THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI -600 032
REGULATIONS OF THE UNIVERSITY
(Post-graduate Degree course under Allied Health Science)
M. Sc MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) (3 YEARS)

In exercise of the powers conferred by Section 44 of the Tamil Nadu Dr. M.G.R. Medical University, Chennai Act 1987(Tamil Nadu Act 37 of 1987) the Standing Academic Board of the Tamil Nadu Dr. M.G.R. Medical University, Chennai hereby makes the following regulations:-

1. SHORT TITLE AND COMMENCEMENT:-
These regulations shall be called as **"M.Sc – MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE)** of the Tamil Nadu Dr. MGR Medical University, Chennai.

They shall come into force from the academic year 2017-2018
The regulations framed are subject to modification by the Standing Academic board from time to time.

2. OVERALL OBJECTIVES:

1. To provide the course that enables, Graduate with updated exposure in terms of Knowledge and practice in the fields of virology, bacteriology especially having relevance on medical importance.
2. To enable graduates to learn in a highly productive environment that gives then the core and comprehensive skills to deal with diagnostics applied and basic research in the fields of microbiology and microbial biotechnology.

3. ELIGIBILITY FOR ADMISSION:
A degree in Science with one or more branches & Life Sciences of biology at the major or ancillary (subsidiary) levels.

4. AGE LIMIT:
No upper age limit for Admission

5. ELIGIBILITY CERTIFICATE:
Candidates who have passed any qualifying examination as stated in (3) other than the Tamil Nadu Dr. M.G.R. Medical University shall obtain an "Eligibility Certificate" from this University by remitting the prescribed fees along with the application form and required documents before seeking admission to any one of the affiliated institutions. The application form is available in the University website: web.tnmgrmu.ac.in.

6. REGISTRATION:
A Candidate admitted to **M.Sc – MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) UNDER ALLIED HEALTH SCIENCES** in any one of the affiliated institutions of this University shall register his / her name with this university by submitting the prescribed application form for registration duly filled in along with the prescribed fee and a declaration in the format to the Controller of Examinations of this University through the affiliated institution within 3 Months from the cut off date prescribed for the course for admission. The applications should bear the date of admission to the said course.

7. MIGRATION/TRANSFER OF CANDIDATE:

(a) A student studying in **M.Sc –MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) DEGREE COURSE UNDER ALLIED HEALTH SCIENCES** can be allowed to migrate / transfer to another institution of Allied Health Science under the same University.

(b) Migration / Transfer can be allowed to another affiliated institutions under extraordinary circumstances. The Vice - Chancellor has the power to issue Migration / Transfer order.

8. COMMENCEMENT OF THE COURSE:

The course shall commence from **1st September** of the academic year. Cut off date for Admission is **30th September** every year.

9. MEDIUM OF INSTRUCTION:

English shall be the Medium of Instruction for all the Subjects of study and for examinations of the **M.Sc –MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) DEGREE COURSE UNDER ALLIED HEALTH SCIENCES.**

10. CURRICULUM:

The Curriculum and the syllabus for the course shall be as prescribed in these regulations and are subject to modifications by the Standing Academic Board from time to time.

11. DURATION OF THE COURSE:

The duration of certified study for the **M.Sc – MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) DEGREE COURSES UNDER ALLIED HEALTH SCIENCES** shall be **Three** years. The admitted candidates should complete this course within 6 years (double the duration) from the date of joining the course.

12. RE-ADMISSION AFTER BREAK OF STUDY:

The regulations for re-admission are as per the University Common Regulation for Re-admission after break of study for all courses.

13. . WORKING DAYS IN THE ACADEMIC YEAR:

Each academic year shall consist of not less than 270 working days Total No. of working days including (Term day 270 days 85% Attendance) Examination period

14. ATTENDANCE REQUIRED FOR ADMISSION / EXAMINATION:

(a) No candidate shall be permitted to appear in any one of the parts of **M.Sc – MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) DEGREE COURSE UNDER ALLIED HEALTH SCIENCES** Examinations unless he/she has attended the course in the subject for the prescribed period in an affiliated institution recognized by this University and produce the necessary certificate of study, attendance and satisfactory conduct from the Head of the institution.

(b) A candidate is required to put in a minimum of 85% of attendance in both theory and practical separately in each subject before admission to the examinations.

15. CONDONATION OF LACK OF ATTENDANCE:

There shall be no condonation of lack of attendance.

16. INTERNAL ASSESSMENT MARKS:

The Internal Assessment should consist of the following points for evaluation:-

i) Theory

ii)Practical

(a) A minimum of three written examinations shall be conducted in each subject during a year and the average marks of the three performances shall be taken into consideration for the award of Internal Assessment marks.

17. CUT-OFF DATES FOR ADMISSION TO EXAMINATIONS:

1. **30th September** of the academic year concerned for Admission.

2. The candidates admitted up to **30th September** of the academic year shall be registered to take up the **1st year examination during October of the next year**.

18. COMMENCEMENT OF THE EXAMINAITONS:

15th October / 15 April

If the date of commencement of examination falls on Saturdays / Sundays or declared Public Holidays, the examination shall begin on the next working day.

19. MARKS QUALIFYING FOR PASS:

50% of marks in the University Theory Examinations

50% of marks in the Practical with Viva

50% of marks in aggregate in Theory, I.A & oral taken together.

20. REVALUATION / RETOTALLING OF ANSWER PAPERS:

Re - totalling / Revaluation of answer papers is not permitted.

