

UNIVERSITY OF RAJASTHAN,
JAIPUR

~~M.A./M.SC./M.COM~~

(~~Microbiology~~)

2013-2014 (PREVIOUS)-I/II SEMESTER

2014-2015 (FINAL)- III/IV SEMESTER

Prepared by

my
16/9/2013

Checked by


24/9

Microbiology
Corrected
 (19/9/2011)

SYLLABUS

M.Sc. MICROBIOLOGY

2013-2015

2. Eligibility:

As per univ. website

A candidate who has secured more than 50% or CGPA of 3.0 in the UGC Seven Point scale [45% or CGPA 2.5 in the UGC Seven Point Scale for SC/ST/Non-creamy layer OBC] or equivalent in the Bachelor degree in Science or Engineering or Technology or Medicine or Pharmaceutical Science shall be eligible for admission to First Semester of a Master of Science course.

3. Scheme of Examination:

- (1) Each theory paper EoSE shall carry 100 marks The EoSE will be of 3 hours duration. Part 'A' of theory paper shall contain 10 Short Answer Questions of 20 marks, based on knowledge, understanding and applications of the topics/texts covered in the syllabus. Each question will carry two marks for correct answer.
- (2) Part "B" of paper will consist of four questions with internal choice (except in cases where a different scheme is specifically specified in the syllabus_ of 20 mark each. The limit of answer will be five pages.
- (3) Each Laboratory EoSE will be of four/six hour durations and involve laboratory experiments/exercises, and viva-voce examination with weightage in ratio of 75:25.

4. Course Structure:

The details of the courses with code, title and the credits assigned are as given below.

Abbreviations Used

Course Category

CCC: Compulsory Core Course

ECC: Elective Core Course

OEC: Open Elective Course

SC: Supportive Course

SSC: Self Study Core Course

SEM: Seminar

PRJ: Project Work

RP: Research Publication

Contact Hours

P. Mallu

L: Lecture

T: Tutorial

P: Practical or Other

S: Self Study

Relative Weights

IA: Internal Assessment (Attendance/Classroom Participation/Quiz/Home Assignment etc.)

ST: Sessional Test

EoSE: End of Semester Examination

FIRST SEMESTER

S. No.	SUBJECT CODE	Course title	Course Category	Credit	Contact hours per week			EoSE Duration (hrs)	
					I	T	P	Thy	P
1	MBC 101	Techniques in Microbiology	CCC	6	6	0	0	3	0
2	MBC 102	General Microbiology and Bacteriology	CCC	6	6	0	0	3	0
3	MBC 103	Virology	CCC	6	6	0	0	3	0
4	MBC 104	Phycology, Mycology & Protozoology	CCC	6	6	0	0	3	0
5	MBC 111	PRACTICAL - I (MBC 101& 102)	CCC	6	0	0	9	0	4
6	MBC 112	PRACTICAL - II (MBC 103& 104)	CCC	6	0	0	9	0	4


SECOND SEMESTER

S. No.	SUBJECT CODE	Course title	Course Category	Credit	Contact hours per	EoSE Duration
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					week			(hrs)	
					L	T	P	Thy	P
1	MBC 201	Nutrition, Growth & Metabolism	CCC	6	6	0	0	3	0
2	MBC 202	Molecular Biology	CCC	6	6	0	0	3	0
3	MBC 203	Microbial Biochemistry	CCC	6	6	0	0	3	0
4	MBC 204	Biostatistics & Bioinformatics	CCC	6	6	0	0	3	0
5	MBC 211	PRACTICAL – I(MBC201&202)	CCC	6	0	0	9	0	4
6	MBC 212	PRACTICAL – II (MBC203& 204)	CCC	6	0	0	9	0	4

THIRD SEMESTER

S. No.	SUBJECT CODE	Course title	Course Category	Credit	Contact hours per week			Exam duration (Hrs.)	
					L	T	P	Thy	P
1	MBC 301	Medical Microbiology	CCC	6	6	0	0	3	0
2	MBC 302	Immunology and Clinical Microbiology	CCC	6	6	0	0	3	0
3	MBC 303	Agricultural Microbiology	CCC	6	6	0	0	3	0
4	MBC 304	Industrial Microbiology	CCC	6	6	0	0	3	0
5	MBC 311	PRACTICAL-I	CCC	6	0	0	9	0	4
6	MBC 312	PRACTICAL-II	CCC	6	0	0	9	0	4

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FOURTH SEMESTER

S.	SUBJECT	Course title	Course Category	Credit	Contact hours per	Exam duration
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No.					week			(Hrs.)	
					L	T	P	Thy	P
1	MBC 401	Environmental Microbiology	CCC	6	6	0	0	3	0
2	MBC 402	Genetic Engineering	CCC	6	6	0	0	3	0
3	MBC 403	Microbial Genetics	CCC	6	6	0	0	3	0
4	MBC 404	Food, Feed &. Dairy Microbiology	CCC	6	6	0	0	3	0
5	MBC 411	PRACTICAL - I	CCC	6	0	0	9	0	4
6	MBC 412	PRACTICAL - II	CCC	6	0	0	9	0	4

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, Capsule, Endospore, Flagella, Acid fast, Fluorochrome staining, Nuclear/ Geimsa's staining.

