents and Emergency Nursing 4th edn	Walsh & Kent
	manual of Anesthesia and Operation Theatre Technology	S. Ahanatha Pillai
	Fundamentals of Operation Theatre Services	TK Dutta
	Manual of Operation theatre room Techniques	leena Martil Gomez
<u>Third Year</u>		
Subject	Book Name	Author
Operation theatre Techniques	Practicals and Viva In Surgery	S.R. Ghosal
	Manipal Manual of Instruments	Rajgopal Shenoy & anita Nilesliwar
	Surgery for Nurses, 17 th edn	Chintamanio devi
	SRB's Surgeries for Nurses	Ganapathi P.
Anesthesia Techniques	Anesthesiology for Nurses	S. Anantha Pillai
	Lee Synopsis of Anesthesia	Morgan



# 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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