21. VACATION:

There is no vacation

22. SCHEME OF EXAMINATIONS:

First Year

S.NO	SUBJECT TITLE	IA		THEORY	
		Max.	Min.	Max.	Min.
1	General Medical Microbiology (Bacteriology, Virology, Mycology, Parasitology and Immunology)	50	25	100	50
2	Fundamentals of Molecular Biology	50	25	100	50
3	Microbial Genetics, Cell biology and Biochemistry	50	25	100	50
4	Epidemiology, Biostatistics and Medical Ethics	50	25	100	50

Common practical for all papers

Second year

S.NO	SUBJECT TITLE	IA		THEORY	
		Max.	Min.	Max.	Min.
1	Systematic Bacteriology	50	25	100	50
2	Virology and Entomology	50	25	100	50
3	Parasitology and Mycology	50	25	100	50
4	Diagnostic Immunology and Pathology of Infectious diseases	50	25	100	50

Common practical for all papers

Third year

S.NO	SUBJECT TITLE	IA		THEORY	
		Max.	Min.	Max.	Min.
1	Molecular Diagnostics	50	25	100	50
2	Recombinant DNA technology and its applications	50	25	100	50
3	Bioinformatics, IPR and Infection Control	50	25	100	50

Common practical for all papers

Theory Examination Pattern

Duration: 3 hrs Max. Marks: 100

Part – A (2 x 20 = 40) Marks

Part – B (10 X 6 = 60) Marks

	Max.	Min.
Project*	100	50
Viva / Practical	100	50
I. A	50	25

- The Final project should include a molecular work component

Practical's should include the following:

Case Discussion / Flash Card / Spotters / Instruments / Specimens (Where ever it is applicable)

Grading Scheme for Practical examination

Subjects	**Mark Allotment**
Medical Microbiology (Bacteriology, Virology, Mycology, Parasitology), Immunology and Biostatistics	200
Molecular Biology ,rDNA technology abd Bioinformaticsand Biochemistry	100

Examination Scheme – I

Practical exercises	**Mark Allotment**
Bacteriology exercise - Pure culture	30
Bacteriology exercise – Mixed culture	30
Mycology exercise	20
Parasitology exercise	20
Virology exercise	15
Tissue culture and Bio Statistics	15
Major immunology	30
Minor Immunology	20
Spotters	20
Total	**200**

Examination Scheme - II

Practical exercises	**Mark Allotment**
Isolation, quantification and electrophoresis of Nucleic acids (DNA, RNA or Plasmid) and proteins from microbes	30
rDNA technology exercise	20
Biochemistry exercise	20
Bioinformatics exercise	10
Spotters	20
Total	**100**

23. Submission of Project:

1. Project with Compulsory Molecular Component should be in a bound volume of a minimum of 30 - 50 pages of typed in Double line spacing and on one side only.
2. It is mandatory to have the "Molecular research component" in the final research project
3. The Project should be submitted to the Institution 3 months before the Third Year Examination.
4. **T**he student should prepare a PPT presentation of the project at the time of Viva – Voce Examination.

24. Log Book:

Based on the curriculum Log Book to be maintained and the same are periodically, assessed by the HOD and presented at the time of discussion of project in Practical Examination.

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Syllabus

The Syllabi for the various courses are designed keeping in view the usefulness of the course to the students for (1) continuation of academic activity (2) leading to research, (2) employability in bacteriology, virology, microbiology and biotechnology related vocations and (3) self-employment. Academic visits to institutions and or industries related to the courses during the semesters of study will form part of the curriculum.

M.Sc. MICROBIAL MOLECULAR BIOLOGY (BASIC MEDICAL SCIENCE) (3 YEARS)

Course Curriculum

Year	Paper	Name of the Paper	Total Marks
I	I (Theory)	General Medical Microbiology (Bacteriology, Virology, Mycology, Parasitology and Immunology)	100
	II (Theory)	Fundamentals of Molecular Biology	100
	III (Theory)	Microbial Genetics, Cell biology and Biochemistry	100
	IV (Theory)	Epidemiology, Biostatistics and Medical Ethics	100
	V (Practical)	Practical on paper I, II, III, and IV	100
II	VI (Theory)	Systematic Bacteriology	100
	VII (Theory)	Virology and Entomology	100
	VIII (Theory)	Parasitology and Mycology	100
	IX (Theory)	Diagnostic Immunology and Pathology of Infectious diseases	100
	X (Practical)	Practical on paper VI VII, VIII, and	100
III	XI (Theory)	Molecular Diagnostics	100
	XII (Theory)	Recombinant DNA technology and its applications	100
	XIII (Theory)	Bioinformatics, IPR and Infection Control	100
	XIV (Practical)	Practical on paper XI, XII, XIII	100
	XV (Project)	Project (Dissertation submission & VIVA)	200

FIRST YEAR
Paper -I

General Medical Microbiology
(Bacteriology, Virology, Mycology, Parasitology and Immunology)

Unit I

Introduction to Medical Microbiology: History, Koach & River's Postulates, Role of Microbiology in medicine, Classification of medically important microbes, Normal Microbial flora, Infections-source, Mode of transmission, Prevention of medically important microbes, Normal microbial flora, Infections- Source, Mode of transmission, Prevention of medically important microbes.

Unit II

Systematic Medical Bacteriology: Mechanism of Bacterial Pathogenesis of medically important bacteria *Staphylococcus aureus*, Group A Streptococci, Pathogenic Enterobacteriaceae, Vibrio, Nieserriae, Haemophilus influenza, Corynebacterium, Pseudomonas, Chlamydia, Mycoplasma, Anaerobic bacteria & infections, Mycobacterium tuberculosis, Atypical Mycobacterium, Clamadiya, Bacillus, Rickettsia, Zoonotic bacteria, Helicobacter pylori. Laboratory diagnosis of bacterial diseases, Antibiotic sensitivity test. Molecular diagnosis.

Unit III

Mycology and Parasitology: Mechanisms of Fungal Pathogenesis, Superficial and Cutaneous Mycoses. Subcutaneous Mycoses, Systemic Mycoses, Opportunistic Mycoses, Mycotoxicoses, Pathogenesis of Parasitic disease, Antiparasitic agents, Intestinal and Urogenital protozoa, Nematodes, Trematodes, Cestodes and Arthropod. Laboratory diagnosis of mycological and Parasitological diseases.

Unit IV

Viral diseases: Influenza viruses, Measles, Mumps, Chicken Pox, Hepatitis A, B, C, D & E, Poliomyelitis, AIDS, Human Papilloma virus (HPV), Rabies, Yellow fever, Dengue and Japanese Encephalitis. Laboratory diagnosis of viral diseases.

Unit V

Immunology: Introduction and history of immunology, primary and secondary organs of immune system, cells of the immune system, Innate immune system, Complement system, Antibody structure and function, Immunoglobin classes, Major histocompatibility complex, Humoral and cell mediated immunity.