Unit II:

Basic principles and methods of sterilization: control of micro organisms 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 functioning of LAF.

Unit III:

Basic principles and methods of media preparation: types of culture media: simple media, complex media, synthetic media, enriched media, selective media, indicator media, differential media, anaerobic media; pH and Buffers; Pure culture techniques: streak plate, pour plate and spread plate method; maintenance of pure culture; methods of preservation of various microbes.

Unit IV:

Basic principles and applications of various techniques: Chromatography: Beer- Lambert law; interaction of radiation with matter, absorption of radiation, emission of radiation; UV-vis Spectrophotometry, Flame photometry and atomic absorption Spectrophotometry; Chromatography (paper, thin layer, column, gel filtration, ion- exchange and affinity chromatography), GLC, HPLC and FPLC. Electrophoresis for protein and DNA; Iso-electric focusing and 2D gel electrophoresis; Autoradiography, X-Ray diffraction; Centrifugation;

Ultracentrifugation: Dialysis, Ultrafiltration; Lyophilization and peed vac.

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Suggested reading:

Wilson K. & Walker J. 2008. Principles and Techniques of Biochemistry and Molecular Biology. 6th Ed. Cambridge University Press.

Berg J. M., Tymoczko J. L. & Stryer, L. 2007. Biochemistry s" Ed. W.H. Freeman and Company, New York.

Nelson D. & Cox M. M. 2009. Principles of Biochemistry s" Ed. W.H. Freeman and Company, New York.

Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.

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

Wiley J, Sherwood L and Woolvenrton C 2007. Prescott/Harley?klein"s Microbiology. McGraw Hill

MBC 102: General Microbiology and Bacteriology

- Unit I:** Discovery of microbial world: History of Microbiology and contribution 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:** 11 Taxonomy and classification: Haeckel's, Whittaker's, Carl Woese and Cavalier Smith's concepts of classification; Modern trends in the classification of microbial world including . 16S rDNA sequencing, Numerical and molecular taxonomy; Introduction to the Bergey's . Manual of Determinative Bacteriology.
- General characters and classification of Archae; General characteristics of Methanobacterium, Methanococcus, Methanomicrobium, Methanosarcina, Halobacterium and Thermococcus; Adaptations and role of Archea in the evolution of microbial world.
 - General characters of Cyanobacteria; Classification of Cyanobacteria; their ultrastructure and reproduction; economic importance of Cyanobacteria.
 - General characters of major groups of eubacteria.
- Unit III:** 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, pilli, gas vesicles, cytoplasmic matrix, reserve food materials, chromosomes, carboxysomes, magnetosomes and phycobilisomes; nucleoid and endospores.
- Unit IV:** Cultivation of bacteria: aerobic, anaerobic; nutritional types of bacteria, culture media used, growth curve, generation time, growth kinetics, synchronous growth; batch and continuous culture; measurement of growth (biomass, turbidity, dry weight and protein content); Physical and chemical factors affecting microbial growth; control of microbes by physical and chemical agents.

P. Mallick

Suggested reading:

Talaro K.P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.
 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.

Aneja K. R., Jain P. & Aneja R. 2008 A text book of basic & applied Microbiology, New Age Int. Publ. New Delhi.

Berg J.M., Tymoczko J. L. & Stryer, L. 2007 Biochemistry 5th Ed. W.H. Freeman and Company, New York.

Nelson D. & Cox M. M. 2009 Principles of Biochemistry 5th Ed. W.H. Freeman and Company, New York.

MBC103: Virology

- Unit I:** General virology: Brief outline on discovery of viruses, nomenclature and classification of viruses: distinctive properties of viruses; morphology & ultrastructure; capsids & their arrangements; types of envelopes and their composition, viral genome, their types and structures
- Unit II:** General characters and ultrastructure of major plant viruses: Tobamovirus group (TMV); Tymovirus group (Circular mosaic virus); Tomato spotted wilt virus; Cauliflower mosaic virus. Effects of these viruses on plants and various histological and physiological changes induced due to viral infection. General characters and ultrastructure of major human and animal viruses: Adenovirus. Poxvirus (DNA containing), Picornavirus, Retrovirus (RNA containing).
- Unit III:** Mechanism of virus adsorption and entry into the host cell including genome replication and RNA production by animal viruses, mechanism of RNA synthesis, mechanism of DNA synthesis. transcription mechanism and post transcriptional processing, translation of viral proteins, assembly, exit and maturation of progeny virions. Cultivation of viruses: Growth of viruses in embryonated egg, in experimental animals and in cell cultures-primary and secondary cell lines. Suspension cell cultures and monolayer cell cultures. Assay of viruses: Physical and chemical methods of assay, (protein, nucleic acid, radioactivity tracers, electron microscopy, etc); Infectivity assay of animal viruses plaque method, pock counting, end point method) and infectivity assay of plant viruses morphology and ultra-structure of bacteriophages, one step growth curve(latent period, Eclipse period, burst size), life cycle and other details.
- Unit IV:** Bacteriophages: Structure and life cycle patterns of T-even phages; one step growth curve and burst size; Bacteriophage typing; Structure of Cyanophages, Mycophages. General principles of phage-bacterium interaction and growth cycle studies of RNA and DNA phages. The biochemistry of phages infected bacterium. Phage genetics. Viroids and Prions: General characters and structure of viroids, their common plant diseases and

