

St. Aloysius' College (Autonomous), Jabalpur, M.P.
Department of Botany and Microbiology
M.Sc II semester Microbiology 2019-20
Choice Based Credit System

Class: M. Sc.
Subject: Microbiology
Paper: I

Semester: II Semester

Title of Subject: Molecular Biology and Recombinant DNA Technology (Core Course)

Max. Marks: 40(T.H.)+10 CCE =50

Course Outcome: Course imparts the conceptual knowledge of properties, structure, function and regulation of genes at the molecular level, mechanisms of DNA repair and recombinant DNA technology in prokaryotes and eukaryotes. In addition to this students develop skills of molecular techniques and hands on related sophisticated instruments required in Molecular Biology and Biotechnology research field.

UNIT - I

Nucleic acids as genetic information carriers: DNA structure, melting of DNA: superhelicity in DNA, linking number and topological properties; DNA replication, general principle, various modes of reading, continuous and discontinuous synthesis, asymmetric & dimeric nature of DNA polymerase III & simultaneous synthesis of DNA leading and lagging strands, polymerase and exonuclease activities, eukaryotic DNA polymerases; Mechanism of action of topoisomerases, ligases.

UNIT - II

Initiation of replication and construction of replication fork in test tube; retroviruses and their unique mode of DNA synthesis; relationship between replication and cell cycle in prokaryotes and eukaryotes; inhibitors of DNA replication (blocking precursor synthesis, nucleotide polymerization altering DNA structure).

UNIT III

Transcription: general principles, basic apparatus types of RNA polymerase; steps: initiation, elongation and termination, inhibitors of RNA synthesis, polycistronic and monocistronic RNA's; control of transcription by interaction by interaction between RNA polymerases and promoter regions, role of alternate sigma factors; regulation of rRNA and tRNA synthesis; maturation and splicing of mRNA, cutting and modification of tRNA: catalytic RNA, group I and group II splicing.

UNIT - IV

Gene expression in prokaryotes: induction and repression operon concept, regulatory and structural genes, operator, promoter, repressor and co-repressor, catabolite repression, cyclic AMP, CRP/CAP protein, regulation of lactose, tryptophan, histidine and arabinose operons, attenuation regulation. Gene expression in eukaryotes, Britton and Davidson's model of regulation involvement of HCP, NIICP and hormones. Regulation by N protein and nut sites in DNA binding proteins, enhancer sequences and control of transcription. Global regulatory responses: heat shock response, stringent response and regulation by small molecules such as ppGpp.

UNIT - V

Basic principle of gene cloning, genomic libraries, vectors, strategies of gene cloning using DNA or cDNA inserts, gene expression in recombinants, screening method for recombinant clones, important molecular techniques like Southern Blotting, PCR, RAPD, RFLP, DNA sequencing, and probe hybridization.

CBCS syllabus has been recommended by the experts and all the members of Board of studies for M.Sc(Microbiology), subject to the approval of relevant statutory body.

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Class: M. Sc.

Semester: II

Semester

Subject: Microbiology

Paper: II

Title of Subject: Microbial Genetics (Core Course)

Max. Marks: 40(T.H.)+10 CCE =50

Course Outcome: Paper II Microbial Genetics

Knowledge about the structure of nucleic acids, gene mutation, repair mechanisms and nuclear genome organization analysis of fine structure of the gene, role of transposable elements equips the learners with an insight into the manipulation of genetic material for a wide variety of purposes and product.

UNIT-I

Gene as unit of mutation and recombination, molecular mechanism of mutation, mutagens, types of DNA damage (deamination, oxidative damage, alkylation, pyridine dimmers), spontaneous mutations-origin, suppression of mutation.

UNIT-II

Gene transfer and genetic mapping, transformations, transfection, conjugation and transduction, genetic mapping of *E.coli*; Molecular aspects of genetic recombination.

