



**JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY,
JAIPUR**

**Faculty of Agriculture and Veterinary Science
Department of Food and Biotechnology**

SYLLABUS

**MASTER OF SCIENCE IN
MICROBIOLOGY
(M. Sc. MB)**

SESSION – 2022-23

DURATION – 2 YEARS

**SYLLABUS FOR:
1-4 SEM**



PROGRAM DETAIL

Name of Program	-	Master of Science (M.Sc.)
Program Code	-	M.Sc. MB
Mode of Program	-	Semester
Duration of Program	-	2yrs/ 4Semester
Total Credits of Program	-	90
Curriculum Type and Medium Choice	-	English

Program Outcomes Obtain a significant knowledge on fundamental and advanced aspects of Microbiology. Gain in-depth knowledge on different antibiotics from the viewpoint of targets, resistance mechanisms and spectrum evaluation methods. Gain insight into the various aspects of immunogenetics, molecular immunology and clinical immunology.

Specific Program Outcomes Assimilate technical skills on immunotechnology and biotechnology. Acquire research skills- plan & execute experimental techniques independently as well as to analyse & interpret data. Gain in-depth knowledge on different antibiotics from the viewpoint of targets, resistance mechanisms and spectrum evaluation methods.



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SYLLABUS DETAIL

I SEMESTER

S. No.	Credit	Name of Course
1	3	Microbiology
2	1	Microbiology Lab
3	3	Microbial Physiology and Biochemistry
4	1	Microbial Physiology and Biochemistry Lab
5	3	Immunology
6	1	Immunology Lab
7	3	Statistical Methods
8	1	Statistical Methods Lab
9	4	Microbial Diversity, Management and Exploitation
	2	Biosafety Regulatory Affairs
Total	22	

II SEMESTER

S. No.	Credit	Name of Course
1	4	Research Methodology
2	4	Microbial Genomics
3	3	Enzyme and Microbial Biotechnology
4	1	Enzyme and Microbial Biotechnology Lab
5	3	Molecular Biology
6	1	Molecular Biology Lab
7	3	Environmental Microbiology
8	1	Environmental Microbiology Lab
9	1	Industrial Visit
Total	21	



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III SEMESTER

S. No.	Credit	Name of Course
1	3	Food Microbiology & Agricultural Microbiology
2	1	Food Microbiology & Agricultural Microbiology Lab
3	3	Microbial Genetics
4	1	Microbial Genetics Lab
5	4	Fermentation Technology
6	3	Bioinformatics
7	1	Bioinformatics Lab
8	4	Microbiology of Waste Water
9	2	Pre Dissertation Training (60 Days) (After II Sem)
Total	22	

IV SEMESTER

S. No.	Credit	Name of Course
1	25	Dissertation/ New Product Development (NPD)
Total	25	



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I Semester

Course Name: Microbiology:

Total- 4 (3T+1P)

Course Outcome : This course develops the concepts of apply the knowledge of basic concepts, fundamental principles and scientific theories and processes related to the fields of life sciences with their relevance in day-to-day life.

UNIT-I (Diversity and classification of microorganisms)

Theory (1 credits)

Introduction to microbial kingdom- - An overview. Morphological details of prokaryotic and eukaryotic microbes.i.e.bacteria, fungi, yeasts, protists, streptomycetes, Microbial nutrition, physiology and life cycles.

Practicals(0.25 credit)

Sr. no.	Name of practical	Nature
1	Preparation of culture media (i) Arrange all required compounds (ii) Calculate as per required amount of media, weighing and autoclaving	Practical

UNIT-II (Microscopy and Sterilization)

Theory (1)

Methods in microscopy and staining procedures, sterilization techniques, kinetics of sterilization, control of microbes by physical and chemical means.

Practicals(0.25 credit)

Sr. no.	Name of practical	Nature
1	Study of different types of streaking methods. (i) preparation of media (ii) Streaking and incubation (iii) Observation of results	Practical

UNIT-III (Microbial growth and measurement)

Theory (1)

Microbial growth- Kinetics of growth, methods of growth measurement. Batch and continuous cultivation techniques, chemostat and turbidostat techniques.