P. Malu

control; General characters of Prions, their structure and major diseases caused by them; controversies about their nature.

Suggested Reading:

- Carter J. & Saunders V. 2007. *Virology: Principles and Applications*.
- Knipe D. M: and Howley P. M. 2006. *Fields Virology*, 5th Ed., Lippincott-Raven, Philadelphia, USA.
- Straus J. H. & Straus E.S. 1998. Evolution of RNA Viruses *Ann. Rev, Microbiol.* 42: 657 - 83.
- Luria S. E. 1978 *General virology*, 3rd Ed., New York. **John Wiley and Sons**.
- Morag C & Tim bury M C 1994. *Medical Virology* 10th Ed., Churchill Livingstone, London.
- Dimmock N. J. & Primrose S. B. 1994. *Introduction to Modern Virology* 4th Edition by Blackwell Scientific Publications Oxford.

MBC 104: Phycology, Mycology & Protozoology

- Unit I:** General characteristics of eukaryotic microbes and current status of fungi: Ultrastructure and organization of a typical eukaryotic cell; classification of fungi; General characters, somatic structure, asexual and sexual reproduction of microbiologically important genera of Myxomycota, Mastigomycotina.
- Unit II:** Important genera of fungi: General characters, somatic structure, asexual and sexual reproduction of microbiologically important genera of Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism; sex hormones in fungi; physiological specialization and phylogeny of fungi. Parasexual life cycle; Symbiotic associations of fungi with algae; Economic importance of fungi.
- Unit III:** General characters of algae: Classification of algae: Somatic structure, asexual and sexual reproduction of microbiologically important genera of chlorophyceae, Phaeophyceae, Bacillariophyceae and Rhodophyceae. Algal nutrition, ecology and biotechnology. Economic impotence of algae.
- Unit IV:** (a) General characters of protozoans: Structure and reproduction of microbiologically important genera of protozoans: Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma and Plasmodium. (b) General characters of microbiologically Important Nematodes: Ancylostoma, Ascaris lumbricoides, Cestodes: Taenia solium, Echinococcus granulosus Fasciola hepatica, Schistosoma.

Suggested Reading:

- Nester E'w., Anderson o.G. & Nester M.T. 2006. *Microbiology: A Human Perspective*, McGraw Hill.

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Atlas R. M. 1997. Principles of Microbiology 11 Ed., McGraw Hill.

Chatterjee, K.o. 1999. Parasitology, Calcutta publication.

Lee. R. E. 1999. Phycology, 3rd Ed., Cambridge University Press, Cambridge.

Tataro K.P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.

Wilfey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.

MBC 201: Microbial Growth, Nutrition and Metabolism

- Unit I:** Nutritional requirements of major groups of microbes (bacteria & fungi): Nutritional uptake; transport across the membranes and cell wall (diffusion, passive diffusion, active transport, group translocation and iron uptake). Microbial metabolism: Anabolism, catabolism; Sulphur metabolism, Biosynthesis of purines and pyrimidines.
- 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 reactions.
- Unit III:** Photosynthesis: Absorption of light, photosynthetic and accessory pigments, (chlorophyll, bacteriochlorophyll, carotenoides, phycobilliproteins); Oxygenic and anoxygenic photosynthesis in prokaryotes. Electron transport chain; phosphorylation; Calvin cycle; effect of light, temperature, pH and CO₂ on photosynthesis; Photosynthetic yield and Photorespiration.
- Unit IV:** Respiratory metabolism: Glycolytic pathway of carbohydrates breakdown, glycolysis, emben Meyer hoff pathway, Kreb's cycle and Entner-Duodoroff pathway, Phospho-ketolase pathway; Pentose phosphate pathway; oxidative and substrate level phosphorylation, gluconeogenesis, glyoxylate cycle, fermentation of carbohydrates, homo and heterolactic fermentation.

Suggested reading.

Berg J. M., Tymoczko J. L. & Stryer, I. 2007. Biochemistry 6th Ed. W.H. Freeman and Company, New York.

Nelson D. & Cox M. M. 2009. Principles of Biochemistry 5th Ed. W.H. Freeman and Company, New York

Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College ,Dimensi.

