

SRI KRISHNADEVARAYA UNIVERSITY :: ANANTAPUR
M.Sc. DEGREE COURSE IN MICROBIOLOGY

II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 201: MEDICAL & DIAGNOSTIC MICROBIOLOGY

Unit - I

Historical developments, public health and importance of communicable diseases. Diagnosis of infectious diseases, guidelines to practice and management. Specimen collection and transport, specimen primary observation, processing and preservation of culture and laboratory safety, Host-parasite interactions in bacterial infections, bacterial toxins - types and modes of action, symptoms and syndromes of bacterial diseases. Epidemiology - transmission of pathogens, pathogenic mechanisms. Nosocomial infections - An overview, classification, epidemiology, host biological environment, physical environment and inanimate environment. Nosocomial infections, urinary tract infections.

Unit - II

Cocci and their clinical importance. General characters, pathogenicity and prophylaxis of *Streptococcus*, *Staphylococcus*, *Neisseria*, *Corynebacterium diphtheriae* and *Clostridium tetani*. Bacilli of medical importance - gram positive and negative bacilli, endospore-forming aerobic bacilli, acid fast bacilli, *Mycobacterium tuberculosis* and *M. leprae*.

Antimicrobial chemotherapy, mechanisms of action of clinically used antimicrobial drugs. Antimicrobial drugs for systemic administration - penicillins, cephalosporins, tetracyclins, erythromycins, anti-tubercle drugs.

Unit - III

Mycotic diseases - Superficial mycosis, deep mycosis, respiratory allergies due to fungi, *Candida albicans*, *Aspergillus fumigatus*, *Blastomyces dermatidis*, mycotic poisoning, Protozoa-parasitic species, pathogenic and molecular aspects of severe malaria, *Plasmodium vivax* and *P. falciparum*, Amoebiasis, Leishmaniasis. Sources and pathogenic mechanism of *Leishmania* disease.

Unit - IV

Pathology and laboratory diagnosis of virus associated human diseases, Human papilloma virus, Hepatitis B virus, Herpes simplex virus and AIDS virus. Molecular diagnostic methods in the detection of diseases, diagnosis of bacterial infections, diseases caused by prions - Kuru, CJD disease, sub-acute spongiform, encephalopathy.

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 201: MEDICAL&DIAGNOSTICMICROBIOLOGY

Recommended Books:

1. Reviews of Medical Microbiology by JAWETZ, MELNICK & ADEBERY
2. Medical Microbiology by CRUICKSHANK Vol. I and II
3. A text book of Microbiology (6th edition) by ANANTANARAYAN
4. Clinical diagnosis and management – Laboratory methods by JOHN BERNARD HENRY
5. Zinser Microbiology by JOKLIK, WILLE, AMOS & WILFERT
6. Microbiology (4th edition) by BERNARD, DAVIS, DULBECCO
7. Text book of Medical parasitology (4th edition) by JAYARAM PANIKER
8. Bailey and Scott's Diagnostic microbiology by MOSBY

SRI KRISHNADEVARAYA UNIVERSITY :: ANANTAPUR
M.Sc. DEGREE COURSE IN MICROBIOLOGY

II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 202: Open Elective (Microbes in Human Welfare)

Unit - I

Microorganisms in the service of man in past, present and future

Basics of microbiology: Microbial diversity & types of microorganisms - Viruses, fungi, bacteria, algae, protozoa

Cultivation of microbes - Sterilisation of media and glass wares, growth of microbes on culture media in fermentors/bioreactors/flasks

Traditional microbial technologies – Curdling of milk, yoghurt, cheese, probiotics. Bread and wine making, alcohol and alcoholic beverages, other traditional foods of India

Unit – II

Production of pharmaceutically and commercially important products – antibiotics, enzymes, vitamins, monoclonal antibodies, vaccines

Alternate sources of energy - Bio-fuel methane, hydrogen and alcohol. Current status and prospects of commercial production of microbial fuels

Biodegradable polymers and surfactants from microorganisms - polylactate and polyhydroxyalkanoates.

Unit – III

Single cell proteins & single cell organisms, mushroom cultivation

Genetically engineered organisms—applications in health, industries, agriculture and environment.