Practicals(0.5 credit)

Sr. no.	Name of practical	Nature
1	Antibacterial activity by disc diffusion method (iv) preparation of media (v) Spreading and incubation (vi) Observation of results	Practical

Recommended Text Books:

1. Microbiology by Pelczar- M.J.Chan ECS & Krieg NR-Tata Mcgraw Hill,
2. Microbiology- Prescottt.

Reference Books:

3. General Microbiology by Brock.
4. Microbial Physiology 4th ed. By Alber G.Moat& John W.Foster Wileylliss.
5. Foundation in Microbiology-by Talaro K, Talaro A, CassidaPelzar and Reid



6. W.C.Brown Pub.
7. General Microbiology by R.Y.Stanier

References/Correlation with Ancient Indian Literature:

1. Rigveda1/191/9<http://www.hinduismfacts.org/hindu-scriptures-and-holy-books/rigveda/>
2. Rasa-Jala-Nidhi or Ocean of Indian chemistry and alchemy/vol.vIEd.1984/AvaniPrakashan,Ahmedabad,India;CharakSamhita<https://onlinelibrary.wiley.com/doi/abs/10.1002/jctb.5000494453>
3. AvS'5/23/5;Medicine in the Veda
IkennethZyskhttps://archive.org/stream/in.ernet.dli.2015.201547/2015.201547.Medicine-In_djvu.txt

Course Name: Microbial Physiology and Biochemistry:

Total- 4 (3T+1P)

Course Outcome :This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetic and regulation of different metabolic processes in microorganisms.

Unit I (Biomolecules & Their role)

Theory (1credits)

Scope and importance Structure and function of biomolecules: Carbohydrates, proteins, lipids Overview of Enzymes: Characteristics, Ribozymes, co-enzymes, Assimilation of sulphur, phosphorus and nitrogen. Biochemical basis of actions of antimicrobial agents

Unit II (Enzyme Kinetics & its regulation)

Theory (1credits)

kinetics-M-M equation, determination of K_m and V_{max} , mechanism of action - binding of substrate and lowering of activation energy, covalent catalysis, acid- base catalysis, allosteric regulation, enzyme inhibition.

Unit III (Concept of Metabolism)

Theory (1credits)

Metabolism: General concepts - application of second law of thermodynamics, redox potential, outline of intermediary metabolism: free energy change of the reactions catabolism – anabolism, ATP as high energy phosphate compound, ATP synthesis Bacterial photosynthesis,

Practical (1credits)

S. No.	Practical's
1	Study of normal micro- biota of mouth and skin; isolation, identification and preservation of microorganisms



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2	Laboratory examination and identification and biochemical tests of pus specimens using avirulent strain of MTCC Culture for Staphylococcus aureus, Streptococcus pyogenes and Pseudomonas aeruginosa
3	Determination of MIC values for antimicrobial chemicals
4	Biochemical, enzymatic and serological tests.

Recommended Text Books:

1. Microbiology – L. M. Prescott
2. A Textbook Of Basic And Applied Microbiology - Aneja K.R.
3. Principles of Biochemistry, A.L. Lehninger. D.L. Nelson and M.M. Cox, 4th Edition. W.H. Freeman and Company, 2004

Recommended Reference Books:

1. Fundamentals of Enzymology. N.Price, and L. Stevens, 1999. 3rd Edition. Oxford University Press Inc. New York
2. Fundamentals of Biochemistry, 3rd Edition by D. Voet, J.G.Voet, C.W. Pratt. 2004, John Wiley and Sons, New York.

Course Name: Immunology:

Total- 4 (3T+1P)

Course Outcome :It is to develop concepts in role and the underlying mechanisms for the functioning of immunological cells and their interactions. The regulation of molecular synthesis, signalling, immune responses and allied activities of immune system at the molecular level.