Potter G. W. H. & Potter, Geoffrey W. 1995. Analysis of Biological Molecules: An Introduction to Principles. Instrumentation and Techniques, Kluwer Academic Publishers.

P. Malis

Wiley J., Sherwood L. and Woolverton C. 2007. Prescott/Herje/Klein's Microbiology, McGraw Hill.
 Atlas R. M. 1997. Principles of Microbiology 11 Ed., McGraw Hill.

MBC 202: Molecular Biology

- Unit I:** Nucleic acids as genetic Information carriers: Experimental evidences; DNA structure; historical aspects & current concepts; types of DNA, melting of DNA; DNA replication in prokaryotes: types of polymerases, steps: initiation, elongation (asymmetric & dimeric nature of DNA Polymerase III & simultaneous synthesis of leading & lagging strands), termination. DNA replication in eukaryotes: types of polymerases, replication origins & initiation, steps involved, synthesis of telomeric DNA. Various modes of replication. Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases. Central dogma of life.
- Unit II:** Types and structural features of RNA (mRNA, tRNA, rRNA): Transcription in prokaryotes: RNA polymerase, promoter, steps: initiation, elongation & termination, antitermination. Transcription in eukaryotes: types of RNA polymerases (I, II & III), promoter, enhancer & silencer sites for initiation, transcription factors, steps: initiation, elongation & termination. Inhibitors of RNA synthesis. Post transcriptional modification of mRNA: capping, polyadenylation & splicing (group I introns, group II introns, hnRNA using spliceosome/snurposome), Ribozymes.
- Unit III:** Basic features of the genetic code: Central dogma of life. Protein synthesis in prokaryotes and eukaryotes; steps-details of initiation, elongation & termination, roles of various factors in the above steps, inhibitors of protein synthesis. Synthesis of exported proteins on membrane bound ribosomes: signal hypothesis. Post translational modification of proteins.
- Unit IV:** Regulation of gene expression: operon concept, negative & positive regulation, instability of bacterial mRNA, inducers and corepressors, catabolite repression. Negative regulation- E. coli. lac operon; positive regulation- E. coli. ara operon; regulation by attenuation- his and trp operons. Anti-termination- N protein and nut sites In lambda: Global regulatory responses; heat shock response, stringent response and regulation by small molecules such as cAMP and ppGpp. Regulation of rRNA and tRNA synthesis.

Suggested readings

Maloy 1994. Microbial Genetics. Jones and Bartlett Publishers.

Dale J. W. 1994. Molecular Genetics of Bacteria. John Wiley and Sons.

Streips and Yasbin 1991. Modern Microbial Genetics. Niley Ltd.

Watson, J. D. Hopkins N. H. Roberts J. W. Steitz J. A. & Welner A. M. 1987. Molecular Biology of the Gene. Benjamin Cummings Publications Co. Inc. California.

Lewin 2000. Gene VII. Oxford University Press.

Friedberg C. Graham C. Walker & Wolfram S. 1995. DNA repair and mutagenesis. ASM Publications.

R. Malik

Larry S. and Wendy 1997. Molecular Genetics of Bacteria. ASM Publications.

MBC 203: Microbial Biochemistry

- Unit I:** Carbohydrates: classification and properties, Chemical structure mono, oligo and polysaccharides. General characters of fats: Primary and secondary metabolites in microbes; Saturated and unsaturated fatty acids; biosynthesis of fatty acids, oxidation of fatty acids
- Unit II:** Structure of proteins: methods of purification and sequencing of proteins, synthesis of peptides, properties of proteins (acid-base property and solubility); Structure of amino acids, classification of essential amino acids based on polarity.
- Unit III:** Laws of thermodynamics: free energy & reactions, oxidation reduction reactions; Classification and nomenclature of enzymes; mechanism of enzyme action, enzyme inhibition, allostery, Cofactors; coenzymes and prosthetic groups; multi enzyme complex (Pyruvate dehydrogenase) and isozyme (Lactate dehydrogenase); Non proteinaceous enzyme (Ribozyme and lysozyme) Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction.
- Unit IV:** (a) Fractionation of microbial cells: Separation of different cell organelles and chemical analysis of microbial cells for carbohydrates, proteins, amino acids, lipids and nucleic acids. (b) Outline of structure and classification of secondary metabolites viz. antibiotics (penicillin, streptomycin), alkaloids (Ergot toxins), lavinoids, Vitamins and bacterial toxins.

Suggested Reading:

- Voet. D. & Voet. J. G. 2005. Biochemistry, John WHey & Sons. Inc.
- Berg J. M., Tymoczko J. L. s stryer, L. 2007. Biochemistry s" Ed. W.H. Freeman and Company, New York.
- Nelson D. & Cox M. M. 2009. Principles of Biochemistry s" Ed. W.H. Freeman and Company, New York.
- Talaro K. P. & Talaro A. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.
- Potter G. W. H. & Potter, Geoffrey W. 1995. Analysis of Biological Molecules: An Introduction to Principles. Instrumentation and Techniques, Kluwer Academic Publishers.
- Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
- Atlas R. M. 1997. Principles of Microbiology 11 Ed., McGraw Hill.

