



**University of Rajasthan
Jaipur**

SYLLABUS

M.Sc.MICROBIOLOGY

2014-2015 (I & II SEMESTER)

2015-2016 (III & IV SEMESTER)

M. Sc. Microbiology ⁵
2014-2015 and 2015-2016.

MAX MARKS 100, PASS MARKS 36, THEORY PAPER DURATION 3 HRS, PRACTICAL 5HRS, 6 CREDITS FOR EACH PAPER.

Paper	Title of the paper	Marks	Total
<u>First Semester</u>			
GM 101	Techniques in Microbiology	100	
GM 102	General Microbiology and Bacteriology	100	
GM 103	Virology	100	
GM 104	Phycology and Micology	100	
Practical I	Based on theory papers GM 101-102	100	
Practical II	Based on theory papers GM 103-104	100	600
<u>Second Semester</u>			
GM 201	Microbial Growth, Nutrition & Metabolism	100	
GM 202	Molecular Biology	100	
GM 203	Microbial Biochemistry	100	
GM 204	Biostatistics and Bioinformatics	100	
Practical III	Based on theory papers GM 201-202	100	
Practical IV	Based on theory papers GM 203-204	100	600
<u>Third Semester</u>			
GM 301	Medical Microbiology	100	
GM 302	Immunology and Clinical Microbiology	100	
GM 303	Agricultural Microbiology	100	
GM 304	Industrial Microbiology	100	
Practical V	Based on theory papers GM 301-302	100	
Practical VI	Based on theory papers GM 303-304	100	600

Fourth Semester

GM 401	Environmental Microbiology	100	
GM 402	Food and Dairy Microbiology	100	
GM 403	Microbial Genetics	100	
GM 404	Genetic Engineering	100	
Practical VII	Based on theory papers GM 401-402	75	
Practical VIII	Based on theory papers GM 403-404	75	
Project work/ Dissertation/ Seminar		50	600
Total Marks	600X4=2400		

SCHEME OF EXAMINATION MICROBIOLOGY 2014-2015

- As per discussion of academic council the student will require to earn 120 credits for PG course out of total 144 credits.
- In theory 15 hrs of credits is equal to one credit.
- In practical 45 hrs of laboratory works is equal to 2 credits.
- Each semester of PG courses shall have 36 credits
- Each semester will have continuous assessment which will include internal assessment in theory and practical by internal examination/seminar/oral examination-viva voce etc. and the maximum marks will be 30. This will not be included for main University examination.
- Each theory paper shall carry 100 marks.
- This will be of 3 (three) hrs duration.
- Part A of question paper shall contain 10 (ten) very short answer type questions covering entire syllabus.
- Each question will vary 2 (two) marks i.e. part A will be of total 20 marks.
- In part B, question I will have 6 (six) parts out of which 4 (four) to be answered carrying weightage of 5 marks each. Maximum word limit for each part is 50-70 words. There shall be 4 questions, one from each unit with internal choice. Each question will carry 15 marks i. e total of 60 marks.

- Each laboratory work will be of four/six hours duration and involve laboratory experiments/exercises and viva-voce examination with weight age in ratio of 75:25 (i.e. 15% for record and 10% for viva).

SCHEME OF PRACTICAL EXAMINATION

For first semester, second semester and third semester the scheme of practical examination is as follows:

MM: 100	Duration 4 hrs.
1. Major Experiment	15 Mars.
2. Major Experiment	15 Marks
3. Minor Experiment	10 Marks
4. Minor Experiment	10 Marks
5. Spotting	24 Marks
6. Seminar	06 Marks
7. Record	10 Marks
8. Viva-Voce	10 Marks
TOTAL	100 Marks

For fourth semester the scheme of practical examination is as follows:

MM: 100	Duration 4 hrs.
1. Major Experiment	10 Mars.
2. Major Experiment	10 Marks
3. Minor Experiment	6 Marks
4. Minor Experiment	5 Marks
5. Spotting	24 Marks
6. Record	10 Marks
7. Viva-Voce	10 Marks
TOTAL	75 Marks
Project/ Dissertation/Seminar	50 Marks

Syllabus M.Sc. Microbiology

MBC 101: Techniques in Microbiology

Unit –I

Microscopy & staining techniques: Basic principles for the examination of microbes by light, dark field, phase contrast, confocal, fluorescent and electron (transmission and scanning) microscopy; Micrometry, Specimen preparation and basic principles of Simple, Gram, Negative, capsule, endospore, flagella, Acid- Fast and Fluorochrome staining.

Unit-II

Basic principles and methods of sterilization: Control of microorganisms by physical methods: heat, filtration and radiation; chemical methods: phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes and sterilizing gases; evaluation of antimicrobial agent effectiveness, Principle and function of Laminar air flow hood (LAF).

Unit-III

Basic principles and applications of various techniques: X-ray diffraction, Autoradiography; Principle procedure & application; UV-vis spectrophotometry, Colorimetry, Flame photometry and atomic absorption spectrophotometry.

Unit-IV

Chromatography, (paper, thin layer, column), gel permeation chromatography, ion-exchange and affinity chromatography, GLC, HPLC, Electrophoresis for protein and DNA; Iso – electric focusing and 2D gel electrophoresis; Centrifugation; Ultracentrifugation; Dialysis; Ultrafiltration and Lyophilization.

List of Practicals:

1. Laboratory rules and requirement, Bio safety equipments.
2. Microscopy (a) Dissecting, Compound & Phase contrast
(b) Micrometry.
3. Simple staining.
4. Negative staining.
5. Differential staining – Gram staining & Acid – Fast staining.
6. Sterilization.
7. Spectrophotometry / Colorimetry - Absorption Maxima.
8. Paper Chromatography.
9. Thin Layer chromatography.
10. Column chromatography.
11. Demonstration of GLC/HPLC.

Suggested Readings:

Wilson K. & Walker J. 2007, Principles and Techniques of Biochemistry and molecular Biology 6th Ed. Cambridge University Press,

Berg M. Tymoczko J. L & Stryer, L. 2007, Biochemistry" d. W.H. and company, Nw Yor.