UNIT-III

Complementation analysis, cis-trans test, deletion mapping; Benzer's concept of cistron, overlapping genes, DNA repair- photo repair, excision or dark repair, recombinational repair, SOS repair, methyl- directed mismatch repair, very short patch repair.

UNIT-IV

Plasmids, F-factors description and their uses in genetic analysis; R factors, colicin and col factors; plasmids as vectors for gene cloning; replication of selected plasmids; compatibility, transposons and their uses in genetic analysis, plasmid vectors and bacteriophage vectors.

UNIT-V

Important application of advances in microbial genetics, production of proteins, hormones and design of vaccines: conventional as well as new generation recombinant DNA vaccine, their design and advantages.

List of Recommended Books

1. Microbial Genetics by Maloy ET. Al. 1994, Jones and Bartlett Publishers.
2. Molecular Genetics of Bacteria by J. W. Dale. 1994, John Wiley and Sons.
3. Modern Microbial Genetics. 1991 by Streips and Yasbin, Niley Ltd.
4. Molecular Biology of the Gene 4th Edition by J.D. Watson, N.H. Hopkings, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. Inc. California.
5. Gene VII by Lewin Oxford University Press. 2000.
6. Bacterial and Bacteriophage Genetics. 4 th Editions by Birge.
7. Microbial Genetics by Freifelder. 4th Edition.
8. Organization of Prokaryotic Genome. 1999 by Robert L. Charlebois, ASM Publications.
9. DNA repair and mutagenesis. 1995 by Errol C. Friedberg, Graham C. Walker and Wolfram, Siede, ASM Publications.
10. Molecular Genetics of Bacteria. 1997 by Larry, Snyder and Wendy, Champness, ASM Publications.
11. Methods of General and Molecular Bacteriology, 1993, Edited by Philip. Gerhardt, ASM Publications.
12. Recombinant DNA by Watson, J.D.
13. Essentials of Molecular Biology by Malacimski.
14. Mobile DNA II by Nancy Craig, Martin Gellert Allan Lambowitz.

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COURSES OF STUDY IN M.Sc. MICROBIOLOGY
SECOND SEMESTER
Practical List

Molecular Biology and Recombinant DNA Technology

Suggested list of Practicals

1. Isolation of genomic DNA.
2. Southern blotting
3. RFLP analysis
4. Isolation of RNA
5. Isolation of poly A+ RNA
6. To study the effect of UV Radiation on yeast cell.
7. To study the dark repair mechanism in the UV radiated yeast cell.
8. To study the photo repair mechanism in the UV radiated yeast cell.
9. To perform replica plating of yeast cell.

Microbial Genetics

Suggested list of Practicals

1. To perform conjugation.
2. To study the effect of UV radiated on Bacterial cells.
3. To study the dark repair mechanism and photo repair mechanism in the UV radiated bacterial cells.
4. To perform replica plating of bacterial cells.
5. To study effect of mutagens (Nitrous acid) on bacterial cells.
6. 1. Purification of chromosomal / plasmid DNA and study of DNA profile:
7. Confirmation of nucleic acid by spectral study.
8. Quantitative estimation by diphenylamine test.
9. DNA denaturation and determination of Tm and G+C content.

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COURSES OF STUDY IN M.Sc. MICROBIOLOGY
SECOND SEMESTER
Practical List

Biostatistics and Computer Application

Suggested list of Practicals

1. Representation of Statistical data by a) Histograms b) Pie diagrams
2. Determination of Statistical averages/ central tendencies. a) Arithmetic mean b) Median c) Mode
3. Determination of measures of Dispersion a) Mean deviation b) Standard deviation and coefficient of variation c) Quartile deviation
4. Tests of Significance-Application of following a) Chi- Square test b) t- test c) Standard error
5. Computer operations-getting acquainted with different parts of Computers. [DOS] and basics of operating a computer.
6. Creating files, folders and directories.
7. Applications of computers in biology using MS-Office.
A] MS-Word B] Excel C] Power Point
8. Creating an e-mail account, sending and receiving mails.
9. An introduction to INTERNET, search engines, websites, browsing and Downloading.