P. Malhotra

MBC 204: Biostatistics and Bioinformatics

Unit I: Frequency distribution; measures of central tendency (mean, median and mode); Measures of dispersion: mean deviation and standard deviation. Correlation and regression: Scatter diagram, coefficient of correlation, rank correlation. Lines of regression. :

Unit II: Testing of hypotheses: Some basic concepts, Errors in hypothesis testing; critical region, Students Hest for the significance of population mean and the difference between two population means; Paired t-test; Chi square test for population variance, goodness of fit and for the independence of two attributes in a contingency table; F-test for the equality of two population variance; Analysis of variance-- One-way and two-way analysis of variance.

Unit III: Probability: Basic concepts related to probability theory, classical probability. Probability distributions: Introduction and simple properties of Binomial, Poisson, Normal and skewed distribution and their applications in biology. Sampling: Concept of sampling and sampling techniques.

Unit IV: Overview of computer systems: Introduction and classification; Components of computer: generation of computers: Number system; Flow chart; Basics for operating system (MS-DOS, WINDOWS, Unix and linux); Introduction to software; MS-Office (MS-WORD, Power Point, MS-Excel) and Photoshop.

Introduction to networking (LAN, WAN, MAN) servers, application of networking; downloading files with anonymous FTP, .Gopher, Mosaic;

Introduction to Bioinformatics; Biological databases (nucleic acid & protein sequence database); obtaining BLAST Documentation and Help; Important bioinformatics websites (NCBI, EBI, DDBJ, etc.). Introduction to genomics and proteomics.

Suggested reading:

Kenny J. F. and Keeping E. S. 1964. *Mathematics of Statistics, Part I & II*. Affiliated East-West Press Ltd., New Delhi.

Bansi L 1968. *Mathematics of Probability of Statistics*, S. Chand & Co. Delhi.

Snedecor G. W. & Cochran W. G. 1968. *Statistical methods*, Oxford & IBH, Delhi.

White R. 2000. *How Computers work*. Tech. Media.

Gralla P. 2000. *How the Internet Work*. Tech. Media.

Bailey N. T. J. 2000. *Statistical Methods in Biology*, English Univ. Press.

Campbell R. C. 1974. *Statistics for Biologist*, Cambridge University Press. UK.

Shina P.K. 2002. *Fundamentals of Computers*, BPa Publication, New_Delhi.

P. Malhotra

MBC 301: Medical Microbiology

- Unit I:** Historical developments In medical microbiology: normal flora of human body. Brief account of major air, water and soil borne diseases of microbial origin and their preventive and control measures. Bacteriology: Important human diseases caused by Staphylococcus; Streptococcus; Pneumococcus; Neisseria; Bacillus; Corynebacterium; Clostridium; Pseudomonas; Yersinia; Haemophilus; Mycobacterium; Antibacterial agents and susceptibility test; Bacterial vaccines.
- Unit II:** Virology: Collection of clinical samples and laboratory diagnosis of important viral diseases; Mumps; Measles; Influenza; Adenovirus;
Enterovirus; Rhinovirus; Poxvirus; Hepatitis virus; Herpesvirus; AIDS; Tumor viruses; Viral vaccines; Interferons; antiviral agents & susceptibility test.
- Unit III:** Mycology: Classification of medically relevant fungi; Collection of clinical samples and laboratory diagnosis of important human fungal diseases:
Candidiasis; Dermatophytosis; Aspergillosis; Otomycosis; Cutaneous and subcutaneous mycoses; Systemic mycoses; Opportunistic mycoses; Antifungal agents & their susceptibility test.
- Unit IV:** Parasitology: Important diseases caused by intestinal and urogenital protozoa: Entamoeba, Giardia, Trichomonas; Plasmodium; Trypanosoma; Leishmania; Cestodes: Taenia; Trematodes: Schistosoma; Nematodes: Ascaris; Ancylostoma; Laboratory diagnosis, treatment and prevention of parasitic diseases, antiparasitic agents and susceptibility test.

Suggested reading

- Greenwood D. 2007. Medical Microbiology 41/1 Ed., I.K. International.
- Murray P.A., Tenover F.e., & Tenover F.e., & Tenover F.e. 2007. Clinical Microbiology, ASM Press.
- Talaro K. P. & Tenover F.e. 2006. Foundations in Microbiology (6th Ed.), McGraw-Hill College Divisions
- Willey J., Sherwood L. and Woolverton C. 2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.
- Atlas R. M. 1997. Principles of Microbiology 11 Ed., McGraw Hill.
- Nester E. W., Anderson D. G. & Nester M. T. 2006. Microbiology: A Human Perspective, McGraw Hill.
- Harvey, R.A., Champe, P.C. and Fisher, B.O. 2007. Uppincott's Illustrated Reviews: Microbiology.
- Lippincott Williams and Wilkins, New Delhi/New York.