Talaro K.P. & Talaro Z. 2006. Foundations in Microbiology (^th Ed.) Mcgraw Hill College Dimensi

Potter G.W.H. & Potter G.W. 1995, Analysis of Biological Molecules: An introduction to principles, instrumentation and techniques, Luwer Academic Publishers

Willey J. Sherwood L and Woolvenrton C 2007, Prescottt/Harley Klevin"s Microbiology, McGraw Hill

Unit -I

Discovery of microbial world : History of Microbiology and contributions of Antony Von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming, Selman Waksman; the spontaneous generation controversy; Current thoughts on microbial evolution including the origin of life; Scope and relevance of Microbiology.

Unit -II

Morphology and ultrastructure of bacteria: Size , shape and arrangement of bacteria, structure and chemical composition of cell wall of gram positive and gram negative bacteria and archae; structure , composition and function of cell membrane, capsule, flagella, pili, gas vesicles, cytoplasmic matrix reserve food materials, nucleoid, plasmids; Bacterial life cycles, nutrition , respiration, reproduction; Economic importance of bacteria.

Unit -III

Microbial diversity: Classification of microorganisms, General methods of classifying bacteria, Bacterial nomenclature, Modern trends of bacterial taxonomy, Bergey's system of bacterial classification , Numerical and molecular taxonomy, 16S rDNA sequencing, General characteristics and classification of Archaeobacteria and cyanobacteria, occurrence, structure, reproduction and economic importance of cyanobacteria.

Unit-IV

Cultivation of bacteria : aerobic , anaerobic: culture media used, growth curve measurement of growth biomass , turbidity, dry weight and protein nucleoid, plasmids; Bacterial life styles nutrition, respiration, reproduction; Economic importance of bacteria.

Culture characteristics : Types of culture media , conditions and nutritional requirements of growth in culture; preparation medium and methods of pure cultures (Pour plate method, streak plate method, spread plate method).

List of Practicals :

1. Identification of Cyanobacteria.
2. Media preparation: Liquid and Solid.
3. Use of indicator media.
4. Anaerobic cultivation.
5. Streak plate technique.
6. Pour plate technique.
7. Spread plate technique.
8. Study of microorganism morphology: Hanging drop method and Wet mount.
9. Effect of temperature and pH on bacterial growth.
10. Preservation of cultures.
11. Determination of microbial growth.

Suggested Readings:

1. Talaro KP. & Talaro A. 2006, Foundations in Microbiology (6th Ed.) McGraw Hill College Dimensi.
2. Willey J, Sherwood Land Woolvenon C. 2007, Prescott Harley/Klein's Microbiology, McGraw Hill Wilson K & Walker J 2008 Principles and Techniques of Biochemistry and Molecular Biology 6th Ed. Cambridge University Press.
3. Aneja K.R. Jain P & Aneja R. 2008, A text book of Basic and applied Microbiology, New Age Int. Publ New Dclhi
4. Berg JM, Tymoczko J. L & Stryer, L 2007, Biochemistrys" Ed. W.H. Freeman and Company, New York,
5. Nelwon D & Cox M.M., 2009, Principles of Biochemistry's Ed. W.H. Freeman and Company New York.

Unit -I

General virology : Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses , morphology & ultra structure; capsids & their arrangements; type of envelopes and their composition, viral genomes: their types and structures , viron , viroids & prions.

Unit-II

General characters of major plant viruses: Tobacomosaic virus group (TMV); Tymovirus group (circular mosaic virus); Tomato spotted wilt virus; cauliflower mosaic virus. Effects of these viruses on plants. General characters of major human and animal viruses: Adenovirus, Poxvirus , Picornavirus, Retrovirus , Reoviruses.

Unit-III

Cultivation of viruses: Growth of viruses in embryonated egg, experimental animals and cell cultures, primary and secondary cell lines, Suspension cell cultures and monolayer cell cultures. Assay of viruses: Physical and chemicals methods of assay (protein, nucleic acid, radioactivity tracers, electron microscopy etc). Infectivity assay of animal viruses, plaque method, pock counting, end point method, infectivity assays of plant viruses.

Unit-IV

Bacteriophages: Classification, morphological groups, virulent dsDNA phages (T-even phages), one step growth curve , ssDNA phage (ϕ x174), bacteriophage typing, lytic cycle, lysogenic cycle; Cyanophages; morphology and growth cycle; Mycophages-types of mycophages, taxonomic affinity, replication of mycoviruses.

List of Practicals :

1. Viral plaques assay.
2. Study of plant virus-TMV.
3. Study of plant virus-CaMV.
4. Study of animal viruses.
5. Study of retroviruses.
6. Growth of viruses in embryonated eggs.
7. One step growth curve of ϕ x174 virus.
8. Animal cell culture media.
9. Cultivation and maintenance of animal cell lines.
10. Use of suspension /monolayer cell cultures for viral cultivation.

Suggested Readings:

13

1. Carter J & Saunders V. 2007, Virology: Principles and Applications.
2. Knipe D.M. and Howley P.M. 2006 Fields Virology. 5th Ed. Lippincott-Raven, Philadelphia USA
3. Straus J.H. & Straus E.S. 1998, Evolution of RNA Viruses Ann. Rev Microbiol. 42: 657-83
4. Luria S.E. 1978 General Virology. 3rd Ed. New York John Wiley and Sons
5. Morag C & Timbury M.C. 1994 Medical Virology 2nd ed. Churchill Livingstone, London
6. Dimmock N.J. & Primrose S.B. 1994 Introduction to Modern Virology 4th Ed. By Blackwell Scientific Publications Oxford.

Unit-I

General characters and classification of algae. Important features, asexual and sexual reproduction in representative genera of Chlorophyceae (*Chlamydomonas*, *Spirogyra*, Dinoflagellates) Pheophyceae (*Ectocarpus*, *Sargassum*), Bacillariophyceae (Diatoms) and Rhodophyceae (*Polysiphonia* Cyanophyceae (*Spirulina*, *Anabaena*).