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Monica Saini
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**COURSES OF STUDY IN M.Sc. MICROBIOLOGY
SECOND – SEMESTER**

Elective Paper

Paper IX: Biology of the Immune System

UNIT-I

Introduction: phylogeny of immune system, innate and acquired immunity, clonal nature of immune response; organization and structure of lymphoid organs, nature and biology of antigens and super antigens.

UNIT-II

Antibody structure and function; antigen-antibody interactions, major histocompatibility complex, BCR & TCR, generation of diversity, complement system.

UNIT-III

Cells of the immune system; hematopoiesis and differentiation, lymphocyte trafficking, B lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophils, neutrophils and mast cells. Regulation of immune response: antigen processing and presentation, generation of humoral and cell mediated immune responses, activation of B-and T-lymphocytes, cytokines and their role in immune regulation: T-cell regulation, MHC restriction, immunological tolerance.

UNIT-IV

Cell- mediated cytotoxicity; mechanism of T cell and NK cell mediated lysis; antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity; hypersensitivity autoimmunity, transplantation.

UNIT- V

Immunity to infectious agents (intracellular parasites, helminthes & viruses); tumor immunology; AIDS and other immunodeficiencies, hybridoma technology and monoclonal antibodies.

Recommended Books:

1. Kuby immunology, 4th Edition, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman)
2. Immunology-A short Course, 4th Edition- Eli Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss).
3. Fundamentals of immunology, William Paul.
4. Immunology, Roitt and others.

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Class: M. Sc.

Semester

Subject: Microbiology

Title of Subject: Microbial Metabolism (Elective Course)
Max. Marks: 40 (TH) + 10 GGE = 50

Max. Marks: 40(TH.)+10 CCE =50

Course Outcome: Paper V Microbial Metabolism
Scholars attain knowledge and skills in the following areas:

Scholars attain basic knowledge of metabolic pathways (catabolism as well as anabolism), their diversity and specific regulation and interrelation in different cells. They also learn about synthesis of certain microbial products of economic importance and gain practical knowledge and hands on tools and techniques for analyzing effect of different factors on microbial growth. The knowledge can be utilized for the growth / control of required microbes.

CNFI-1

Microbial growth: mathematical expression of growth, growth measurement, efficient growth curve, synchronous growth and continuous culture, effect of environmental factors on microbial growth, nutrients diffusion, active transport, group translocation, solutes, temperature, oxygen relations.

UNIT-II

Chae mololithotrophy: Sulphur, iron, hydrogen, carbon monoxide, nitrogen oxidations. Methanogenesis, luminescence. Brief account of photosynthetic and accessory pigments chlorophyll, bacteriochlorophyll, carotenoids, oxygenic, anoxygenic photosynthesis. Electron transport- photoautotrophic generation of ATP, fixation of CO₂- Calvin cycle, reverse TCA, carbohydrate anabolism.

UNIT-III

Respiratory metabolism: Embden Mayer Hoff pathway, Entner Doudroff pathway, glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, Pasteur effect, fermentation of carbohydrates-homo and heterolactic fermentations. Synthesis of polysaccharides-gluconeogenesis and other pathways.

UNIT-IV

Assimilation of nitrogen: Dinitrogen - nitrate nitrogen-ammonia- denitrification, synthesis of major amino-acids, polyamines; peptidoglycan-biopolymers as cell components.

UNIT-V

Microbial development, sporulation and morphogenesis, hyphae vs. yeast forms and their significance. Multicellular organization of selected microbes. Dormancy. Endospore-structure, properties and germination.

List of Recommended Books

1. Doelle H.W. 1969. Bacterial Metabolism. Academic Press.
2. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag, Moat AG. 1979. Microbial Physiology. John Wiley & Sons.
3. Sokatch JR. 1969. Bacterial Physiology and Metabolism. Academic Press.
4. Moat A G., Foster J W., Spector M P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009.

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