MBC 302: Immunology and Clinical Microbiology

- Unit I:** Introduction to the Immune system: Innate immunity, adaptive immunity; natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils &

P. Malis

eosinophils. Auxiliary cells; basophils, mast cells & platelets). Organs involved in immune system: primary & secondary lymphoid organs.

- Unit II:** Antigens: Preparation of antigens, types of antigens- haptens, super antigens & clusters of differentiation molecules (COs); Processing and presentation of antigens, Immunoglobulins: structure & types of immunoglobulins, genetic diversity of immunoglobulins, catalytic antibodies. B-cell & T-cell biology (major histocompatibility complex (MHC) molecules) HLA and H-2 Systems. Complement: Classical, alternative and lectin pathway of complement activation, regulation of complement system, biological consequence of complement activation. Cytokines; interferons, TNF, interleukins, hematopoietins & chemokines, regulation of immune response.
- Unit III:** Vaccines and Immunization: Types of Vaccines (DNA, Recombinant DNA, Synthetic Peptide and Multivalent vaccine) and their characteristics, Immunization of test animals, hyperimmunization, prophylactic immunization. Immune disorders; hypersensitivity, autoimmune diseases, Tissue transplantation & rejection, Immunodeficiencies and antibiotics
- Unit IV:** Clinical Microbiology: Clinical sample collection and serological testing for important pathogens (bacterial viral and fungal) Antigen Antibody reactions in vitro; agglutination reactions (Widal. Haemagglutination), precipitation reactions (Immunodiffusion, Immuno electrophoretic method), Immunoblotting, ELISA, RIA, fluorescence immunosorbent assay, immunoelectronmicroscopy. Hybridoma technology, applications of monoclonal antibodies.

Suggested reading

- Riott I M 1998. Essentials of Immunology. Blackwell Scientific Publishers, London.
- Kindt, Goldsby and d Osborne (2007). Kuby Immunology. Freeman and Co. New York.
- Claus D 1996. Immunology- Understanding of Immune System. Wiley - Liss. New York.
- William P 2002. Fundamentals of Immunology.
- Abbas 2004. Cellular and Molecular Immunology.
- Benjamin 2004. Immunology- A short Course.

MBC 303: Agricultural Microbiology

- Unit I:** Microorganisms as biofertilizers: Biofertilizers and symbiotic associations; Rhizobium-taxonomy, physiology. host-rhizobium interaction. mass cultivation; Associative and non symbiotic association-Azospirillum, Azotobacter, Cyanobacteria Mycorrhiza and actinorrhiza in plant nutrition and stress tolerance; Interaction of mycorrhiza with Rhizobium and Pseudomonas; Commercial production of biofertilizers, formulations and BIS specifications; their applications and limitations for Indian agriculture.

P. Mallu

- Unit II:** (a) Disease forecasting and basic principles of plant disease control. (b) Pathology, etiology and control of economically important crop diseases of wheat, rice, barley, maize, sugarcane, vegetables and pulses caused by fungi, bacteria and viruses. (c) Management & storage of agricultural products, post-harvest diseases, their prevention and control.
- Unit III:** Microbial diseases of farm animals, their prevention and control. Microorganisms as biopesticides: Microbiology of plant surfaces; Principles and mechanism of biological control; biocontrol agents for insect pest and weed control. Commercial production of biopesticides with reference to *Bacillus thuringiensis*; integrated pest management; their applications and limitations for Indian agriculture.
- Unit IV:** Soil microbiology: Soil as a habitat for microorganisms; Soil enzymes, Soil water & microbial activity, Soil microflora. Soil fertility and management of agricultural soils. Microbiology of composting and compost enrichment, and green manuring; reclamation of barren lands using microbial technology. Microbiology of plant surfaces: Rhizosphere, phylloplane and rhizoplane microbes & their interaction with plants.

Suggested readings

- Agrios G. N. 1997. Plant Pathology. Academic Press. San Diego.
- Cook R. J. & Baker K. F. 1983. The Nature and practice of Biological Control of plant Pathogens. Amereca Phytopathological Society Press, St. Paul, MN.
- Forster C. F. & John DA 2000. Environmental Biotechnology. Ellis Horwood Ltd. Publication.
- Christon J. H. 2001. A Manual of Environmental Microbiology. ASM Publications.
- Rao, N.S.S. 1999. Soil Microbiology. Oxford & ISH Publishing Co., New Delhi.