UNIT-I(Immunity and Immune system)

Theory (1 credits)

Natural immunity, defensins, pathogen associated recognition motifs, Toll receptors, complement system, applications of complement proteins in rapid clearance of pathogens, acquired immunity: immune cells, antigens haptens, B and T cell epitopes.

Practicals(0.25 credit)

Sr. no.	Name of practical	Nature
1	ELISA Test (i) Basic of ELISA (ii) Reagent preparation (iii) Observation after reaction time	Practical

UNIT-II (Antibody and Antigen)

Theory (1 credits)

Antibodies: structure and function, monoclonal antibodies, single chain antibodies, domain antibodies, antigen antibody reactions, genetics of immunoglobulins and antibody diversity, Major Histocompatibility Complex,



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structure and functions of class I and class II MHC molecules, antigen presentation by MHC and non MHC molecules.

Practicals(0.25 credit)

Sr. no.	Name of practical	Nature
1	Radial immunodiffusion (i) Preparation of Slide (ii) Practice (iii) Observation and calculation	Practical

UNIT-III (Hypersensitivity, Transplantation, Vaccination)

Theory (1 credits)

Cytokines, in vivo regulation of immune responses, B and T cell activations, hypersensitivity, mucosal immunity, introduction to transplantation immunology tolerance, tumor immunology and vaccines

Practicals(0.5 credit)

Sr. no.	Name of practical	Nature
1	RBC count (i) preparation of reagent (ii) Spreading on slide (iii) Observation of results	Practical

Text Books:

- 1 Janes Kuby; Immunology 2nd edition. W.H. Freeman and Company New york(1994).

Suggested Readings:

- 1 M. Roit; Essential Immunology. Blackwell Scientific publication,1988.
- 2 Immunology by Tizard

References/Correlation with Ancient Indian Literature:

1. Suśruta 600 BC, SS. Sū chaps. 4, 15, 21 edited by Singhal et.al. ChoukhambaSurbharati 2nd edition Varanasi/Delhi, India, 2002<https://pdfs.semanticscholar.org/68ec/5838cad4c40baf2563699c8e1d2514249fea.pdf>
2. Suśruta 600BC, SS Ci Chap. 27-30 edited by Singhal et al ChoukhambaSurbharati 2nd edition Varanasi/Delhi, India 2002https://ayushdhara.in/review/pdf/ayush_5218193.pdf
3. Sarangdhara 1300AD, SarandharasamhitaChoukhamba publications Varanasi/Delhi, India<http://www.carakasamhitaonline.com/mediawiki-1.32.1/index.php?title=Rasayana>

Course Name: Statistical Methods

Course Outcome:To enable the students to 1. Describe the basic concepts and principles of statistics. 2. Understand the role of statistics and computer applications to conduct research studies. 3. Apply statistical techniques to research data for analyzing. 4. Interpreting the data meaningfully and differentiate between the qualitative and quantitative methods of analysis of data. 5. Suitably apply data reduction strategies and illustrate data using various graphical methods. 6. Use appropriate parametric



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and non-parametric statistical tests. 7. Draw the conclusions and interpretations from the analysis of data using various statistical software.

Total- 4 (3T+1P)

UNIT I (Basics of Tabulation of Data & Central Tendency)

Theory (1 Credits)

Classification and tabulation of data, Frequency distribution, Histogram, Frequency polygon and frequency curve, cumulative frequency curves, Measures of central tendency: mean, median, mode; Measures of dispersion: range, mean deviation, variance and standard deviation.

Practicals: (1 credits)

Sr. no.	Name of practical	Nature
1	To find out Mean	Practical/Practice
2	To find out Median	Practical/Practice
3	To find out Mode	Practical/Practice

UNIT II (Probability, Correlation, Regression & Sampling)

Theory (1.0 Credits)

Elementary Probability Distribution, Correlation: Positive and negative correlation and calculation of Karl Pearson's coefficient of correlation. Regression, Sampling: concept of population and sample, Sampling distribution and standard error.