Unit - IV

Bio-catalysis for steroidal transformation

Role of Microorganisms in Sustainable agriculture: Biocontrol agents/biopesticides – Bacterial, fungi and viruses. Biofertilisers—production, formulations and applications

Microbial Standards for water and food. Quality control

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 202: Open Elective (Microbes in Human Welfare)

Recommended Books:

1. Principles of fermentation technology (2nd edition) by STANBURY, WHITAKER & HALL.
2. Biotechnology: A Text Book of Industrial microbiology 2nd edition by CRUEGER. & CRUEGER
3. Microbial Technology Vol I by PEPPLER & PEARLMAN (Editors).
4. Microbial Technology Vol II by PEPPLER & PEARLMAN (Editors).
5. Microbial enzymes and bioconversions by ROSE.
6. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd edition) by GLAZER & NIKAIDO.
7. Prescott & Dunn's Industrial Microbiology 4th edition Editor REED.
8. Biotechnology Vol III. DELLWEG (Editor).
9. Concepts in Biotechnology by BALASUBRAMANIAN, BRYCE, DHARMALINGAM, GREEN & JAYARAMAN.
10. Immobilized cells: Principles and Application by TAMPION & TAMPION.
11. Industrial Microbiology by THOMA.
12. Methods in Food and Dairy Microbiology by DILIELLO.
13. Industrial Microbiology by CASIDA.
14. Industrial Microbiology by MILLER & LITSKY.
15. Brock Biology of Microorganism (9th edition) by MADIGAN, MARTINKO & PARKER.

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 203: MOLECULAR BIOLOGY

Unit - I

DNA replication: Modes of replication. Experimental evidences for semi-conservative mode of replication-Meselson–Stahl, and Cairns experiments. Replication fork, continuous and discontinuous DNA synthesis. Enzymes and proteins in replication - Single strand DNA binding proteins (SSB), Helicases, Topoisomerases, DNA ligases. Priming by RNA polymerase and primase. DNA polymerases - *E. coli* DNA polymerase I, II and III, and Eukaryotic DNA polymerases. Replication of *E. coli* chromosome and M13 genome. Rolling circle replication in λ bacteriophage. Eukaryotic DNA replication. Autonomous replication sequences (ARS). Regulation of ColE1 plasmid DNA replication. Termination and fidelity of DNA replication. Nearest neighbour base pair analysis. Inhibitors of DNA replication. Reverse transcriptase. DNA damage. Repair of thymine dimmers, Photoreactivation, excision repair, recombination repair. SOS response.

Unit - II

Transcription (RNA biosynthesis): Polynucleotide phosphorylase. RNA polymerases - *E. coli* RNA polymerase, and eukaryotic RNA polymerases. Promoters and their characterization. Enhancer sequences. Initiation, elongation and termination of RNA synthesis. Monocistronic and polycistronic RNAs. Post-transcriptional modifications of eukaryotic mRNA – capping, methylation and polyadenylation. RNA splicing and splicing mechanisms. Splicing of nuclear pre-tRNA, group I and group II introns, and pre-mRNA splicing. Excision of multiple introns. Role of catalytic RNA.

Unit - III

Translation (Protein synthesis): Elucidation of the genetic code - experimental studies of Nirenburg and Khorona. General features of genetic code, codon degeneracy and universality. Mitochondrial genetic code, tRNA role in protein synthesis. Amino acyl-tRNA synthetases, wobble hypothesis. Mechanism of initiation, elongation and termination of protein synthesis. Translational factors. Inhibitors of protein synthesis - antibiotics and other inhibitors. Post-translational modifications. Protein sorting and targeting. Signal hypothesis - signal sequences, signal recognition particle, and molecular chaperones, protein degradation, Lysosomal degradation. The ubiquitin pathway - protein stability and N-end rule.

Unit - IV

Regulation of gene expression: House-keeping genes, constitutive genes, and regulatory genes. Induction and repression. Regulatory proteins – DNA-binding motif of regulatory proteins. Role of zinc fingers, leucine zippers, helix-turn-helix. Regulation of gene expression in prokaryotic operons. Negative regulation and positive regulation. Fine structure of *lac* operon. Repressor and the catabolite activator proteins in gene regulation of *lac* operon. Dual functions of the repressor in *ara* operon. Transcriptional control by attenuation in *trp* operon. Regulation of gene expression in λ and *nif* operon. Regulation of gene expression in eukaryotes – *gal* operon in yeast. Eukaryotic translation control - translation control by haeme, interferon, mRNA masking, antisense RNA. Hormones and environmental factors affecting gene expression. Homeotic genes and their regulation.