MBC 304: Industrial Microbiology

P. Malhotra

- Unit I:** Historical account of microbes in industrial microbiology; sources and characters of industrially potent microbes; their isolation, purification & maintenance; Screening of useful strains; primary screening & secondary screening; Strain improvement through random mutation (random & rational selection). genetic recombination & genetic engineering; Microbial growth kinetics in batch, continuous & fed-batch fermentation process.
- Unit II:** Aerobic bioreactor: principles & designing; types of bioreactors; Raw materials used in industrial fermentation media. Solid state fermentation & submerged fermentation: their advantages & disadvantages. Microbial transformations with special reference to steroids & alkaloids. Primary & secondary metabolites. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.
- Unit III:** Microbiology & production of alcoholic beverages; Malt beverages, distilled beverages, wine & champagne; Commercial production of organic acids like acetic, lactic, citric, &

gluconic acids; Commercial production of important amino acids (glutamic acid, lysine & tryptophan), insulin & vitamins (vitamin B12, riboflavin & vitamin A) & antibiotics. Industrial enzymes production; Cellulases, Xylanases, Pectinases, Amylases & Proteases and their applications.

Unit IV: Immobilization of microbial enzymes and whole cells and their applications in industries; Bioprocess Engineering; Downstream processing, various steps for large scale protein purification. Petroleum microbiology; Biofuels (ethanol and methane) from organic residues: fuels from algae; Mushroom cultivation; Patent protection and IPR for biological inventions.

Suggested reading

Aneja K.R., Jain P. & Aneja R. 2008. A text book of Basic & Applied Microbiology. New Age Int. Publ. New Delhi.

Reed G. 1997. Industrial Microbiology. CBS Publishers (AVI Publishing Co.)

Stanbury PF, Whitekar A. and Hall. 1995. Principles of Fermentation Technology. Pergaman. McNeul and Harvey

Rehm and Reed. 1983. Biotechnology. Verlag Chemie.

Bhosh, Fiechter and Blakebrough 1999. Advances in Biochemical Engineering. Springer Verlag Publications.

Creuger and Creuger. 2001. Biotechnology- A Textbook of Industrial Microbiology, Sinaeur Associates.

Casida LE. 1997. Industrial Microbiology, WHey Eastern.

MBC 311- PRACTICAL -I

MBC 312- PRACTICAL -II

P. Mallu

MBC 401: Environmental Microbiology

Unit I: Microbes In extreme environments: Environment induced genetic and physiological adaptations in microbes; Characteristic features of thermophiles, psychrophiles, methanogens, methylotrophs, acidophiles, alkalophiles, halophiles and their survival strategies.

Unit II: Biodegradation and Biogeochemical cycling: Microbial degradation of lignocellulosic substances, keratin and chitin and Xenobiotics; Microbes in nutrient cycling with special reference to carbon, phosphorous, sulfur and nitrogen cycles.

- Unit III:** Techniques In environmental microbiology: Methods for determination of numbers, biomass and activities of microbes in soil, water, air and on plant surfaces and dead organic materials. Biodeterioration: Biodeterioration of properties & cultural heritage; microbial deterioration of paper, textile, wood, paint and metal corrosion. Principal methods for their protection,
- Unit IV:** (a) Bioremediation: Microbial degradation of pesticides; hydrocarbons; clean up of sites polluted with oil spills, heavy metals and chlorinated solvents; biological treatment of effluents of sugar, pulp and paper industry. (b) Recovery of minerals and metals from ores. Microbes In waste disposal: Microbes in solid waste and sewage treatment systems. Disinfection of potable water supplies; Bacterial indicators of water safety; Microbial assessment of water quality; Standards for tolerable levels of fecal contamination.

Suggested reading

Pepper I. t., Gerba C. P. & Brusseau M. L 2006. Environmental and Pollution Science, Academic Press. USA.

Johri B. N. 2000. Extremophiles. Springer Verlag. New York Colwd D. 1999. Microbial Diversity, Academic Press.

Atlas R. M. & Bartha A. 1998. Microbial Ecology -Fundamentals and Applications. Addison Wesley Longman, Inc.

Campbell 1983. Microbial Ecology. RkckweH Publications.

Maier R. M. Pepper I. L. s Gerba C. P. 2000. Environmental Microbiology. Academic Press. USA.

Baker K. H. & Herson D. S. 1994. Bioremediation. MacGraw Hill Inc. N.Y.

Ralph M. A. 1997. Environmental Microbiology. John Wiley and Sons. Inc.

Forster C. F. & John D. A. 2000. Environmental Biotechnology, Ellis Horwood Ltd. Publication.

Christon J. H. 2001. A Manual of Environment al Microbiology. ASM Publications.

MBC 402: Genetic Engineering

Small

- Unit I:** Basics of RNA technology: Enzymes used in r-DNA technology; DNA ligase, DNA polymerase, Klenow fragment, reverse transcriptase, exonuclease, endonuclease, terminal deoxynucleotidyl transferase, alkaline phosphatase, polynucleotide kinase, and dephosphatases; restriction modification systems and their types; sticky and blunt end ligation, joining with linkers, adapters & homopolymer tailing.
- Unit II:** PCR its various schemes and applications (Basic PCR, inverse-PCR, multiplex-PCR, RT- PCR, anchored-PCR, asymmetric-PCR, realtime-PCR); DNA sequencing methods: dideoxy and chemical methods, strategies for sequencing large DNA fragments, automated sequencing and pyrosequencing; Non-radioactive & radioactive labeling of probes; RFLP, AFLP, RAPD, PFGE, microarray and northern blotting.