Unit-II

General Characters & Classification of fungi: Mastigomycotina (*Albugo*, *Phytophthora*), Zygomycotina (*Rhizopus*), Ascomycotina (*Saccharomyces* and *Neurospora*), Basidiomycotina (*Puccinia* and *Agaricus*) & Deuteromycotina (*Cercospora* and *Colletotrichum*).

Unit-III

Economic Importance of algae: Algae as pollution indicators, eutrophication agent and role in bioremediation, algae in global warming and environmental sustainability, cyanobacteria and selected microalgae in agriculture-biofertilizer and algalization.

Unit-IV

Lichens: Structure, relationships, reproduction, ascolichens, basidiolichens, deuterolichens, Mycorrhiza; ecto-, endo, ectendo VAM, Fungi as insect symbionts, fungi as biocontrol agent, attack of fungi on other microorganisms; Economic importance of fungi.

List of Practicals :

1. Fungi cultivation methods.
2. Study of mycorrhizae.
3. Study of lichens.
4. Study of representative algae listed in syllabus.
5. Identification of fungi from food samples.
6. Study of representative fungi listed in syllabus.
7. Study of specific fungi. e.g. from crops.
8. Characterization and identification of *S. cerevisiae* (yeast).
9. Spore print of mushrooms.
10. Use of algae for biofuel production .

Suggested Readings:

1. Nester EW Anderson O. G. & Nester M.T. 2006 Microbiology A Human perspective McGraw Hill
2. Atlas R.M. 1997 Principles of Microbiology 11ed McGraw Hill
3. Chatterjee K.O. 1999, Parasitology, Calcutta Publication
4. Lee R.E. 1999, Physiology 3rd Ed. Cambridge University Press Cambridge Tataro KP. And Talara A. 2006 Foundations in Microbiology 6th Ed. McGraw Hill college Dimensi
5. Wilfey J. Sherwoold L ad Woolverton C 2007 Prescott Harley/Klien's Microbiology McGraw Hill.

Unit -I

Microbial nutrition & growth: Nutritional categories of microorganisms ; nutritional requirements; growth factors; mechanisms of nutrients uptake , microbial growth; Batch culture (growth curve), synchronous growth; Continuous culture (open system), Fed-batch culture; Measurement of microbial growth, direct & indirect measurement of microbial growth; Influence of environmental factors on microbial growth, Control of microbial growth.

Unit-II

Nitrogen fixation in symbiotic and free living system; oxygen and hydrogen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, Pathway of nitrate assimilation in photosynthetic and non photosynthetic systems, transamination and deamination reaction, synthesis of essential & non essential amino acids, synthesis of peptidoglycans and synthesis of polyamines.

Unit-III

History of photosynthetic prokaryotes, Classification of photosynthetic bacteria (purple bacteria, purple sulphur bacteria, green bacteria, purple non sulphur bacteria), polysynthetic pigments (chlorophyll, bacteriochlorophyll, carotenoids, phycobilliproteins), Mechanism of photosynthesis in oxygenic and non-oxygenic bacteria, Photorespiration, Calvin cycle, Chemolithotrophs.

Unit -IV

Respiratory metabolism : Glycolytic pathway of carbohydrates breakdown, glycolysis, (Embden Meyerhoff pathway) , Kreb's cycle and Entner -Duodoroff pathway, Phosphoketolase pathway , pentose phosphate pathway; oxidative and substrate level phosphorylation , gluconeogenesis, Glycogen metabolism glyoxylate cycle, fermentation of carbohydrates, homo- and hetero-lactic fermentation.

List of Practicals:

1. Physiological differentiation of microorganisms of TSIA differential media.
2. Study of nitrification.
3. Isolation and identification of symbiotic nitrogen fixer (Rhizobium) from root nodules.
4. Isolation and Identification of free living Nitrogen fixer from soil.
5. Study of ammonification .
6. Fermentation of carbohydrates.
7. Study of photosynthesis/ respiration.
8. Chemolithotrophs.
9. Litmus milk-Homo-fermentation/Hetero-fermentation.

Suggested Readings:

1. Berg J.M. Tymoczko J.L. & Stryer I 2007 Biochemistry 6th Ed. W.H. Freeman and Company
New York
2. Nelson D & Cox M.M. 2009 Principles of Biochemistry 5th Ed. W.H. Freeman and Company
New York
3. Talaro K.P. and Talaro A. 2006 Foundations In microbiology 6th ed. Mcgraw Hill College,
Dimensi
4. Potter G.W.H. & Potter Geoffrey W. 1995 Analysis of Biological Molecules
5. An Introduction to Principles. Instrumentation and techniques Kluwer Academic Publishers
6. Willey J. Sherwood L and Woolverton C. 2007 Prescott VHarJey Kleins Microbiology
McGraw Hill
7. Atlas R.M. 1997 Principles of Microbiology, 1st ed. McGraw Hill

Unit -I

Nucleic acids: DNA structure; Chargaff's rule; types of DNA; reannealing and hybridization; DNA replication in prokaryotes and eukaryotes: Polymerases, replication origin, initiation, elongation and termination; synthesis of telomeric DNA, topological properties: linking number, superhelicity, mechanism of topoisomerases; Drugs & inhibitors of DNA synthesis.

Unit -II

Transcription: Prokaryotes - polymerase, promoter, initiation, elongation and termination; Eukaryotes - promoters, initiation, elongation, termination and post translational modification of mRNA [capping and polyadenylation, Splicing: L & Y splicing (Group I and II introns) hRNA using spliceosome/snurposome]; Ribozymes; inhibitors of transcription.

Unit -III

Types of RNA: structural features (mRNA, rRNA, tRNA); Genetic code: Degeneracy of the code, three rules governing the code; protein synthesis in prokaryotes and eukaryotes: initiation, elongation and termination; protein synthesis on membrane bound ribosomes: signal hypothesis, post translation modification in ER and Golgi complex; drugs & inhibitors of protein synthesis.