Reference books:

1. Medical Microbiology (2001) by Jawetz, Melnickand Adelberg's 22nd edition McGraw Hill Medical Publication division
2. Medical Microbiology (2000) by David Greenwood, Richard Slack and John Peutherer 15th edition, ChurchHill Living stone Publication.
3. Medical Microbiology (1999) by Anathanarayanan
4. Foundations in Microbiology (2005) by Cathleen park Talaro 6th edition, McGraw Hill Medical Publication division.
5. Microbiology Lab Manual (2007) by John P. Harley 7th edition McGraw Hill Medical Publication division.
6. Microbiology (2007) by Prescott, Harley, Klein's 7th edition McGraw Hill Medical Publication division.
7. Medical Virology, Timbury, Churchill Livingstone Publications, UK.

Paper II

Fundamentals of Molecular Biology

UNIT I: Genome Organisation

Introduction and historical development of molecular biology –DNA structure –primary structure-secondary structure –complimentary base pairing and base stacking, tertiary structure - Supercoiling – Quaternary structure – Concatamer. Genome organisation – repetitive DNA sequence architecture in repetitive DNA satellite DNA – mini –micro Transposons – Concept of genes.

UNIT II: Molecular Events of Replication and Transcription

Central dogma of molecular Biology – DNA replication – Origins of Replication – Enzymes of replication – DNA polymerases – Reverse transcriptase – Ligase, Topoisomerase structure and function. Concurrent synthesis and termination – details in phages, bacteria and eukaryotes. Transcription in eukaryote enhancers, transcription factors, initiation, elongation and termination**.**

UNIT III: Post Transcriptional modifications and translation

Post transcriptional modifications – RNA processing – RNA, tRNA. Structure of mRNA, introns, exons – Eukaryotic mRNA end modifications – 5' capping, structure and function of the 5' cap-3' Polyadenylation structure, biosynthesis and functions of the Poly (A) – mRNA splicing, alternate splicing, RNA editing, Genetic code, tRNA structure, ribosome structure and organization. Translation – Prokaryotes and Eukaryotes initiation complex formation. Elongation – translocation – tranpeptidation and termination of translation

UNIT IV: Gene expression and Regulation

Gene expression – regulation of gene expression in prokaryotes and eukaryotes – lac Operon as negative and positive regulation of gene expression, Regulation of gene expression in eukaryotes. DNA sequencing, Maxim-Gilbert method, Sangers method – automated sequencing, Genome sequencing, Whole genome sequencing, Shot-gun sequencing - Microbial genome sequencing.

UNIT V: Basics of 'OMICS'

'Omics' definition- genomics - functional –structural – proteomics - transcriptomics and metabolomics – definition. classification and applications.

Reference books

1. Malacinski GM and Freifelder D (1998) Essentials of Molecular Biology, 3rd edition, John and Bartlett Publishers.
2. Lewin B. (2000). Genes VII. Oxford University press
3. HF Lodish, Berk, Arnold, and S. Lawrence Zipursky. Molecular cell biology. Vol. 4. New York: WH Freeman, 2000.
4. Alberts, Bruce, et al. "Molecular biology of the cell." Garland Science, New York 4 (2002)
5. Sambrook, Joseph, Edward F. Fritsch, and Tom Maniatis. Molecular cloning. Vol. 1. No. 7.58. New York: Cold spring harbor laboratory press, 1989.
6. Kleinsmith, L. J. and Kish, V. M. 1995 Principles of Cell and Molecular Biology (2ndEdn.) Harper Collins Coll. Publisher, New York, USA.
7. Malacinski, G. M. and Freifelder, D. 1998 Essentials of Molecular Biology (3rd Edi.) Jones and Bartiet Pub. Inc., London
8. Wolf, S. L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA

Paper III Microbial Genetics, Cell biology and Biochemistry

UNIT I: Microbial genetics

Basic concepts of microbial genetics (Complementation, recombination, & mapping), Bacterial genomes and functions; Microbial replication, Transcription, Transformation, Transduction, transposition and conjugation, Microbial gene organization and Operon; Plasmid; Regulatory elements in Bacterial genome, Extra chromosomal moveable elements, Transposons, DNA Mutations and repair, Mutagenesis, Viral genetics

UNIT II: Cell biology

Basic principles of microscopy, different light microscopic techniques (Phase contrast, Dark field, Differential interference contrast and Fluorescence). Electron Microscopy – SEM, TEM. Cell structure and organisation, Structure and function of Cellular organelles, Cytoskeleton, Cell division, Events in Mitosis and Meiosis, Biomembranes, Cell adhesion and Junctions. Cell signalling: Signal transduction pathways

UNIT III: Biochemistry

Classification of macromolecules: Polysaccharides, fats, proteins & nucleic acids structure and properties of:- Mono, di, oligo and polysaccharides, Complex carbohydrates - Aminoacids, peptides & proteins- Fatty acids, Glycerolipids, phospholipids, glycolopids and steroids- Pigments – chlorophyll

Nutritional types and carbohydrate metabolism: Concepts of metabolism-catabolism-anabolism-Bioenergetics-Free Energy-Entropy- Enthalpy-Thermodynamics laws - Nutrition and nutritional types – nutrients – organic – inorganic. autotrophs – heterotrophs – lithotrophs – Organotrophs – phototrophs. Autotrophy - anoxygenic – oxygenic photosynthesis. Chemolithotrophy – sulphur – iron – hydrogen – nitrogen oxidation – methanogenesis – luminescence's - respiratory metabolism – fermentation of carbohydrates – glycolysis – Kreb's cycle – mitochondrial transport pathways - pentose phosphate pathway, the Entner – Doudoroff pathway – homo and hetero lactic fermentations.

Nucleic acids: Structure & types of - DNA & RNA - their topology and functions. Chromosome organization in microbes. Artificial nucleic acid - PNA. Structure of tRNA, rRNA and mRNA.

