

Department of Botany and Microbiology
St. Aloysius' College (Auto.), Jabalpur
M.Sc. Microbiology
Semester II
Choice Based Credit System
Session 2023-24

(A) Continuous evaluation, Theory, Practical		Credits	Maximum Marks		
			Continuous Evaluation	End Semester Exam	Total
Course Code	Course Title				
I Core courses					
P I	Molecular biology and Recombinant DNA Technology	4	10	40	50
P II	Microbial Genetics	4	10	40	50
P III	Biostatistics & Computer Application	4	10	40	50
	Practical based on P I &P II	4			50
	Practical based on P III & P IV/ P V	4			50
II Electives courses (Any one to choose)		4	10	40	50
P IV	Biology of the Immune System				
P V	Microbial Metabolism				
III Skill Development course					
	Skill Development	1	Grade Point will be provided by Skill Development Centre		
Total valid credits		25			
M.Marks					
(B) Seminar and viva voce		2	25		

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M.Sc. Microbiology
Semester IV
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Total Credits 21

DISSERTATION	Credits	Maximum Marks
A. Valuation		
(i) Language & Presentation	4	50
(ii) Review of Literature	4	50
(iii) Methodology	4	50
(iv) Analysis & interpretation of Result	4	50
B. Viva-Voce INTERNAL	2	25
C. Viva-Voce EXTERNAL	2	25
Skill development	1	Grade Point will be provided by Skill Development Centre

COURSES OF STUDY IN M.Sc. MICROBIOLOGY

SECOND –SEMESTER

Session 2023-24

Paper I: Molecular Biology and Recombinant DNA Technology M.M:40

On completion of this course, the learners will -

CO 1 - be able to understand basics of Nucleic acid (DNA and RNA), DNA replication, reverse transcription, transcription, gene expression in prokaryotes and eukaryotes.

CO 2 - gets the Knowledge of global regulatory responses.

CO 3 - be able to understand fundamentals of recombinant DNA technology.

CO 4 – to equip with the knowledge of important molecular techniques

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, NHCP 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, rDNA product: Insulin, gene expression in recombinants, screening method for recombinant clones, important molecular techniques like Southern Blotting, PCR, RAPD, RFLP, DNA sequencing, and probe hybridization.

List of recommended books

1. Molecular cloning: A Laboratory Manual, J. Sambrook; Fritsch and T. Maniatis Cold Spring Harbor Laboratory Press, New York, 2000
2. Introduction to practical molecular biology P.D. Dabre, John Wiley & sons Ltd. New York 1988
3. Molecular Biology LabFax, T.A. Brown (Ed) Bios Scientific Publishers Ltd. Oxford, 1991
4. Molecular Biology of the Gene (4th edition), J.D. Watson N.H. Hopkins, J.W. Roberts J.A. Steitz and A.M. Weiner, The Benjamin/ Cummings Publ Co. Inc. California, 1987.
5. Molecular Cell Biology (2nd Edition) J. Darnell, H. Lodish and D. Baltimore, Scientist American Books, Inc., USA, 1994.
6. Molecular Biology of the Cell (2nd Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, Garland Publishing, Inc., New York, 1994.
7. Gene VI (6th Edition) Benjamin Lewin, Oxford University press, U.K., 1998.
8. Molecular Biology and biotechnology; a comprehensive desk reference, R.A. Meyers (Ed.) VCH Publishers, Inc, New York, 1995
9. Genomes, T.S. Brown.

COURSES OF STUDY IN M.Sc. MICROBIOLOGY
Second Semester
Session 2023-24

Paper II: Microbial Genetics

M.M:40

On completion of this course, the learners will

CO 1- be able to identify the molecular basis and types of mutation, their cause and effect.

CO 2- be able to investigate different mechanisms of DNA repair, gene transfer and genetic recombination mechanisms.

CO 3- be able to define types and significance of plasmids in rDNA technology.

CO 4- be able to describe role of microbial genetics in industries, environment and health.