Unit -IV

Regulation of gene expression: Operon concept, negative & positive regulation, inducers, corepressors and catabolite repression; Negative regulation-Lac operon; Positive regulation-Ara operon; Regulation by attenuation -trp operon; Anti termination -N protein and nut sites in lambda.

List of Practicals:

1. Preparation of buffers.
2. DNA isolation from different cell types-microbes and eukaryotic cell.
3. Check for purity of isolated DNA sample.
4. Quantification of DNA using spectrophotometer.
5. DNA denaturation and determination of T_m and G+C content.
6. Perform Agarose gel electrophoresis of DNA.
7. Viable count of *E. coli*, use of minimal and LB Plates.
8. Total RNA isolation from bacterial cells.
9. Use of genetically different marked strains to demonstrate the use of selective minimal plates and scoring of phenotypic markers.
10. Exercise on gene expression.

Suggested Readings:

1. Maloy 1994, Microbial Genetics Jones and Bartlett Publishers Dale J.W. 1994 Molecular Genetics of Bacteria John Whey and Sons
2. Streips and Yasbin 1991 Modern Microbial Genetics Niley Ltd
3. Watson J.D. Hopkiss N.H. Roberts J.W. Steitz J.A. and Welner A.M. 1987
4. Molecular Biology of the Gene Benjamin Cummings Publication Co. Inc California
5. Lewin 2000 Gene VII Oxford University Press
6. Friedberg C. Graham C Walker and Wolfram S 1995 DNA repair and mutagenesis ASM Publication
7. Larry S and Wendy 1997 Molecular Genetics of Bacteria ASM Publications

Unit-I

Chemical properties of water: ionization and acid base chemistry; Carbohydrates- classification, configuration and conformation of monosaccharides, disaccharides polysaccharides, (structural-cellulose, peptidoglycan, storage-glycogen) and glycoproteins; lipids :General characters and classification, biosynthesis of saturated and unsaturated fatty acids, structure and functions of triglycerides, phospholipids, glycolipids and steroids.

Unit -II

Structure of amino acids, classification of essential amino acids based on polarity; Proteins: structure -secondary tertiary, quaternary & protein folding and stability ; properties of proteins : acid - base & solubility; Ramchandran plot; Methods of purification: general approach, protein solubility chromatography, electrophoresis & ultracentrifugation; Sequencing of proteins: Preliminary steps, polypeptide cleavage ,Edman degradation & reconstruction of protein sequence.

Unit -III

Laws of thermodynamics: First and second law ,concept of free energy , oxidation reduction reactions; Enzymes:Classification and nomenclature, mechanism of enzyme action, enzyme inhibition, allostery, Cofactors, coenzymes and prosthetic groups; enzyme kinetics; Derivation of Michaelis - Menton equation and its significance, Lineweaver-Burke plot & Haldane-Briggs relationship.

Unit-IV

Chemical analysis of microbial cells for- carbohydrates, amino acids, proteins, lipids and nucleic acids. Structure and classification of secondary metabolites: Antibiotics (penicillin, streptomycin etc), alkaloids (Ergot toxins), Flavanoids, Vitamins and bacterial toxins.

List of Practicals:

1. Qualitative tests for lipids, carbohydrates and proteins.
2. Calibration of standard curve.
3. Quantitative estimation of proteins.
4. Quantitative estimation of blood glucose & glycogen.
5. Quantitative estimation of lipids & cholesterol.
6. Quantitative estimation of DNA & RNA.
7. Quantitative estimation of any enzyme.
8. Quantitative estimation of polyphenol & carotenoids.
9. Quantitative estimation of secondary metabolites- flavanoids.
10. Vitamin production and estimation.
11. Cell organelle separation.

Suggested Readings:

21

1. Voet D & Voet J.G. 2005 Biochemistry John Whey and sons Inc.
2. Berg J.M. Tymoczko J. L. S. Stryer L. 2007 Biochemistry S" Ed. W.H. Freeman and Company New York
3. Nelson D & Cox M.M> 2009 Principles of Biochemistry s" ed. W.H. Freeman and company New York
4. Talator K.P & Talaro A. 2006 Foundations in Microbiology 6th ed. McGraw Hill College Dimensi
5. Potter G.W.H. & Potter, Geoffrey W. 1995 Analysis of Biological Molecules
6. An Introducton to principles instrumentation and techniques Kluwer Academic Publishers
7. Atlas R.M. 1997 Principles of Microbiology, 11ed. McGraw Hill

(17)

Unit-I

Definition and applications of biostatistics; Frequency distribution; Presentation of data, Measures of central tendency (mean, median and mode) Measures of dispersion; mean deviation and standard deviation, Standard error, Correlation and regression; Scatter diagram, coefficient of correlation, rank correlation. Equations and lines of regression.

Unit-II

Testing of hypothesis: Null & alternative hypothesis, levels of significance, errors in hypothesis testing; critical region, Students t test (unpaired & paired test), Chi square test and F test for population variance, ANOVA (one way & two way).

Unit-III

Probability: Basic concepts related to probability theory, Classical probability. Probability distributions; Properties of Binomial, Poisson, Normal and skewed distribution and their applications in biology.

Unit-IV

Overview of computer systems: Types of computers ; components of computer; generation of computers; Number system; Basics for operation system; (MS-DOS, WINDOWS, Unix and Linux); Introduction to software; MS office (MS-WORD, Power Point, MS Excel, Photoshop) Types of networking (LAN, WAN, MAN) servers, applications of networking; downloading files with anonymous FTP.

Introduction of Bioinformatics: Biological databases (nucleic acid & protein sequence database); sequence alignment (BLAST & FASTA), Important bioinformatics websites (NCBI, FBI, DDBJ etc.), Introduction to genomics and proteomics.