Proteins: Primary, secondary and tertiary structure – structure determination –Ramachandran plot – Purification of proteins

Vitamins and hormones: Structure and properties of vitamins and hormones – Definition and nomenclature – biological availability

References:

1. Friedberg EC, Walker GC, Siede W. (2005). DNA repair and mutagenesis. ASM press
2. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann, Molecular Biology of the Gene, Fifth Edition
3. Rowland H. Davis, The Microbial Models of Molecular Biology: From Genes to Genomes.
4. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH (2002).
5. Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH 5. Blackburn GM, Gait MJ. (1996). Nucleic acids in chemistry and biology. Oxford University press.
6. Malacinski GM and Freifelder D (1998) Essentials of Molecular Biology, 3rd edition, John and Bartlett Publishers.
7. Lewin B. (2000). Genes VII. Oxford University press
8. Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial genetics. Jones and Bartlett publishers.
9. Singer M, Berg P. (1991). Genes and Genomes. University Science Books.
10. Stryer L. (2002). Biochemistry. 5th edition, W.H.Freeman and company.
11. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.
12. Biochemistry by Lubert Stryer, Freeman Press, USA.
13. Cell Biology, De Robertis, Wiley Publications

Epidemiology, Biostatistics and Medical Ethics

UNIT I: Epidemiology

Introduction: Historical aspects and evolution of epidemiology, definitions and concepts in Epidemiology.

Approaches in epidemiology: Descriptive and analytical epidemiology, disease burden, natural history of diseases and measures of risk and death.

Study design and sampling: Sample size estimation and introduction to study design in epidemiological investigations.

UNIT II: Biostatistics

Fundamentals of biostatistics: Introduction, types of data, tabular and graphical presentation of data. Measures of location, dispersion and correlation: Measures of central tendency. Mean, mode, median, GM, HM, quartiles Measures of dispersion—range, standard deviation, variance, coefficient of variation.

Probability and statistical inference: Concept and probability distribution. Normal distribution—density curves, applications and statistical tables. Concept of significance tests, parametric and nonparametric tests, standard error and confidence intervals.

Inferential statistics: Probability and distributions – Poisson, Binomial and Normal distribution – Chi-square test – Hypothesis test - Student's t-test – Correlation and Regression – ANOVA.

UNIT III: Medical Ethics

Bioethics and Medical ethics: Historical perspectives & Introduction to Bioethics, Nuremberg Code, Declaration of Helsinki, Principle of essentiality, informed consent, confidentiality, minimisation of risk, accountability and responsibility. Ethics of clinical trials: Drug trials, vaccine trials, Clinical trials with medical devices/surgical procedures/radioactive materials, Research in transplantation and stem cell therapy. Regulatory framework and guidelines for conduction of human research: Review processes, Institutional ethical committees, composition of committees, review procedures, WHO, UNESCO and ICMR guidelines.

References :

1. Epidemiology: An Introduction. Kenneth J. J. Rothman. Latest edition / Pub. Date: May 2002. Publisher: Oxford University Press.
2. Epidemiology. Leon Gordis. Latest edition / Pub. Date: November 2004. Publisher: Elsevier Health Sciences.
3. Diseases and Human Evolution. Ethne Barnes. Latest edition / Latest edition / Pub. Date: March 2005. Publisher: University of New Mexico Press.
4. Epidemiology: Beyond the Basics. F. Javier Nieto, Moyses Szklo. Latest edition / Pub. Date: November 2003. Publisher: Jones & Bartlett Publishers, Inc.
5. Basic and Clinical Biostatistics. Beth Dawson, Robert G. Trapp, Robert Trapp. Latest edition / Pub. Date: March 2004.
6. Discovering Statistics Using SPSS. Andy Field. Latest edition / Pub. Date: April 2005. Publisher: SAGE Publications.
7.Arora PN & Malhon PK (1996). Biostatistics Imalaya Publishing House, Mumbai.
8. Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
9. Stanton A & Clantz, Primer of Biostatistics — The McGraw Hill Inc., New York.
10.Government of India. Good Clinical Practices for Clinical Research in India. New Delhi: 2001
11. Indian Council of Medical Research. Ethical Guidelines for Biomedical Research on Human Subjects. New Delhi: 2000
12. United Nations Educational, Scientific and Cultural Organisation (UNESCO). Universal Declaration on Bioethics and Human Rights. Paris; 2005

Practical V

Practical on Paper I, II &III & IV (Two days)

Unit I: General Medical Microbiology

1. Aseptic practices in laboratory and safety precautions

2. Collection/transport of specimens for microbiological investigations

3. Preparation, examination & interpretation of direct smears from clinical specimens

4. Preparation of Culture media

Preparation of simple solutions such as Normal saline, Buffered saline, VDRL saline (0.9&10%), Preparation and PH adjustment of media such as Peptone water, Alkaline Peptone water Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, MacConkey agar, Muller-Hinton agar. Sugar containing media for biochemical testing. Triple sugar Iron agar, Mannitol motility medium, Peptonewater, Simon's Citrate agar, Lysine iron agar, Glucose phosphate broth (for MR VP), Preparation of media for more specialized use such as Xylose, Lysine Desoxycholate Agar, Thiosulphate Citrate Bile salt Sucrose agar, Desoxycholate Citrate agar, Lowenstein-Jensen medium, Leoffler's Serum Slant, Sabouraud's Dextrose agar, Robertson's cooked meat broth, thioglycollate broth , MacConkey's broth for water analysis.

5. Preparation of stains viz. Gram, Albert's, capsule s, spores, Ziehl Neelsen (ZN) and

Silver impregnation stain et

6. Plating of clinical specimens on media for isolation, purification, identification and quantitation purposes.

7. Operation of autoclave, hot air oven, distillation plant, filters like Sietz and membrane filters

8. Care and operation of microscopes

9. Washing and sterilisation of glassware (plugging and packing)

10. Care and maintenance of common laboratory equipments like water bath, centrifuge, refrigerators, incubators etc. Sterility tests

11. Maintenance of microbial cultures

Unit II: Molecular Biology

1. Isolation of antibiotic resistant microbes.
2. Induction of mutation by ultra-violet radiation and chemical mutagens – NTG, MNNG.
3. Transformation (competent cell preparation) and Transduction using P1.
4. Isolation of microbial genomic DNA and RNA
5. Isolation of plasmid DNA from E.coli (mini preparation).
6. Isolation of plasmid DNA from Gram Negative (bacteria) (mini preparation)
7. Quantification of plasmid by Spectrophotometric methods.