UNIT III (Vital Statistics & ANOVA)

Theory (1.0 Credits)

Hypotheses testing: null and alternative hypothesis, T-test, Chi-square test, goodness of fit test and homogeneity of samples, F-test. ANOVA: one way and two way analysis of variance, Design of experiments. Use of statistical packages for data analysis (SPSS).

Text Books:

1. Elements of Mathematical Statistics; S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi
2. Elements of Biostatistics; S. Prasad; Rastogi Publications, Meerut

Suggested Readings:

1. Basic Statistics:-B.L.Agarwal
2. Principles and Procedure of Statistics:-A Biometrical Approach:-R.G.D. Steel and J.H.torrie
3. Fundamentals of Applied Statistics, S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi.

References/Correlation with Ancient Indian Literature:

1. Sankhyā: The Indian Journal of Statistics Published by: Indian Statistical Institute <https://www.springer.com/statistics/journal/13171>
2. The Sulbasūtras http://www-history.mcs.st-and.ac.uk/Projects/Pearce/Chapters/Ch4_2.html
3. History of Hindu Mathematics, Asia Publishing House, Bombay, 1962 <https://link.springer.com/article/10.1007/BF02836134>



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Course Name: Microbial Diversity, Management and Exploitation:

Total- 4 (4T)

Course Outcome: This course introduces the development of taxonomy and systematic, the various characters used for this purpose, the rules governing the different taxonomy and classification systems and the salient features of the different microbial groups. It also focuses on the rapidly evolving nature of taxonomy and systematic.

Unit I (Diversity of Microbial World)

Theory (1 credit)

The microbial world: Major domains and their general characteristics General concepts regarding biodiversity: Definition, diversity indices and diversity gradients.

Unit II (Cultivation & Non-cultivation Approaches)

Theory (2 credits)

Exploration and quantification of the microbial diversity: Cultivation and non-cultivation approaches; complementarity between cultivation and non-cultivation approaches; the relevance of classical taxonomy of the postgenomic era; role of genomics in higher order classification, species concept in microbial world.

Unit III (Management & Exploitation of Microbial Diversity)

Theory (1 credit)

Microbial diversity and ecosystem function-theories/hypotheses and experimental results. Management and exploitation of microbial diversity. Use of microbes in environmental bioremediation

Recommended Text Books:

4. Microbiology – L. M. Prescott
5. A Textbook Of Basic And Applied Microbiology - Aneja K.R.
6. Principles of Biochemistry, A.L. Lehninger. D.L. Nelson and M.M. Cox, 4th Edition. W.H. Freeman and Company, 2004

Recommended Reference Books:

3. Fundamentals of Enzymology. N.Price, and L. Stevens, 1999. 3rd Edition. Oxford University Press Inc. New York
4. Fundamentals of Biochemistry, 3rd Edition by D. Voet, J.G.Voet, C.W. Pratt. 2004, John Wiley and Sons, New York.

Biosafety Regulatory affairs

Unit I (Biosafety manual)

Theory (1)

Course Outcome: This paper develops concepts a holistic and comprehensive regulatory approach to ensure biosafety would be based on the precautionary principle, covering the entire range of activities from research and development of GMOs to their commercialization, and post-release monitoring.

Introduction and development of Biosafety; Practices & Principles; General lab equipments; Definitions & Biosafety levels, 1, 2, 3, 4; Biological safety cabinets, centrifuge; Shipment of biological specimens; Biological waste management; Decontaminations, Biosafety manuals; Medical surveillance, Emergency response.



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Quality System Regulations (QSR), Good Manufacturing Practice (GMP), Good Laboratory Practices (GLP), Good Clinical Practice (GCP)

Unit II (Bioethics in Biological Science)

Theory (0.5)

Bioethics- History & Introduction; Social, Legal & Ethical Issues in biological science, ethical concerns of biological research, Bioethics Committees Animal ethics- Norms in India-

Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Hazardous materials used in biological studies, their handling and disposal.