List of Practicals:

1. Graphical representation of data : bar diagram, histogram, frequency polygon, frequency curve and ogives or cumulative frequency curve and pie diagram.
2. Measure of central tendency, Mean deviation, standard deviation and standard error (individual, discrete and continuous series).
3. Plotting of scatter diagram and regression lines. Calculation of correlation coefficient, regression equation and regression analysis.
4. Test of significance by student's t test, chi-square test, one way and two way ANOVA.
5. Conversion of decimal into binary, octal and hexadecimal number system.
6. On line searching of biological literature related to bioinformatics.
7. Scoring schemes and methods of sequence alignment.
8. Use of M.S. Word.
9. Statistical calculations using MS Excel.
10. Preparation of graphs using computers.

Suggested Readings:

1. Kenny J.F. and Keeping E.S. 1964 Mathematics of Statistics part 1 and 2 Affiliated East West Press Ltd. New Delhi
2. Bansi L 1968 Mathematics of Probability and statistics S Chand and Co Delhi
3. Snedeco G.W. and Cochran W.G. 1968 Statistical methods oxford and IBA delhi
4. White R 2000 How computers work Tech Media
5. Gralla P 2000 How the internet work Tech Media
6. Bailey N.T.J. 2000 Statistical Methods in Biology English Univ Press
7. Campbell R.C. 1974 Statistics for Biologists Cambridge University Press UK
8. Shina P.K. 2002 Fundamentals of Computers BPA Publications New Delhi

Unit: I

Historical development in medical microbiology, normal flora of human body, pathogenicity, progress of diseases, transmission of diseases, types of diseases, establishment of diseases and nosocomial infections.

Unit: II

Occurrence, pathogenesis, symptoms, diagnosis, prevention and treatment of the bacterial airborne diseases (tuberculosis, diphtheria, meningococcal meningitis, pneumococcal pneumonia, whooping cough) food and water borne disease (botulism, clostridial food poisoning, typhoid fever, cholera) soil borne diseases (tetanus) sexually transmitted diseases (gonorrhoea, syphilis, leprosy, urinary tract infection) and bacterial vaccines.

Unit III

Occurrence, pathogens, symptoms, preventions, diagnosis and treatment of viral diseases (influenza, mumps, measles, small pox, rabies, polio, hepatitis, AIDS, chicken pox, swine flu, bird flu) viral cancers, viral vaccines, antiviral agents, fungal diseases (superficial mycoses, subcutaneous mycoses, systemic mycoses, opportunistic mycoses), antifungal agents.

Unit IV

Occurrence, pathogenesis, symptoms, diagnosis, prevention and treatment of protozoan diseases amoebiasis, giardiasis, trypanosomiasis, trichomoniasis, leishmaniasis, malaria) helminthes diseases (liver fluke diseases, beef and pork tapeworm diseases, pinworm, disease, roundworm disease, hook worm disease, filariasis)

List of Practicals:

1. Identification of pathogens in various samples using different stains.
2. Collection of samples and containers used for collecting samples.
3. Isolation of pathogens from clinical samples pus, blood and urine.
4. Conventional and rapid methods of isolation and identification of pathogens.
5. Normal flora of skin.
6. Pathogenic bacteria: *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* & *Vibrio cholera*.
7. Pathogenic fungi: *Candida albicans*.
8. Parasites: *Entamoeba histolytica*, *Giardia lamblia*, *Plasmodium Trypanosoma leishmania sp.*, *Trichomonas vaginalis* & *Taenia solium*
9. Drug susceptibility testing.
10. Models /Diagrams showing structure of various pathogenic viruses.



Suggested Readings:

1. Greenwood D. 2007 Medical Microbiology 41/1 ed. I.K. International
2. Murray PA Ptaller MA Tenover F.E. & Tenover A.H. 2007 Clinical Microbiology ASM Press
3. Talaro K.P. & Talaro A. 2006 Foundation in Microbiology 6th Ed. McGraw Hill College Dimens
4. Willey J. Sherwood L and Woolverton C. 2007 Prescott VHarJey Kleins Microbiology McGraw Hill
5. Atlas R.M. 1997 Principles of Microbiology, 11 ed. McGraw Hill
6. Nester E.W. Anderson D.G. and Nester M.T. 2006 Microbiology A Human perspective McGraw Hill
7. Harvey R.A. Champe P.C. and Fisher B.O. 2007 Uppincott's Illustrated Reviews Microbiology
8. Lippincott Williams and Wilkins New Delhi New York

Unit I

Immune system: Innate immunity, adaptive immunity, natural and artificial immunity; Cells of immune system : Lymphocytes, lineage subsets of lymphocytes, Myeloid lineage- Phagocytes, Neutrophils, Macrophages, Mast cells, Basophils, Eosinophils; Lymphoid tissues and organs-primary (Thymus, Bone marrow) & secondary (Spleen, Lymph nodes, Mucosa-associated lymphoid tissues).

Unit II

Antigens: Types-haptens, super antigens and cluster of differentiation molecules(Co); determinants –linear, conformational and neo-antigenic determinants; Immunoglobulin: structure and types; genetic diversity of immunogloblins; catalytic antibodies; Humoral and cell mediated immune response; Major Histocompatibility Complex(MHC) molecules and genes- structure of class I & II molecules, organisation of class I & II molecules, peptide binding of MHC molecules , Presentation of antigens to T-cells, cross presentation of exogenous antigens & regulation of MHC expression; Complement activation: classical, alternative and lectin pathway, regulation of the complement system; Cytokines: general properties, Interferon, TNF, Interleukins, TGF stem cell factor (c-kit ligand); regulation of immune response.

Unit III

Vaccines and Immunization: Types of vaccines (DNA, recombinant vector, synthetic peptide and Multivalent peptide) and their characteristics; National immunisation schedules, Hypersensitivity- Gell and Coombs classification, type I,II & III hypersensitivity; Autoimmune diseases-Classification of autoimmune diseases, Mechanism of autoimmunisation; Transplantation –Types of grafts, types of graft rejection, HLA typing, GVH reaction, Xeno- transplantation & immunosuppressive drugs and use of monoclonal antibodies in therapy; Immunodeficiency- B cell deficiencies, T cell deficiency (SCID,MHC Class II deficiency) & Secondary immune deficiency(AIDS).