8. Characterization of plasmid DNA by Agarose gel electrophoresis.

Unit III: Biochemistry
Quantification of Macromolecules - Isolation and Colorimetric estimation of:
1. Amino acids - Ninhydrin method
2. Protein - Biuret method/Lowry's method
3. Carbohydrate reducing sugars - Anthrone method/Benedicts method.
4. Cholesterol estimation - Acetic anhydride method
5. DNA - Diphenylamine method
6. RNA - Orcinol method
7. Determination of Phosphorous content of nucleic acids - perchloric acid test.
8. Pigments (chlorophyll - carotenoids – phycobiliproteins)
9. Estimation of lipid

Unit IV: Biostatistics and Epidemiology
1. Graphical Presentation of Data
2. Presentation of Data: Mean, Deviation, Standard Error & ANOVA
3. Epidemiological Exercise – Study Design
4. Biostatistics (Sampling Technique & Sample Size)

Second Year
Paper VI

Systematic Bacteriology

UNIT I
General attributes and virulence factors of bacteria causing infections.
Gram positive cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus, anaerobic cocci etc.

Gram negative cocci of medical importance including Neisseria, Branhamella, Moraxella etc.

Gram positive bacilli of medical importance including Lactobacillus, Coryneform organisms, Bacillus & aerobic bacilli, Actinomyces, Nocardia, Actinobacillus and other actinomycetes, Erysipelothrix, Listeria, Clostridium and other spore bearing anaerobic bacilli etc.

Gram negative bacilli of medical importance including Vibrios, Aeromonas, Plesiomonas, Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas & other non-fermenters, Pasturella, Francisella, Bacteroides, Fusobacterium, Leptotrichia and other anaerobic gram negative bacilli etc.

Helicobacter, Campylobacter & Spirillium, Enterobacteriaceae, Mycobacteria, Spirochaetes , Chlamydiae, Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas. Rickettsiae, Coxiella, Bartonella etc.

UNIT II
Host Parasite relationships- Nonspecific host immune mechanisms. Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis.

UNIT III

Morphology, classification, cultural characteristics, pathogenicity, pathology, laboratory diagnosis and treatment of diseases caused by the following organisms: Staphylococci, Streptococci, Pneumococci, Neisseriae (Gonococci & Meningococci), Corynebacterium, Mycobacterium, Clostridium, Bacillus.

UNIT IV

Morphology, classification, cultural characteristics, pathogenicity, pathology, laboratory diagnosis and treatment of diseases caused by the following organisms: Salmonella, Shigella, Vibrios, Brucella, Gram negative anaerobes, Spirochetes, Rickettsiae, Chlamydiae, Mycoplasmas and Ureoplasmas.

UNIT V

Zoonotic diseases and their control, Hospital acquired infections, Hospital Infection control committee functions, Hospital waste disposal and processing.

Reference books:

1. Bergey's Manual of Systematic Bacteriology, Baltimre: Williams & Wilkins, 1984
2. Medical Microbiology by F. H. Kayser, Stuttgart: Thieme, 2005
3. Medical Microbiology by Jawetz, Melnickand Adelberg's 22nd edition McGraw Hill Medical Publication division, 2001
4. Medical Microbiology by David Greenwood, Richard Slack and John Peutherer 15th edition, Church Hill Living stone Publication, 2000
5. Medical Microbiology by Anathanarayanan, Orient Longman Publication, 1999

Paper VII

Virology and Entomology

UNIT I: Introduction to Clinical virology

History and principles of virology, virus taxonomy, introduction to replication strategies.. DNA viruses of medical importance including Poxviridae, Herpesviridae, Adenoviridiae, Hepadna virus, Papova and Parvo viruses etc. RNA viruses of medical importance including Enteroviruses, Togaviridae, Flaviviruses, Orthomyxoviruses, Paramyxoviruses, Reoviridiae, Rhabdoviridae, Arenaviridae, Bunyaviridae, Retroviridae, Filoviruses, Human immunodeficiency virus, Arboviruses, Coronaviridae, Calci viruses. Slow viruses including Prions, Viriods.

UNIT II: Pathogenesis, Diagnosis and Treatment of viral infections

Viruses associated with diarrhoea and gastroenteritis: Adenoviruses, Astroviruses, Norwalk and Sapporo-like viruses and Enteroviruses. Role of papilloma HIV, Epstein Barr virus, HTLV and Herpes in pathogenesis of cancers and their diagnosis and prevention. Clinical features, Epidemiology, pathogenesis and biology of respiratory viruses - SARS, Human rhino virus and Corona virus, Viruses associated with haemorrhagic fever. Viruses associated with Dengue, Yellow fever, KFD, Chikungunya and Ebola diseases. HIV – Structure, replication, immunopathogenesis and laboratory diagnosis of HIV infection. Pathogenesis and biology of viruses causing Viral Encephalitis and Viral Hepatitis (HAV, HBV, HCV, & HEV). Vaccines and Antiviral drugs.

UNIT III: Introduction to Entomology

Introduction to general entomology, insect morphology and classification of insects and other arthropods of medical importance and their structures and functions. Methods of collecting these insects and arthropods, their preservation, maintenance and transportation.

UNIT IV: Biology and ecology of medically important insects

Biology and life history of Aedes, Culex, and Anopheles, their behaviour and ecology with special reference to Dengue, Chikungunya, Japanese Encephalitis. Biology, morphology and life history of sandflies (Sandfly fever and Chandipura). Fleas, Lice, Culicoides, Ticks and morphology of mites.

Reference Books:

1. Fields virology, 4thEd, Vol 2 Ed by David M Knipe, and Peter M Howley

2. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses.

S. J. Flint.

3. V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date:

December 2003 Publisher: American Society Microbiology.

4. Clinical Virology, Second edition (Richmans Hayden)

5. Hepatitis Viruses (Japan medical research forum)

6. Viral Hepatitis and liver disease. A.J.Zuckerman

7. Viral hepatitis molecular biology diagnosis and control, by Isa Mushahwar. Elsevier Perspectives in medical virology. Series Editor: Arie.J.Zuckerman, Uk Isa K. Mushahwar.