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 203: MOLECULAR BIOLOGY

Recommended Books:

1. Molecular Biology of the Cell – B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D.Watson (Garland Publishing , New York and London)
2. Molecular Biology – A Comprehensive Introduction to Prokaryotes and Eukaryotes – D. Freifelder (Jones and Bartlett, USA)
3. Recombinant DNA : A Short Course – J.D. Watson, J. Tooze and D.T.Kurtz (Scientific American Book, W.A.Premon).
4. Molecular cloning : Laboratory Manual – Maniatis, E.F. Fritsch and J. Sambrook (Cold Spring Harbor Laboratory, New York).
5. Modern Genetics (2nd Edition, 1984) – A.J. Ayala and W. Castra (GoomHelns, London).
6. Techniques in Molecular Biology (1992) – Ed., J. Walker and W. Castra (GeomHelns, London).
7. Practical Methods in Molecular Biology (1991) – R.F. Schecleif and P.C. Wensik (Springer Verlag).
8. Genes V. (1994) – Benjamin Lewin (Oxford University Press).

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 204: BIOSTATISTICS AND BIOINFORMATICS

Unit - I

Data - Data types, collection of data, classification and tabulation. Measures of central tendencies – Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation. Probability – Addition and multiplication theories, conditional probability and probability distributors – Binomial, poisson and normal distribution.

Unit - II

Correlation and linear regression – Scatter diagram method – Karl Pearson's Rank correlation methods. Regression lines – fitting of regression lines by least squares method – Regression coefficients and properties. Small sample tests – t, F and chi square tests. ANOVA – one way and two way classifications. Duncan's multiple range (DMR) test.

Unit - III

Introduction - Origin of bioinformatics biological data (genome projects), computer and information technology contributions. Disciplines of bioinformatics – Genomics, transcriptomics, proteomics, functional genomics, structural genomics, metabolomics, pharmacogenomics, structure prediction and drug design.

Genome projects - General introduction to genome projects (rice genome project and Mycobacterium tuberculosis genome project). Special emphasis on Human Genome Project (HGP) – Science behind HGP, benefits of HGP, ELSI of HGP in use of genetic information, genetic testing standard, quality and commercialization.

Biological database - Introduction of database (DB), need, organization, search of DB. An over view of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, and KEGG.

Unit - IV

Database querying with NCBI using key words, sequences (proteins and genes), finding similarities, identifying genes and proteins from different organisms.

Sequence alignment - Introduction, significance of sequence alignments and use of dot matrices. Pair wise and multiple sequence alignment (MSA) using Clustal programs.

Sequence analysis - concepts of sequence analysis and their importance. BLAST – blastn, blastp, blastx, tblastx, output analysis matrix BLOSSUM, PAM, e-value.

Proteomics - Introduction, principle, technique, 2-D database. Gel analysis software, post gel analysis, MALDI-TOF. Significance and applications of proteomics in modern biology.

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 204: BIostatistics AND BIOinformatics

Recommended Books:

1. Statistical methods. S.P. Gupta
2. Fundamentals of mathematical statistics. S.C Gupta & Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton & J.O. Tsokan.
4. Primrose SB. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. 2nd Ed. 1998. Blackwell Science: Oxford. ISBN 0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press: Oxford, New York.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreille's Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins Willie Taylor. (2006)

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P 201 : MEDICAL & DIAGNOSTIC MICROBIOLOGY

Identification of pathogenic bacteria using Gram stain and acid-fast staining techniques.

Collection and culture of nosocomial microorganisms.

Bacterial examination of blood, urine and pus.

Examination of blood smears for malaria.

Blood hemoglobin estimation.

Erythrocyte sedimentation rate.

Liver function test for hepatitis virus.