Unit IV

Immunization of test animals, hyperimmunization, prophylactic immunization; Preparation of antigen, Clinical Microbiology: Sample collection and serological testing for important pathogens (bacterial viral and fungal) Antigen antibody reaction, *in vitro* agultination reactions (Widal Haemagglutination), Precipitation reactions (Immunodiffusion, Immuno electrophoretic method), Immunoblotting, ELISA, RIA, Fluorescence immunosorbent assay, immunoelectronmicroscopy. Hybridoma technology and application of monoclonal antibodies.

List of Practicals:

1. Study of blood cells- Determine total leucocyte count (TLC) of the given blood sample.
2. Haemagglutination- Blood grouping .
3. Study of routes of immunization & procedures for collection of blood sample from immunized animal.

4. Raising antibodies in mice/rabbit.
5. Separation of serum from the blood sample.
6. Widal Test.
7. Ouchterlony's Double Diffusion.
8. Radial Immuno Diffusion.
9. Titre Test.
10. ELISA.
11. Immunoelectrophoresis.
12. Demonstration of Western blotting.

Suggested Readings:

1. Riott I M 1998 Essentials of Immunology Blackwell Seicnetific publishers London
2. Kindt Goldsby and D Osborne 2007 Kuby immunology Freeman and Co New York
3. Claus D 1996 Immunology Understanding of Immune System Wiley Liss New York
4. William P 2002 Fundamentals of immunology
5. Abbas 2004 Cellular and Molecular Immunology
6. Benjamin 2004 Immunology A Short Course

Unit: I

Microbial biofertilizers and biopesticides; Production of bacterial biofertilizer, Algal and other biofertilizers, biofertilizers aiding phosphorus nutrition, production of mycorrhizal biofertilizers, microbial herbicides, bacterial insecticides, virus insecticides, Entomopathogenic fungi, microbial nematodes, commercial production of biofertilizers.

Unit : II

Disease forecasting and basic principles of plant disease control: Pathology, etiology and control of economically important crop diseases of wheat (Rust, smut), paddy (Blast), barley (Smut), bajra (Ergot), maize (Downy mildew), sugarcane (Red rot), vegetable potato (Late blight and early blight) caused by fungi; Management & storage of agricultural products, post harvest diseases, their prevention and control.

Unit III

Microbial diseases of farm animals (Anthrax, fowl cholera) their prevention and control; Principles and mechanism of biological control; commercial production of biopesticides with reference to *Bacillus thuringiensis*; integrated pest management, their application and limitations for Indian agriculture organic farming.

Unit IV

Soil Microbiology: soil microbes (algae, bacteria, actinomycetes protozoans, nematodes and fungi), Rhizosphere micro organisms, Rhizosphere effect, Effect of microflora on host plant, factors affecting microbial community in soil, organic matter decomposition, factors affecting organic matter decomposition, microbial biomass as an index of soil fertility and biogeochemical cycles (Sulphur, Carbon & Phosphorus).

List of Practicals:

1. Enumeration of soil micro-organisms.
2. Rhizosphere micro-organisms.
3. Commercial production of biofertilizers
4. Standard ISI regulations for mass cultivation of biofertilizers
5. Crop diseases of fungi listed in the syllabus.
6. Farm animal diseases (any two).
7. Physico-chemical testing of soil.
8. Pheromones traps.
9. Bioassay methods.
10. Microbes in composting.

Suggested Readings:

30

1. Agrious G.N. 1997 Plant Pathology Academic Press San Diego
2. Cook R.J. and Baker K.F. 1983 The Nature and Practice of Biological Control of Plant pathoges
3. Amereca Phytopathological Society Press St Paul MN
4. Porster C.F. & John DA 2000 Environmental Biotechnology Ellis Horwood Ltd Publication
5. Christon J.H. 2001 A manual of Environmental Microbiology ASM Publication
6. Rao NSS 1999 Soil Microbiology Oxford & ISH Publishing Co. New York

26

Unit:1

Historical account of microbes in industrial microbiology: Sources and characters of industrially potent microbes; their isolation, purification and maintenance, screening of useful strains, primary screening and secondary screening, strain improvement through random mutation. Microbial growth kinetics in batch, continuous and fed batch fermentation process. Application of genetically engineered bacteria.

Unit : II

Aerobic bioreactor: Principles and designing, types of bioreactors, Raw materials used in industrial fermentation media. Solid state fermentation and submerged fermentation: their advantages and disadvantages. Microbial transformations of steroids and alkaloids. Microbes used for production of antibiotics. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.

Unit III

Microbiology and production of alcoholic beverages; Malt beverages, distilled beverages, wine and champagne, commercial production of organic acids like acetic, lactic, citric and gluconic acids; commercial production of important amino acids (glutamic acid, lysine and tryptophan) insulin and vitamin (vitamin B12, riboflavin and vitamin A) Industrial enzymes production: cellulases, xylanases, pectinases, amylases and proteases and their applications.

Unit IV

Immobilisation of microbial enzymes and whole cells and their applications in industries; bioprocess engineering; Downstream processing, various steps for large protein purification. Petroleum microbiology, Biofuels (ethanol and methane) from organic residues; fuels from algae, Mushroom cultivation patent protection and IPR for biological inventions.

List of Practicals:

1. Study of Growth curve.
2. Solid state fermentation.
3. Primary Screening techniques (crowded plate).
4. Secondary screening techniques.
5. Amino acid production using *E. coli* mutant strains.
6. Use of Growth & production media for citric acid production.
7. Amylase production.
8. Protease production.
9. Enzyme immobilization.
10. Mushroom cultivation.
11. Production of biofuels.