8. Gordon RM, Lavoipierre MMJ (1962) *Entomology for students of Medicine*. Blackwell Scientific Publ.

9. Service MW (1996) *Medical entomology for students*. Chapman and Hall

10. Kettle DS (1984) Medical and veterinary entomology *CAB international*

11. Richard and Davies Imm's general Text book of Entomology, Vol I & II. Chapman and Hall

12. Roy DN and Brown AWA (1970) Entomology (Medical & veterinary) *Bangalore printing and Publishing co.*

13. Bates M (1949) Natural History of mosquitoes *The Macmillan Co*

14. Baker RH and Wharton R(1952) Introduction to Acarology *The Macmillan Co*

Paper VIII

Mycology and Parasitology

UNIT I: Classification of medically important fungi and Taxonomy

Superficial and Subcutaneous mycoses: Piedra, Dermatophytosis, Mycetoma, Zygomycosis, Phaeohyphomycosis, Chromoblastomycosis, Rhinosporidiosis. Dimorphic and systemic Mycoses: Sporotrichosis, Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis. Opportunistic mycoses: Candidiasis, Cryptococcosis, Aspergillosis, Penicillosis.

UNIT II: **Antifungal agents, Immunity to fungal infections, lab diagnosis of fungal infections**

Detection and recovery of fungi from clinical specimens. Newer methods in diagnostic mycology. Immunity to fungal infections. Mycotoxins. Antifungal agents testing methods and quality control. Antifungal agents, antifungal assay methods, guidelines for antifungal therapy, immune mechanisms of resistance to fungal infections, lab diagnosis - microscopy, culture, serology, rapid tests, Molecular methods for detection of fungi.

UNIT III: Introduction to Medical Parasitology

General Parasitology: Associations between parasites and host, Basic concepts and classification of Parasites of clinical importance:

UNIT IV: Pathogenesis, Biology and Diagnosis of Clinically relevant Parasites

Medically relevant Protozoa: Entamoeba, Giardia, Trichomonas, Leishmania, Trypan osoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Babesia, Balantidium etc; Medically important helminths belonging to Cestodes (Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipyllidium, Multiceps etc) Trematode (Schistosoma, Fasciola, Gastrodiscoides, Paragonimus, Clonarchis, Opisthorchis, etc) Nematode (Trichuris, Trichinella, Strongyloides, Ancylos toma, Ascaris, Enterobius, Filarial worms, Dracunculus). Ectoparasites: common arthropods and other vectors. Laboratory Diagnosis of Parasitic diseases, Serological test for parasitic diseases.

Reference books:

- Medical Mycology: The Pathogenic Fungi and the Pathogenic Actinomycetes by John Willard Rippon PhD , W.B.Sanders& Co, Philadelphia
- Davise H. Larone. (2002). Medically important fungi- A guide to identification. 4th edition. Pub: ASM press, Washingdon D.C.
- Jagdish Chander. Text book of Medical Mycology. 3rd edition, Mehta Publishers
- Burton J. Bogitsh , Clint E. Carter, Thomas Oeltmann. Human Parasitology. Pub: Academic Press Inc, Fourth Edition.
- Elizabeth A. Zeibig, Clincial Parasitology, A practical approach. Pub: Saunders. Second revised edition

Paper IX

Diagnostic Immunology and Pathology of infectious diseases

UNIT I: Molecular Immunology

Peptide epitopes T cell B cell antigenic properties, prediction of T and B cell epitopes, chimeric peptides, polytype vaccines Major Histocompatibility complex-1, polymorphism. *Antigen Presentation,* Immunodeficiency conditions, Lymphocyte Traffic, Haematopoiesis, Innate and adoptive immune response in protection. Secondary signalling, VDJC, Class switching, Antibody expression, co-stimulation, cell signalling in immune response. DC activation, B cells as APC, experimental models in APC

UNIT II: Effectors Mechanisms

Mucosal immunity, peyer's patches, gut barriers oral immunization oral tolerance cytotoxic response, ADCC, NK cells, CTL, Th, T reg, immunoregulation, anergy, tolerance, anti idiotype, mechanisms of antiviral innate immune response, mechanisms of antiviral immune response, persistent infection (EBV, LCMV), experimental models in immunopathogenesis.

UNIT III: Immunological Diseases

Autoimmunity-mechanisms, altered antigens, systemic lupus erythematosus, Graves disease, rheumatoid arthritis,, myasthenia gravis, multiple sclerosis, animal models of autoimmunity, transplantation immunology, GvH, immunodeficiency: phagocytic, humoral, CMI, combined HLA association with disease. Immune system in AIDS, transplantation immunology, cancer and the immune system

UNIT IV: Immunology in viral vaccine development: Conventional vaccines prophylactic and therapeutic- Immunoglobulin's-specific and non specific-killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines). Immunological diagnostic methods: Immunoassays, ELISA, IFA, Western blotting, immunostaining methods, Immunohistochemistry etc.

References:

1.Ivan M. Roit (1994) Essential Immunology – Blackwell Scientific Publications, Oxford

2. Kuby J (2001) Immunology Fourth Edition – WH Freeman and Company, New York

3. Chapel H and Halbey M (1986) Essentials of Clinical Immunology

4. Donal M. Weir, John Steward (1993) Immunology – VII edition. ELBS, London

5. Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing company.

6.Abbas AK & AH Lichtman (2006): Basic Immunology: Functions and Disorders of the Immune System. With Student Consult Online Access. Edn. 3. WB Saunders Co.

7. Delves PJ, SJ Martin, DR Burton & IM Roitt (2006): Roitt's Essential Immunology. Edn. 11. Blackwell Publishing.

8. Kindt TJ, RA Goldsby & BA Osborne (2007): Kuby Immunology. Edn. 6. WH Freeman & Co.

9. Mak TW, M Saunders & W Tamminen (2008): Primer to the Immune Response. Elsevier.

10. Male D, J Brostoff, D Roth & I Roitt (2007): Immunology: With Veterinary Consult Access. Edn. 7. CV Mosby & Co.

11. Roitt I, J Brostoff, D Male & D Roth (2006): Immunology. With Student Consult Online Access. Edn. 7. CV Mosby & Co.

12. Sompayrac L (2008): How the Immune System Works. Wiley- Blackwell.

13. Wood P (2006): Understanding Immunology. Edn. 2. Prentice Hall/ Pearson Education, Harlow, England.

Practical X

Practical on papers VI, VII, VIII, IX

Unit I: Systematic Bacteriology

1. Systematic study (morphology, culture characters, biochemical reactions, pathogenesis in brief) of pathogenic bacteria including procedures for their isolation and identification from clinical specimens
2. Laboratory diagnosis of infections (Collection, culture, identification, antimicrobial susceptibility tests (AST) and serology)
Bacteria to be studied in detail:
Staphylococci, Streptococci, Neisseriae, Corynebacteria, Mycobacteria, Aerobic spore formers, Anaerobic non sporing bacteria, Anaerobic spore forming bacteria, Enterobacteriaceae, Vibrionaceae, Pseudomonas and other Non-fermenting Gram Negative Bacilli
3. Tests for Motility: hanging drop, Cragie's tube, dark ground microscopy for spirochaetes
4. Special tests-Bile solubility, sheep cell haemolysis, CAMP test, satellitism, catalase, oxidase, slide & tube agglutination tests etc,.
5. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing, eg. Kirby-Bauer, Stoke's method, Estimation of Minimal Inhibitory/Bactericidal concentrations by tube/ plate dilution methods
6. Tests for Beta-lactamase production