Slide observations: *Candida albicans*, *Mycobacterium leprae*, bacterial spores, *Corynebacterium* sp., *Clostridium tetani*, *Aspergillus fumigatus*

Differential count

RBC

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II SEMESTER(CHOICE BASED CREDIT SYSTEM)

P 202: MOLECULAR BIOLOGY AND BIOINFORMATICS

Determination of log phase during culturing of *E. coli*
Demonstration of β -galactosidase induction in *Ecolilac*⁺ strains.
Estimation of DNA by diphenylamine method.
Determination of purity and quantity of DNA by UV absorption method.
Determination of melting temperature (T_m) of DNA
Estimation of RNA by orcinol method.
PAGE electrophoresis of proteins.
Problems related to molecular genetics.
Southern and western blotting.
Electro-elution of DNA.
Restriction digestion of DNA.
Separation of RE-digested fragments by gel electrophoresis.
Restriction mapping of a plasmid.
Cloning of foreign DNA insert into a plasmid followed by transformation.
Polymerase chain reaction.

Familiarization with Windows, UNIX and Internet
Database searching (Give name of the gene/protein search sequence with key words, download the sequence, locate related literature references)
Use of tools at NCBI, EMBL and SWISSPORT
BLAST analysis and FASTA analysis
Pair wise and multiple sequence alignment (CLUSTAWX/W)
Finding composition of sequence, open reading frames
Detecting signals, Mptots and repeats in sequence
Secondary structure prediction of protein sequence
Phylogenetic tree construction
Design of PCR primer

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III SEMESTER (CHOICE BASED CREDIT SYSTEM)

MB 301: GENETIC ENGINEERING

Unit - I

Genetic engineering –Scope and milestones of genetic engineering Restriction and modification enzymes – Classification, nomenclature and importance of restriction endonucleases. DNA ligases, polynucleotide kinase, alkaline phosphatases, S1 nuclease, terminal transferase, Bal 31 nuclease. Cloning Vectors – Characteristics of a cloning vector, disadvantages of natural plasmids in gene cloning, Artificial plasmids as cloning vectors – Construction of pBR322, vectors used for cloning genes in E .coli (plasmids, bacteriophage derivatives, cosmids BACs) yeast (YACS, shuttle vectors), higher plants (Ti plasmid derivatives, caulimovirus) and animal cells (constructs of SV40 and retroviruses). DNA and RNA probes – Synthesis and their applications. Bacterial strains used for cloning (E.coli JM101, strain 109, strain C43 (DE3).

Unit - II

Cloning strategies– Generation of DNA fragments containing a gene (shot-gun method, southern analysis, and cDNA synthesis). Joining of DNA fragments to vector molecules, cohesive termini ligation and blunt end ligation using linkers, adaptors and homopolymer tails. Introduction of recombinant DNA molecules into appropriate cloning hosts – Preparation of competent cells, Cold CaCl₂ transformation, electroporation and tripartite mating In Vitro packaging of recombinant cosmids. Introduction of recombinant cosmids into E. coli cells. Screening of recombinants for a positive clone – Genetic, biochemical and hybridization methods, Construction of DNA libraries – genomic and cDNA libraries.

Unit – III

Overexpression of cloned genes: Polymerase chain reaction – Principle, types (RT-PCR, nested, multiplex and inverse PCR), primer design, and application of PCR. PCR amplification of cloned gene. Characteristics of expression vectors. Construction of expression vectors: Vectors having inducible lac, taq promoters. Codon optimization Engineering hosts for overexpression. IPTG - Induction of a cloned gene expression .Expression of proteins with His tag and its significance in simultaneous expression and purification of recombinant proteins. Problems associated with expression of cloned genes - Inclusion bodies, solubilisation and reconstruction of expressed proteins. Characterization of recombinant proteins

Unit - IV

Restriction mapping of linear and circular DNA. Sequencing of cloned gene – Sanger's method, Maxam-Gilbert's method and automated sequencing. Application of site – directed mutagenesis in protein engineering. Studying gene regulation – Northern blot, primer extension, S1 mapping and reporter assays. Development of a recombinant E. coli strain expressing human insulin. Agrobacterium –mediated gene cloning for developing a transgenic plant. Transfection - Salient features and its significance in transforming animal cells. DNA Finger Printing - RAPD, RFLP and AFLP analysis and their applications. Antisense technology and its application. Gene knockout technology. Gene therapy – Strategies of gene delivery and application of gene therapy. Micro arrays and applications. Proteomics – Principle, techniques and applications

MB 301: GENETIC ENGINEERING

Recommended Books:

1. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000
2. DNA Cloning : a Practical Approach, DM Glover and BD Hames, IRL Press
3. Molecular and Cellular methods in Biology and Medicine. PB Kaufman,W.Wu.D Kim and LJ Cseke, CRC
4. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, SL Berger and AP Kimmel, Academic Press, Inc San Diego, 1998
5. Methods in Enzymology Vol. 185, Gene Expression Technology, D V Goeddel, Academic Press, Inc. San Diego, 1990
6. DNA Science. A first Course in Recombinant Technology, DA Mickloss and GA Freyer, Cold Spring Harbor Laboratory Press, New York 1990
7. Molecular Biotechnology (2ndEdn) SB Primrose, Blackwell Scietific Pub. Oxford, 1994
8. Milestones in Biotechnology. Classic papers on Genetic Engineering. JA Davies and WS Reznikoff, Butterworth-Heinemann, Boston, 1992
9. Route Maps in Gene Technology, MR Walker and R Rapley, Biackwell Science Ltd, Oxford 1997
10. Molecular Biotechnology – Glick
11. Concepts of Biotechnology D. Balasubramanian
12. Principles of Gene Manipulation by Old and Primrose, Blackwell

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III SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 302: OPEN ELECTIVE (IMMUNITY & HUMAN HEALTH)

Unit – I

History and evolution of immunology, Humoral and cellular immunity, Primary body defence mechanisms, Innate immune systems –Skin, Tears, Saliva and gastric enzymes, cells of immune system B and T lymphocytes, NK cells, antigen presenting cells, phagocytic cells, phagocytosis. Primary and secondary lymphoid organs, antigen recognition by T cells, antigen processing and presentation pathways of exogenous and

endogenous antigens, Major classes of antigens, functions of antigens, structure and functions of antibodies, Protection, Immune responses to different infections Up-regulation of immune system against popular and communicable diseases, Applications of immune-based and serological tests in diagnosis of diseases

Unit – II

Cancer Biology and Immunology: Cancer, types of cancers (Carcinoma, Sarcoma, Lymphoma and Myeloma, & leukemia, germ cell tumours) Pathological symptoms- local, systemic symptoms and metastasis, Benign tumours and malignant tumours, immune system of tumors & cancers, Immuno-surveillance, immunoediting, viruses in development of cancers, cancer therapy

Unit - III

Health and Hygiene – Home and everyday life hygiene, Hand Hygiene, House hold water treatment & safe storage, Hygiene in Kitchen, Bath rooms and toilets, Laundry Hygiene, Medical hygiene, Safe and potable drinking water, Intake of Healthy diet, nutritional quality of diet, High fibre diet, healthy heart and strong muscles, medical care and dental care. Elements of Mental Health, Handling of stress, Public health, community health, Vaccination, Health Hazards – Tobacco, Alcohol, Drug Abuse

Unit - IV

Sanitary Microbiology – Faecal and sewage contamination, outbreaks of diseases during natural calamities and floods, microbiological hazards, Microbiological monitoring of indicator microorganisms (bacteriological standards) in water and food, applications of novel technology for microbiological analysis of water and food

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III SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 302: OPEN ELECTIVE (IMMUNITY & HUMAN HEALTH)

Recommended Books:

1. Immunobiology - The immune system in Health and disease by JANEWAY & TRAVERS.
2. Immunology - An Introduction by TIZARD.
3. Text Book of Immunology by UNANI & BENACERRAF.
4. Fundamentals of Immunology by PAUL.
5. Immunology by KUBY.
6. Immunology - A short course by BENZAINI, SUNSHINE & LESROWITZ.
7. Basic and clinical immunology by STITES, TERR & PARSLOW.
8. Antibodies: A Laboratory Manual by HARLOW & LANE.
9. Practical Immunology by HUDSON & HAY.
10. Manual of Clinical Immunology by ROSE & FRIEDMAN.
11. Immunochemistry in Practice by JOHNSTONE & THROPE.
12. Hand Book of Experimental Immunology, Vol I & II by WEIR.
13. Immunology by ROIT
14. Microbial Ecology: Fundamentals and Applications (4th edition) by ATLAS & BARTHA.
15. Food microbiology by William C Frazer & Dennis Westhoff

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M.Sc. DEGREE COURSE IN MICROBIOLOGY

III SEMESTER(CHOICE BASED CREDIT SYSTEM)
MB 303: ENZYMOLOGY AND BIOENERGETICS

Unit- I

Enzymes - Classification, nomenclature, chemical nature of enzymes. Assay of enzymes. Kinetics of enzyme-catalyzed reactions – Michaelis-Menten equation, determination of V_{max} , K_m , K_{cat} and their significance. Effect of pH, temperature, concentration of enzyme and concentration of substrate on rate of enzyme-catalyzed reactions.