Unit III: Cloning vectors: General properties, plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast (Ylp, YE_p, YC_p, VAC), higher plants (Ti based vectors, binary and cointegrate, chloroplast-based vectors) & for animal cells (SV 40, vaccinia, retroviruses). Isolation and purification of genomic and plasmid DNA. Gene libraries: genomic library, screening of libraries (Shot gun approach), cDNA library (different methods for synthesizing cDNA molecules).

Unit IV: Introduction of recombinant vectors into bacterial & non bacterial cells: Selection of recombinant clones: colony hybridization, plaque hybridization, immunochemical methods & southern blotting. Application of genetic Engineering : Human genome project, scientific, Medical, Industrial, Agricultural and Environmental applications

Suggested reading:

Nicholl D. S. T. 2008. An Introduction to Genetic Engineering, Cambridge University Press.

Glick BR, Pasternak JJ. 2003. Molecular Biotechnology. ASM Press Washington D.C.

Old and Primrose 2001. Principles of Gene Manipulation. Blackwell Scientific Publication.

Brown TA 2006. Gene Cloning. Blackwell Publishing.

Sambrook J. & Russell D. W. 2001. Molecular cloning- A laboratory manual. Cold Spring Harbor Laboratory Press.

MBC 403: Microbial Genetics

Unit I: Fine structure of a gene in prokaryote: complementation test, recombination mapping, deletion mapping, cistron, recon, muton. Mutation; spontaneous mutation. Induced mutagenesis and mutagens, molecular mechanism of mutagens. Suppressor mutation: intragenic mutation & intergenic mutation; Detection & isolation of mutants; DNA repair mechanism; repair by direct reversal, excision repair, mismatch repair systems, recombinational repair & SOS repair.

Unit II: Recombination: Reciprocal and non reciprocal, mechanism of recombination; Holiday model, Fox model, Enzymatic mechanism of recombination, Transposable element; Classes of transposable elements, nomenclature of transposable elements; insertion sequences (IS elements), Transposons (composite structure and complex transposons structure) 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 and pilli in

R. Math

conjugation, the 'F' factor, the conjugal transfer process, high frequency recombination (Hfr) Strains, the order of chromosome transfer, formation of F prime (F), Mapping by using transformation, transduction and conjugation.

Unit IV: Plasmids: F plasmids, R plasmids, Col plasmids & Ti plasmid; control of copy no. and incompatibility; Bacteriophages, lytic phages-T7 and T4; lysogenic phages- λ . & P1; M13 & ϕ X 174; Recombination & genome mapping in viruses.

Suggested reading

Freifelder O. Microbila. 2009. Genetics, Narosa publishing House.

MaJoy 1994. Microbial Genetics. Jones and Bartlett Publishers.

Willey J. Sherwood I. s Woolverton C. 2007. PrescottJHarley/Klein's Microbiology, McGraw Hill.

Berg J. M., Tymoczko J. I. & Stryer I. 2007. Biochemistry 61h Ed. W. H. Freeman and Company, New York.

Glick B. R. Pasternak J. J. 2003. Molecular Biotechnology. ASM Press Washington D.C.

Brown T. A. 2006. Gene Cloning. Blackwell Publishing.

Lewin B. 2007. Genes IX, Jones & Bartlett Publishers, Inc.

MBC 404: Food, Feed & Dairy Microbiology

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 cattles: use of microbes and microbial enzymes in the improvement of nutritive quality of feed; Rumen microbiology; leaf protein extract.

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, biosensors and immuno assays, Indian fermented foods.

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,

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ability of milk to cause disease; Manufacture of cheeses, butter, yoghurt and fermented milk.

Suggested reading:

Adams M. R. & Moss M. O. 1995. Food Microbiology, Royal Society of Chemistry Publication, Cambridge.

Frazier W. C. & Westhoff D. C. 1998. Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi.

Stanbury P. E. Whitekar A. & Hall S. J. 1995. Principles of Fermentation Technology, 2nd Ed. Pergamon Press.

Banwart G. J. 1993. Basis Food Microbiology, CBS Publishers and Distributors, Delhi.

Hobbs B. C. & Roberts D. 1993. Food poisoning and Food Hygiene, Edward Arnold (A division of Hodder and Stoughton London).


Robinson R. K. 1990. Dairy Microbiology, Elsevier Applied Sciences, London.

Crueger W & Crueger A 2000 Bio-Technology: A Textbook of Industrial Microbiology, Panlma Publication Co. New Delhi.

Jay, J. M. 1992. Modern Food Microbiology, 4th edition, Van Nostraaand Reinhold Co., New York.

MBC 411- PRACTICAL -I

MBC 412- PRACTICAL -II


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