7. Testing of disinfectants

8. Bacteriological tests for water, air and milk

9. Collection and transport of specimens for Bacteriological / Serological tests
10. Maintenance and Preservation of stock cultures
11. Lyophilisation - demo

Unit II: Mycology and Parasitology
1. Basic techniques for collection of specimens for mycology
2. Isolation and identification of fungi like Aspergillus spp, Pencillium, Rhizopus, Candida, Cryptococcus
3. Direct examination of specimens by KOH, Gram's, Acid fast, Giemsa, Lactophenol cotton blue & special fungal stains
4. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture
5. Collection and transport of specimens for diagnosis of parasitic diseases
6. Examination of faeces for parasite ova and cysts etc. by direct and concentration methods (salt floatation and formol-ether methods)
7. Egg counting techniques for helminths micrometry and mounting of slides
8. Examination of blood for protozoa and helminths by wet mount, thick and thin stained smears
9. Preparation & performance of stains -Leishman, Giemsa, Lugol's iodine Micrometry
10. Identification of medically important adult worms
11. Identification of common arthropods and other vectors viz. mosquito, sandfly, ticks, mites, cyclops
12. Preservation of parasites-mounting, fixing, staining etc

Unit III: Virology and Entomology

1. Preparation, maintenance of Cell Cultures & Viral Inoculation
2. Freezing & revival of cell Lines
3. Estimation of TCID50
4. Routes of Inoculations in Embryonated Eggs
5. Lymphocyte separation
6. ELISA in Viral diagnosis
7. IFA in viral diagnosis
8. Serodiagnosis of HCV, HBV and HIV
9. Water sample analysis (as breeding sources of vector Mosquitoes)
10. Feeding patterns of Mosquitoes & Houseflies & Mouthparts- Dissection
11. Mosquito collection & Taxonomy
12. Mosquito inoculation and IFA.
13. Taxonomy of Ticks & Sandflies
14. Processing of Arthropods
15. Biochemical Analysis of Insects (Protein & Sugar)
16. Insecticidal Bioassays (larva and adult insects)

Unit IV: Diagnostic immunology

1. Collection of venous blood from human and separation and preservation of serum/plasma
2. Blood grouping, Identification and enumeration of RBC, WBC and platelets
3. Identification and enumeration of immune cells
4. Agar gel diffusion – Ouchterlony's method
5. Counter Immuno electrophoresis
6. Electrophoresis – serum proteins
7. High titre sera preparation and its estimation
8. Latex agglutination test
9. Widal tube and slide agglutination technique
10. HA and HAI tests
11. Estimation of "C" reactive protein
12. Enzyme Linked Immunosorbent Assay (ELISA)
13. Western blotting
14. Immunization protocols and raising antibody
15. Dissection of primary and secondary lymphoid organs in a selected animal

Third year
Paper XI

Molecular Diagnostics

UNIT I: Advanced techniques in Molecular diagnostics

Nucleic acid extraction - principle and methods; Polymerase Chain Reaction principle, different types of PCR (including RT-PCR, Real-time PCR, QF-PCR, Multiplex PCR, Nested PCR, Labelling PCR, Allele specific PCR, Alu PCR, Hot-start, Insitu PCR) and applications; DNA sequencing methods principle, types, automated process, DNA sequencers; Hybridization techniques: Southern, Northern, *Insitu methods* (including FISH), Mutation detection (SSCP, RFLP). Microarrays types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot, DNA Fingerprinting and its applications.

UNIT II: Immuno diagnostics
Introduction, antigen-antibody binding interactions and assays; Immunoassays types [RIA, ELISA, Chemiluminescent IA IA, FIA] and specific applications; Immunohistochemistry principle and technique.

UNIT III: Molecular diagnosis of Genetic diseases
Origin and direction of human Cytogenetics; General features of chromosomes, Chemistry and packaging of chromosomes, Chromosome bands, banding techniques and their molecular correlates; Fluorescence *Insitu* hybridization (FISH), Comparative Genomic Hybridization (CGH) arrays; Genetic linkage and chromosome and genetic mapping in human diseases

Reference books
1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications 2nd edition. Authors: Lela Buckingham and Maribeth Flaws
2. The Principles of Clinical Cytogenetics, second edition. Edited by Steven L. Gersen and Martha B. Keagle. Totowa, NJ: Humana Press, 2004
3. Immunodiagnostics Principles and Practice, Author S.C. Rastogi, Tylor and Francis pub, 1996

Paper XII

Recombinant DNA technology and its applications

UNIT 1: Enzymes in Recombinant DNA technology

Restriction Endo nucleases, Klenow Enzyme, T4 DNA polymerase, Polynucleotide Kinase, Cohesive and blunt end ligation, linkers and adaptors, homopolymer tailing, alkaline phosphatase, double digestion, TA cloning, Hybridisation techniques; Southern, Northern and colony hybridisation, labelling of DNA probes: Nick Translation, Random priming, Radioactive and non-radioactive probes

UNIT II: Properties of Cloning vectors
Plasmid Vectors: PBR 322, PUC19 Vectors, Bacteriophages vectors: Insertion and replacement vectors, Cosmids, M13 Vectors, Methods for introducing DNA into cells, Transformation, Selection of recombinants, alpha complementation, replica plating. Expression vectors, Constitutive and inducible promoters, pMAL, GST, pET based vectors, shuttle vectors, yeast vectors, artificial chromosomes vectors; YAC and BAC

UNIT III: Construction of Genomic and cDNA Libraries

Construction of genomic and cDNA libraries, partial digests, preparation of mRNA, cDNA, Choice of vectors, Screening of libraries – gene probes, with antibodies, characterisation of plasmid clones

UNIT IV: Principles of DNA sequencing

Principles of DNA sequencing: Sanger's methods, Maxam and Gilbert method. Automated DNA Sequencing, shotgun sequencing, pyro sequencing, Whole genome sequencing, PCR, Types of PCR: multiplex, RT-PCR, nested, touch-down, RACE. Applications of PCR, Gene silencing techniques: Introduction to SiRNA, SiRNA technology

UNIT V: Recombinant Protein Expression

Recombinant protein expression, Insulin, Human Growth hormone, Hepatitis B viral vaccine, Use of Fusion proteins to aid in Recombinant protein purification, site specific mutagenesis methods.