Suggested Readings:

1. Aneja K.R. Jain P & Aneja R. 2008, A text book of Basic and applied Microbiology, New Age Int. Publ New Delhi
2. Reed G. 1997 Industrial Microbiology CBS Publisher (AVI Publishing Co.)
3. Standbury PF Whitekar A and Hall 1995 Principles of Fermentation technology Pergaman Nmneul and Harvey
4. Rehm and Reed 1983 Biotechnology Verlag Chemie
5. Bhosh Fiechter and Blakedrough 1999 Advances in Biochemical Engineering Springer Verlar Publication
6. Creuger and Creuger 2001 Biotechnology A Tet book of industrial microbiology sinaeur associates
7. Casida LE 1997 Industrial Microbiology Whey Eastern

Unit-I

Microbial diversity; Microbiology of air, soil & water; Microbes in extreme environments; Environment induced genetic and physiological adaptation in microbes; Characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkophiles, halophiles and their survival strategies.

Unit-II

Biodegradation and Bioremediation: Microbial degradation of lignocellulosic substances, keratin and chitin; Bioremediation: Microbial degradation of herbicides, pesticides, hydrocarbons including polyacylic (petroleum, gas production, fossil fuel & polychlorinated biphenyls etc.), oil spills, heavy metals, chlorinated and polychlorinated compounds, Biological treatment of effluents of sugar, pulp and paper industry.

Unit -III

Biodeterioration: Biodeterioration of buildings and monuments of cultural heritage, microbial deterioration of paper, textile, leather, rubber, glass, paints and metals; Principal methods for their protection.

Unit -IV

Disinfection of potable water supplies and hospital wastes; Bacterial indicators of water safety ; Microbial assessment of water quality; Standard for tolerable levels of fecal contamination; Techniques in Environment Microbiology : Methods for determination of numbers, biomass and activities of microbes in soil, water, plant surfaces and dead organic materials; Bioremediation techniques: *in situ* (Bioventing, air sparging , liquid delivery system, aerobic bioremediation & phytoremediation) and *ex situ* (land farming, composting, biopiling & slurry -phase) and Metagenomics.

List of Practicals:

1. Study of Thermophiles & Psychrophiles.
2. Study of Halophiles.
3. Enumeration of micro-organisms from air/soil.
4. Micro-organisms degrading oil/textile dyes/petrol.
5. Biodeterioration of paper/textile.
6. Standard plate count.
7. Membrane filtrations.
8. Bacteriological examination of water (Potable /hospital wastes):
 - a. Presumptive test
 - b. Confirmed test
 - c. Completed test
9. IMViC test.
10. Pathogen identification.
11. Chemical Oxygen Demand(COD) & Biological Oxygen Demand(BOD).

Suggested Readings:

1. Pepper IT Gerba CP and Brusseau M. L 2006 Environmental and Pollution Science Academic Press USA
2. Johri B.N. 2000 Extremophiles Springer Verlag New York
3. Colwd D 1999 Microbial Diversity Academic Press
4. Atlas R.M. and Barth A 1998 Microbial Ecology Fundamentals and Applications Addison Wesley Longman Ind
5. Campbell 1983 Microbia Ecology Rkckweh Publication
6. Maier R.M. Pepper IL S gerba CP 2000 Environmental Microbiology Academic Press USA
7. Bake KH and Herson D.S. 1994 Bioremediation Macgra Hill Inc NY
8. Ralph MA 1997 Environmental Microbiology John Wiley and Sons Inc
9. Forster CF. and John DA 2000 Environmental biotechnology Ellis Horwood ltd Publication
10. Christon JH 2001 A Manual of Environment al Microbiology ASM Publications

34

Unit: I

Important microbes involved in spoilage of food; meat, poultry, vegetables and dairy products; food preservation, microbial deterioration of cereals, pulses, fish and sea foods during storage. Feed for cattle: use of microbes and microbial enzymes in the improvement of nutritive quality of feed.

Unit : II

Toxins: Bacterial and mycotoxins, important microbes secreting toxins, chemical nature of important toxins, their role in food poisoning; physiology and mechanism of action, modification and detoxification, prevention and control of toxin contamination.

Unit III

Microbial biomass and single cell proteins; uses of microbes in meats and poultry products vegetables etc., use of microbial enzymes in food; low calorie sweeteners, flavour modifiers, food additives, food quality monitoring Indian fermented food single cell protein.

Unit IV

Role of microbes in milk and dairy products; microbiological examination of milk, standard plate count, direct microscopic count and reductase test composition of milk, sources of contamination of milk, types of microbes in milk pasteurization of milk, ability of milk to cause diseases; manufacture of different types of cheese, butter, yoghurt and fermented milk.

List of Practicals:

1. Microorganisms in food spoilage.
2. Pathogens causing food poisoning.
3. Single cell Protein (SCP) cultivation.
4. Methylene Blue Reduction Test (MBRT).
5. Statutory tests for microbiological analysis of canned foods
6. Presumptive test for coliforms in butter.
7. Fermented milk .
8. Preparation of Sauer Kraut, Koji & Soya sauce.
9. Sampling & analysis of microbial load on food contact surfaces.

Suggested Readings:

36

1. Adams M.R. Moss M.O. 1995 Food Microbiology Royal Society of Chemistry Publication Cambridge
 2. Frazier W.C. Westhoff D.C. 1998 Food Microbiology Tata Mcgraw Hill publishing company ltd New Delhi
 3. Stanbury PE. Whiekar A & Hall S.J. 1995 Principles of fermeritation technology 2dnd Ed. Pergamons Press
 4. Banward G. J. 1993 Basis Food Microbiology CBS Publishers and Distributos Delhi
 5. Hobbs B.S. Roberts D. 1993 Food Poisoning and and Food Hygiene Edward Arnod (a division of Hoder and Stouhton London)
 6. Robbinson RK. 1990 Dairy Microbiology Elseview applied sciences London
 7. Crueger W and Crueger A 2000 Biotechnology A text book of Industrial Microbiology Panlma Publication C. New Delhi
 8. Jay J.M. 1992 Modern Food Microbiology 4th Ed. Van Nostraanad Reinhold Co. New York
-

32

Unit-I

Gene: Seymour Benzer experiment, complementation test, Cistron, Recon & Muton; Mutation mapping at molecular level; Mutation: Spontaneous mutation, induced mutation and mutagens, molecular mechanism of mutagens, suppressor, intragenic and intergenic mutation, Isolation and detection of bacterial mutants; DNA repair: direct repair, excision repair (base and nucleotide), mismatch repair, SOS repair and translesion DNA synthesis.