UNIT-I

Gene as unit of mutation and recombination, molecular mechanism of mutation, mutagens, types of DNA damage (deamination, oxidative damage, alkylation, pyridine dimers). 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. Innovative topic added – Replica plating

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. Gene VII by Lewin Oxford University Press. 2000.
5. Bacterial and Bacteriophage Genetics. 4 th Editions by Birge.
6. Microbial Genetics by Frefielder. 4th Edition.
7. Organization of Prokaryotic Genome. 1999 by Robert L.Charlebois, ASM Publications.
8. DNA repair and mutagenesis. 1995 by Errol C. Friedberg, Graham C. Walker and Wolfram, Siede, ASM Publications.

9. Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM Publications.
10. Methods of General and Molecular Bacteriology, 1993. Edited by Philip. Gerhardt, ASM Publications.
11. Recombinant DNA by Watson, J.D.
12. Essentials of Molecular Biology by Malacinski.
13. Mobile DNA II by Nancy Craig, Martin Gellet Allan Lambowitz.

COURSES OF STUDY IN M.Sc. MICROBIOLOGY
Second Semester
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Paper III: Biostatistics and Computer Application

M.M:40

On completion of this course -

CO 1-Proficiency of students in various techniques of collection, collation, summarization and presentation of data.

CO2-They could learn basic concepts of probability and probability distribution functions along with applications.

CO 3-Understanding and applications of descriptive and inferential statistics enabling students to use tests of significance in biological data.

CO 4-Can apply Analysis of Variance tools and different experimental designs to biological experiments, enabling them to minimize experimental and sampling errors.

CO 5-Understands concepts of correlation and regression tools and techniques, attempts extrapolation and simulation of biological processes.

CO 6-Empowers students to utilize software packages in digital analysis and processing of biological data.

CO 7-Integrate informatics with biology through data submission protocols, sequence alignment and searches, annotations and possible applications in human health and welfare.

UNIT-I

Importance and scope of statistics in biochemical experimentation; Elements of Probability-Mathematical and Statistical definitions; Addition and Multiplication theorems; Probability Distribution Functions – Binomial, Poisson and Normal; Area under normal distribution curve.

UNIT-II

Measures of central tendency: Arithmetic, geometric & harmonic means; Measures of dispersion: range, quartile deviation, variance, standard deviation, coefficient of variation, confidence limits of population mean. Tests of significance hypotheses and errors; student t statistics- population mean equals a specified value; equality of 2 independent means (equal & unequal variance), equality of 2 means (paired samples).

UNIT-III

Analysis of variance: one-way analysis (sample sizes equal and unequal), completely randomized design; two-way analysis (one observation per cell), randomized block design; multiple comparisons: least significant difference, Duncan's new multiple range test.

UNIT-IV

Linear regression: regression diagram and equation, regression coefficient, standard error, significant tests, prediction of dependent variable from the independent variable; linear correlation- scatter diagram, correlation coefficient, standard error, significance tests;

relationship between regression and correlation coefficients; Non parametric tests: Chi-square statistics, test of goodness of fit, test of independence of attributes; standard line interpolation.

UNIT-V

Introduction to Computers: Basic architecture, generations of computer hardware and software; operating systems-WINDOWS and UNIX; system and application software; introduction to internet-LAN, MAN, WAN, Concept of bioinformatics; application of bioinformatics in microbiology.

List of Recommended Books

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) Mc Graw Hill, NewYork.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
3. Programming in C by E. Ballaguruswamy
4. How Computers work - 2000. By Ron White. Tech. Media
5. How the Internet Work 2000 by Preston Gralla Tech. Media.
6. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
7. Biostatistics - 7th Edition by Daniel
8. Fundamental of Biostatistics by Khan
9. Biostatistical Methods by Lachin

COURSES OF STUDY IN M.Sc. MICROBIOLOGY

Second Semester

Session 2023-24

Paper IV: Microbial Metabolism

M.M:40

Course Outcome

On successfully completing the module -

CO 1-Students will be able to understand the basic knowledge of metabolic pathways, their diversity, specific regulation and their interrelation in different cells.

CO 2-Students will be able to learn about synthesis of certain microbial products of economic importance.

CO 3-Learners will be able to explain the transport of different metabolites generated, with application in industrial processes.

CO 4-Students will be able to gain practical knowledge for analyzing effect of different environmental factors on microbial growth.

UNIT-I

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

Chemolithotrophy: 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