Unit III (Intellectual Property Rights)

Theory (0.5)

Introduction to IPR, IPR in India, IPR in abroad, Types of IPR- Patent, Copyright, Trademark, Design & Trade Secret, Biotechnology/Microbiology & IPR- Commercial potential of new biological inventions; Patenting, Protection of geographical indication

Biological Inventions-Objective, Concept of novelty, Concept of inventive step, Microorganism, Moral issues in patenting biological inventions.

Recommended Text Books:

1. Ethical Issues in Biotechnology by Richard Sherlock & John D. Morrey, Rowman & Littlefield Publishers
2. Regulatory Framework for GMOs in India, Ministry of Environment and Forest, Government of India, New Delhi. 2006
3. Cartagena Protocol on Biosafety, Ministry of Environment and Forest, Government of India, New Delhi. 2006
4. Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi. 2012

Recommended Reference Books:

1. Agarwal, K..2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Beier, F.K., Crespi, R.S. and Straus, T.2007 Biotechnology and Patent protection Oxford and IBH Publishing Co. New Delhi.
3. Sasson A, 1988 Biotechnologies and Development, UNESCO Publications.

II Semester

Course Name: Research Methodology:

Total- 4

UNIT – I (Introduction & Types of research)

Course Outcome: This course develops the concepts of research and covers all aspects ranging from biosafety in the laboratory, experimental protocol, presentation of data and viva voce.

Theory (1 Credit)

Research methodology: Introduction & meaning of research, Objectives of research, motivation in research. Types of research & research approaches. Research methods vs. methodology, Criteria for good research.

Research problem: Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem.



UNIT – II (Research design)

Theory (2 Credits)

Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.

Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.

UNIT – III (Methods of data collection)

Theory (1 Credits)

Methods of data collection: collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules.

Report Writing

Recommended Text Books:

1. Kothari CR (2004). Research Methodology: Methods and Techniques, New Age International.
2. Bhattacharya DK (2009). Research Methodology, Excel Books.

Reference Text:

1. Annals of Food Science & Technology
2. Journal of Nutrition
3. Journal of Food Science & Technology

Course Name: Microbial Genomics

Total- 4 Credits

Course Outcome: This course develops concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Unit I (Gene Manipulation Techniques)

Theory (1 credit)

Tools for studying DNA/genes: Enzymes for DNA manipulation, molecular cloning, DNA libraries, fluorescent in situ hybridization (FISH), denaturing gradient gel electrophoresis (DGGE).

Unit II (Advanced Techniques of Molecular Biology)

Theory (2 credits)

Genomes: Size, physical structure, genome analysis, gene duplication. Mapping of genome: Molecular markers as tools for mapping, restriction fragment length polymorphism (RFLP), randomly amplified polymorphic DNA (RAPD), simple sequence length polymorphism (SSCP), amplified fragment length polymorphism (AFLP).

Unit III (Expression of Genes)

Theory (1 credit)



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Functional genomics: entire genome expression analysis-microarrays, expressed sequence tags (ESTs), serial analysis of gene expression (SAGE), single nucleotide polymorphism (SNP). Proteomics- basic concept and importance.

Recommended Text Books:

1. Microbiology – L. M. Prescott
2. A Textbook Of Basic And Applied Microbiology - Aneja K.R.

Recommended Reference Books:

1. Biotechnology – Fundamentals of Microbial Genetics and Genetic Engineering (Vol. 12) by R.H. Rehm and G. Reed, Veriag Press, NY, 1992.
2. Gene Cloning by T.A. Brown, Van Nesterland and Rainold, NY, 1996.
3. Genes VII by B. Lewin, John Wiley & Sons, NY,

Course Name:Enzyme and Microbial Biotechnology

Total- 4 (3T+1P)

Course Outcome:This course develops concepts in technologies used in agriculture, mining, energy production and human health with respect to microorganisms and genetically engineered microorganisms. Introduces concepts of nanotechnology.

Unit I (Enzymes & Enzyme Kinetics)

Theory (1credits)

Enzymes from microbial sources, large scale production of enzymes, recovery of enzymes, enzyme purification methods - enzyme precipitation, separation by chromatography, enzyme reactors. Immobilized enzymes: Physical and chemical methods of immobilization, immobilization supports, kinetics of immobilized enzymes.