Unit -II

Homologous recombination: Holliday junction (ssstrand & dsbreak); homologous recombination protein: Ruv AB complex & Ruv C; Rec BCD pathway and Rec F pathway FLP/FRT and Cre/Lox system; Transposable elements: Classes and genetic organisation of transposable elements, insertion sequences (IS elements), composite and complex transposons & mechanism of transposition.

Unit-III

Gene transfer mechanisms: Bacterial transformation (mechanism of transformation, transfection, competence); transduction: generalized transduction, specialized transduction abortive transduction; Conjugation: effective contact & pili in conjugation, the "F" factor, conjugal transfer process, high frequency recombination (Hfr) strains, the order of chromosome transfer, formation of F' (F prime), mapping by using transformation, transduction and conjugation.

Unit IV

Genome organisation: Prokaryotic genome- nucleoid ; Eukaryotic genome: structure of chromatin, nucleosome, organisation & remodelling and high order organization of chromosomes, centromere, telomere, histone modification -methylation, acetylation & phosphorylation with its effect on structure and functions, Organelle genome: Chloroplast and mitochondrial DNA; DNA methylation and gene imprinting; C value paradox and Cot curves repetitive and non repetitive DNA sequences Cot ½ and Kot ½ values. Pseudogenes, gene families, gene cluster super families.

List of Practicals:

1. Study of conjugation in *E. coli*.
2. Effect of UV radiations and repair mechanisms in bacteria.
3. Isolation of antibiotic resistant mutants by disc methods.
4. Isolation of antibiotic resistant mutants by gradient plate method.
5. Isolation of mutants by replica plate method.
6. Ames test.
7. Preparation of competent cells
8. Transformation.
9. Transduction.
10. Curing of plasmid DNA by Acridine orange/ SDS and determination of plasmid loss by loss of resistance to antibiotics.
11. Isolation of Plasmid DNA

Suggested Readings:

38

1. Freifelder O Microbial Genetics 2009 Narosa Publishing House
2. Majoy 1994 Microbial Genetics Jones and Bartlett Publisher
3. Wiley J Sherwood I S. Wolverton C 2007 Prescott Jarhey Klein's Microbiology Mcgraw Hill
4. Berg J.M. Tymoczko J.I & Stryer S. 2007 Biochemistry 6th Ed. W.H. Freeman and Company New York
5. Click B.R. Pasternak J.J. 2003 Molecular Biotechnology ASM Press Washington DC
6. Brown TA 2006 Gene Cloning Blackwell Publishing
7. Lewin B. 2007 Genes IZ Jones and Bartlett Publishers Inc

38

MBC 404: Genetic Engineering

Unit I

Basics of recombinant DNA technology: Enzymes used in r DNA technology: Nuclease, DNA ligase, polymerase, reverse transcriptase, terminal deoxynucleotidyl transferase, alkaline phosphatase; Modification of restriction fragment ends: sticky and blunt end ligation with linkers & adapters and homopolymer tailing.

Unit-II

Polymerase chain reaction (PCR); Basic principle, components of PCR, PCR techniques; Standard PCR, Inverse PCR reverse transcriptase mediated PCR, Anchored PCR, Asymmetric PCR & Real time PCR; STS, EST & STMS; DNA sequencing: dideoxy method (Sanger sequencing), Chemical degradation (Maxam-Gilbert method); strategies for sequencing large DNA fragments; automated sequencing and pyrosequencing ; Probes: Radioactive & non radioactive; RFLP, AFLP, RAPD & PFGE; Microarray and Northern blotting.

Unit -III

Cloning vector: Properties of plasmids, yeast plasmid (YIP, YRP, YCP, YAC), shuttle vectors, bacteriophages, cosmids, bacterial artificial chromosomes, Ti based vectors, chloroplast based vectors, retroviruses; Isolation and purification of genomic and plasmid DNA; Gene libraries: genomic library, screening of libraries (shotgun approach) & cDNA library.

Unit-IV

Introduction of recombinant vectors into bacterial and non bacterial cells; Selection of recombinant clones; Colony hybridization, plaque hybridization immunochemical methods and Southern blotting, Application of genetic engineering: Scientific medical, industrial, agricultural and environmental applications of the human genome project.

List of Practicals:

1. Isolation of genomic DNA
2. Visualization and documentation of genomic DNA using gel doc system.
3. Restriction digestion of DNA.
4. Ligation of restricted DNA sample.
5. Recovery of genomic DNA embedded in Agarose gels (freeze squeeze, column).
6. 7. Analysis of recombinant proteins using polyacrylamide gel electrophoresis.
7. SDS PAGE.
8. Single colony isolation and checking genetic markers.
9. Demonstration of Southern hybridization technique.
10. Transposons.
11. PCR techniques.

Suggested Readings:

1. Nichol DST 2008 An introduction to genetics engineering Cambridge university pres
2. Glick BR Pasternak JJ 2003 Molecular Biotechnology ASM Press Washington DC
3. Old and Primrose 2001 Principles of Gene Manipulation Blackwell scientific publication
4. Brown TA 2006 Gene Cloning Blackell Publishing
5. Sambrook J and Russel D W. 2001 Molecular Cloning A laboraty Manual Cold spring harber laboratory press



Marking Scheme

41

MM: 100

Time 4 hrs.

- | | |
|---------------------|----------|
| 1. Major Experiment | 15 Marks |
| 2. Major Experiment | 15 Marks |
| 3. Minor exercise | 10 Marks |
| 4. Minor exercise | 10 Marks |
| 5. Spotting | 24 Marks |
| 6. Seminar | 06 Marks |
| 7. Record | 10 Marks |
| 8. Viva voce | 10 Marks |