Unit - II

Enzyme inhibition of active site and identifying functional groups essential for catalysis, factors contributing to the catalytic efficiency such as proximity and orientation steric hindrance, covalent catalysis, general acid-base catalysis, factors of strain in enzyme catalysis. Mechanism of action of enzymes, lysozyme, chymotrypsin, RNase. Regulatory enzymes – noncovalently-regulated enzyme (allosteric enzymes), covalently-regulated enzymes, isozymes. Ribozymes and abzymes.

Unit - III

Enzyme purification - Methods of isolation, purification. Recovery and yield of enzymes. Criteria for testing purity of enzyme preparations. Characterisation of enzymes. Immobilised enzymes - Methods of immobilisation. Comparison of kinetics of immobilised and free enzymes. Application of immobilised enzymes

Unit - IV

Bioenergetics - ATP cycle, free energy, standard free energy change, conventions in biochemical energetics, free energy change in biochemical reactions, standard free energy of hydrolysis of phosphate compounds. Energy transducers. Oxido-reduction reactions, redox potentials, free energy changes in redox reactions. Respiratory chain in mitochondria and bacteria along with their components, respiration-linked proton translocation, oxidative phosphorylation and its coupling to electron transport chain, uncouplers, inhibitors, mechanisms of oxidative phosphorylation. Bioluminescence.

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MB 303: ENZYMOLOGY AND BIOENERGETICS

Recommended Books:

1. Biochemistry (2nd edition) by VOET & VOET.
2. Outlines of Biochemistry (5th edition) CONN, STUMPF, BRUENING & DOI.
3. Biochemistry (3rd edition) by STRYER.
4. Biochemistry by ZUBAY.
5. Principles of Biochemistry by LEHNINGER, NELSON & COX.
6. Harper's Review of Biochemistry by MARTIN, MAYER & RODWELL.
7. Biochemistry Vol. III by DAS GUPTA.
8. Biochemistry by GARRET & GRISHAM.
9. Biochemistry: The chemical reactions of living cells Vol. I & Vol II by METZLER.
10. An Introduction to Practical Biochemistry by PLUMMER.
11. Principles of Biochemistry: General aspects by SMITH, HILL, LEHMAN, LEFKOWITZ, HANDLER & WHITE.

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M. Sc. COURSE IN MICROBIOLOGY
III SEMESTER(CHOICE BASED CREDIT SYSTEM)

MB 304: MICROBIAL GENETICS

Unit – I

Genetic notations, conventions and terminology. Chromosome and gene – Chromosomal organization in prokaryotes and eukaryotes. Diversity in eukaryotic and prokaryotic genomes. An overview of Mendelian laws of inheritance. One gene-one polypeptide concept. Modern concept of gene structure. Colinearity of the gene and product concept, experimental evidences. Genetic material – DNA and RNA. Organization of histone genes, rRNA and tRNA genes in prokaryotes and eukaryotes. Overlapping genes, split genes, constitutive genes, regulatory genes, luxury genes, oncogenes and tumor suppressor genes.

Unit – II

Genetic recombination - Types of recombination: homologous, reciprocal and nonreciprocal, site-specific and illegitimate. Different models of homologous recombination. Molecular mechanism of recombination. Coefficient of coincidence of double crosses, chiasmata interference. Plasmid-Types, properties, functions, detection, amplification, incompatibility and isolation of plasmids. Episomes. replication and transfer of F plasmid. Transposable elements- Prokaryotic: insertion sequences, types of bacterial transposons, Eukaryotic: *sp* and *dsp* in maize. Ty elements of the yeast, *PandCopia* elements of *Drosophila*. Mechanism of transposition. Relevance/importance of transposable elements

Unit – III

Modes of gene transfer in bacteria: Transformation – Discovery and molecular mechanism of natural transformation and recombination. In vitro transformation – Cold CaCl_2 technique, electroporation and triparental mating. Transduction – Discovery, types of transduction: generalized, specialized, abortive, co-transduction. Mechanism of transduction for the development of transducing particles (*dg* and *pbio*) during specialized transduction. Conjugation – Discovery of sex elements in bacteria. Development of Hfr strains. $F^+ \times F^-$, $Hfr \times F^-$ and $F' \times F^-$ (sexduction) crosses and their significance.