References

1. Molecular biology and Microbial genetics by David Frifielder, Stanely R. Maloy, 2nd edition Jones and Barlett Publishers.
2. Genetics by Peter J Russell (1997) 5th edition Benjamin-Cummings Publishing Company.
3. Molecular Biotechnology (2003) by Bernard R. Glick and Jack J.Pasternak., 2nd edition by ASM press.
4. Gene Cloning and DNA analysis (2004) by T.A.Brown 2nd edition. By ASM press.
5. Principles of Gene Manipulation and Genomics (2006) Sandy Primrose. 7th Edition, Black Well Publishers.

Paper XIII

Bioinformatics, IPR and Infection control

Unit I: Biology in the computer age

Computational Approaches to Biological questions. Basics of computers – servers, workstations, operating systems, Unix, Linux. World Wide Web. Search engines, finding scientific articles - Pubmed – public biological databases.

Unit II: Genomics

Sequence analysis – Sequencing genomes – sequence assembly – pairwise sequence comparison - geneome on the web – annotating and analysing genome sequences. Genbank – sequence queries against biological databases – BLAST and FASTA– multifunctional tools for sequence analysis. Multiple sequence alignments, Phylogenetic alignment – profiles and motifs. Phylogenetic analysis and tree building methods, motif searches, epitope prediction, data mining tools and applications, promoter and gene prediction, comparative analysis.

Unit III: Proteomics

Protein Data Bank, Swiss-prot - biochemical pathway databases -Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure – protein modeling.

Unit IV: Legal protection & IPR

GATT and IPR, forms of IPR, IPR in India, WTO Act, TRIPS, Budapest Treaty for International recognition of microbes for patent purposes, microbial patenting, patenting of genes, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material, GLP, GMP.

Unit V: Public Health management of Infectious diseases

Types and methods of public health and infectious disease surveillance, establishing surveillance system. Analytical Epidemiology*:* Case control and cohort studies. Outbreak Investigations: Needs and steps to be taken for outbreak investigations, collaboration with state and national health authorities.

Unit VI: Guidelines for Clinical trials and Ethics in biomedical research

Ethical and regulatory issue in animal experiment, Ethical issues in biotechnology Epidemiological tools in disease prediction, recording, outbreak investigations and reporting

Reference books:

1. W.J. Ewens, Gregory Grant,(2005). Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology & Health), Springer.
2. Bryan Bergeron,(2003).Bioinformatics Computing First Indian Edition, Prentice Hall,
3. Cynthia Gibas & Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai
4. HH Rashidi & LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London
5. Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press
6. Baxevanis AD & Ouellette BEF (2001) Bioinformatics: A practical guide to the analysis of genes and proteins, Wiley Interscience – New York
7. Introduction to Bioinformatics- Lesk.A
8. Introduction to Bioinformatics- Attwood
9. Instant notes in Bioinformatics- Westhead, Parish &Twym
10. Bioinformatics: A practical guide to the analysis of genes and proteins- Baxevanis, Qoellette, John & Sons, NY
11. Epidemiology: An Introduction. Kenneth J.J.Rothman. Latest Edition/Pub Date: May 2002. Publisher: Oxford University Press.
12. Epidemiology: Leon Gordis, Latest Edition/ Pub Date: November 2004. Publisher: Elsevier Health Sciences.
13. Diseases and Human Evolution: Ethne Barnes. Latest Edition/ Pub Date: March 2005. Publisher: University of New Mexico Press.
14. Epidemiology: Beyond the Basics- F. Javier Nieto, MoysesSzklo. Latest Edition/ Pub Date: November 2003. Publisher: Jones & Bartlett Publishers, Inc.

Practical XIV

Practical on papers XI, XII, XIII

Unit I: Techniques in Molecular diagnostics

1. PCR and amplification of target gene of interest
2. SDS- PAGE
3. Real time PCR and Blotting techniques - demo
4. HA I & HA
5. IgM CAPTURE ELISA for Chikungunya
6. IgM CAPTURE ELISA for Dengue
7. Rubella Diagnosis
8. Measles Diagnosis
9. Neutralization Test
10. MTT Assay
11. Cell Toxicity Determination

12. Immunological methods for Viral diagnostics - HIV Diagnosis
13. Lymphocyte Separation
14. Serum ALT, Urine Bile Salt & Bile Pigments
15. Immuno Florescence Assay for Influenza
16. Animal Experiments – Mice, Guinea Pig, Rabbit & Goose

Unit II Bioinformatics

1. Biological Data Banks & Bio-informatics
2. NCBI, IVR, SWISSPROT & GISAID
3. Sequence Alignment Tools
4. Multiple Sequence Alignment
5. BLAST tool and its types
6. Nucleic Acid to Translation
7. Sequence Assembly
8. Phylogeny Analysis
9. Softwares: Mega & Bio Edit
10. Motif data bases, Epitope prediction.
11. Molecular modelling & visualization
12. QSAR-Drug Protein interactions-docking

Unit III: Recombinant DNA technology

1. Isolation of Plasmid DNA from E.coli by Alkaline lysis method
2. Gene Cloning
    a. PCR Amplification
    b. Restriction Digestion
    c. DNA Ligation
    d. Competent cell preparation
    e. Transformation
    f. Screening of recombinant DNA
3. Induction of gene expression in E.coli, cell lysis and protein extraction
4. Visualization of proteins by SDS PAGE