Unit – IV

Genetic mapping – Map units, mapping by recombination analysis and mapping of circular chromosomes. Mapping of bacterial chromosomes by interrupted mating and transduction. Recombination in bacteriophages. Benzer's studies on *r-II* locus of T4 bacteriophage to establish the units *recon*, *muton* and *cistron*. Eukaryotic viral genetics – Recombination, reassortment, genetic drift and shift, transcapsidation. Mutagenesis – Mutagens (physical, chemical and biological), types of mutations, molecular mechanism of mutation. Isolation and analysis of mutants. Site-directed mutagenesis and their applications

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MB 304: MICROBIAL GENETICS

Recommended Books:

1. Cooper Geoffrey, M. 2000. The Cell – a molecular approach. 2nd Edn. ASM Press. Washington.
2. Sharma AK & A Sharma. 1980. Chromosome techniques: Theory & Practice. Butterworth.
3. Alberts A et al. 1994. Molecular biology of the cell. Garland publ. New York
4. De Robertis EDP & EMF De Robertis. 2001. Cell and Molecular biology. Lippincott Williams & Wilkins. Bombay.
5. Freifelder D. 1990. Molecular biology. Narosa Publ. house, New Delhi
6. Gardner E J & D P Snustad 1996. Principles of genetics. John Wiley, New York.
7. Sambamurthy, AVSS. 1999. Genetics. Narosa Publ. New Delhi.
8. Sinnot EW., LC Dunn & T Dobzhansky 1958. Principles of genetics. V Edn McGraw Hill, New York.
9. Stansfield WD 1991. Theory & Problems in genetics III Ed McGraw Hill, New York.

10. Strickberger MW 1996. Genetics III Ed. McMillan, New York.
11. Winchester, AM. 1967. Genetics. Oxford & IBH, New Delhi.

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P 301: GENETIC ENGINEERING

Bacterial culture and antibiotic selection media. Preparation of competent cells.

Isolation of lambda phage DNA

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA

Cloning in plasmid/phagemid vectors – Selection of positive clones using blue/white colours.

Preparation of helper phage and its titration using M13 mp18/19 vectors.

Preparation of single stranded DNA template

DNA sequencing

Gene expression in E.coli and analysis of gene product

PCR

Reporter gene assay (Gus/CAT/b-GAL)

RFLP

RAPD

Handling of laboratory animals routes of immunization, bleeding of animals and preparation of serum.

Animal surgery, identification of spleen, lymph nodes and thymus.

Isolation and separation of adherent and non adherent cells.

Lymphocyte viability test (Trypan blue dye exclusion test).

Mitogen activity on lymphocytes.

Differential action and measurement of soluble and particulate antigen.

Serum electrophoresis and separation of serum proteins.

Precipitation test, immunodiffusion, radial immunodiffusion.

Agglutination reactions.

Differential count and identification of immune cells.

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P 302: ENZYMOLOGY & MICROBIAL GENETICS

Assay of chymotrypsin and trypsin.

Isolation and partial purification of enzymes, amylases and cellulases.

Determination of characteristics of enzyme-catalyzed reaction (V_{max} and K_m).

Effect of temperature and pH on the rate of enzyme catalysed reaction.

Immobilization of enzymes.

Characterisation of immobilised enzymes.

Preparation of cytological slides for mitosis using root tips.

Preparation of cytological slides for meiosis-I using flower buds; chiasma frequency

Identification of different stages of mitosis and meiosis.

Demonstration of chromosomal (structural and numerical) aberrations

Study of polytene chromosomes.

Karyotypic study.

Demonstration of Mendelian laws using color marbles or beads

Evaluation of segregation and random assortment using Chi square test or test of fitness.

Construction of genetic maps based on Problems in two and three factor crosses