Practical (0.5 Credits)

Sr. no.	Name of practical	Nature
1	Optimization of conditions for optimal production of enzyme: Media composition, Incubation temperature, Aeration, Incubation time.	Practical
2	Effect of pH and temperature on enzyme activity	Practical
3	Protein purification by Gel exclusion chromatography	Practical



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4	Enzyme/cell immobilization in different matrices	Practical
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Unit II (Application of Enzymes)

Theory (1 credits)

Enzyme catalysis in apolar medium, reverse micellar entrapment of enzymes and its applications. Application of enzymes: synthesis of chemicals using enzymes, food technology and medicine. Enzymes in diagnostic assays. Enzyme electrodes, immunoenzyme techniques.

Practical (0.5 Credit)

Sr. no.	Name of practical	Nature
1	Isolation of useful microorganisms from natural samples	Practical
2	Growth of microorganisms and estimation of Monod parameters	Practical
3	Assay of enzymes (amylases, lipases, proteases)	Practical
4	Screening of microbes for production of industrially important enzymes.	Practical

Unit III (Useful Microbs)

Theory (1credit)

Commercial products of microbes: Antibiotics, biopolymers, biosensors, biopesticides Production of biofuels. Microbial toxins: Types, biochemical and molecular basis of toxin production, implications. Genetically engineered microbes, anti-HIV, anticancer, antifungal, antiplasmodial, antiinflammatory compounds.

Recommended Text Books:

1. Microbiology – L. M. Prescott
2. A Textbook Of Basic And Applied Microbiology - Aneja K.R.

Recommended Reference Books:

1. Food Microbiology: Fundamentals and Frontiers by Dolye.
2. Food Microbiology : An Introduction by Montville
3. Environmental Microbiology: aLaboration Manual by Ian L. Pepper and Charles P. Gerba.



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References/Correlation with Ancient Indian Literature:

1. Rig-Veda 1-163, 1,2,3,4 Figure 7 <http://xn--j2b3a4c.com/rigveda/1/163/1>
2. The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi. <http://voiceofdharma.org/books/rig/>
3. Hindi translation of Rigveda by Ramgovind Tripath <http://literature.awgp.org/book/rigveda/v1>

Course Name: Molecular Biology:

Total 4(3T+1P)

Course Outcome: This course develops concepts in molecular biology: DNA packaging, DNA damage and repair, gene structure, expression and regulation in both prokaryotes and eukaryotes.

UNIT-I(Genome packing and replication)

Theory (1credit)

Nucleic acids, DNA structure, Replication: eukaryotic and prokaryotic replication. Replication of double stranded and single stranded circular DNA, telomere replication, Nucleosomes: eukaryotic and prokaryotic genome packing, heterochromatin, euchromatin.

Practicals(0.5 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from E.coli. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate DNA from E.coli.
2	To prepare Agarose gel for gel electrophoresis (i) Preparation of agarose solution (ii) Gel casting
3	To separate and visualize genomic DNA of E.coli. (i) Loading of DNA into agarose gel (ii) Visualization of DNA

UNIT-II(RNA synthesis and its processing, geneticcode)

Theory (1 credit)

Transcription: mechanism of RNA transcription in prokaryotes and eukaryotes; model systems of transcriptional control: lac operon, lambda phage; promoters, enhancers, repressors; RNA processing: processing of heterogeneous nuclear RNA: splicing, capping, polyadenylation; Translation: universal genetic code, mechanisms of initiation, elongation and termination of translation, wobble hypothesis, genetic code in mitochondria.

Practicals(0.25 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from blood. (i) Reagent preparation. (ii) Blood collection. (iii) Isolation of DNA.



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2	To isolate DNA from plant sample. (i) Grinding of plant sample (ii) Isolation of DNA
3	To determine the concentration of DNA.

UNIT-III (Mutation, DNA repair and transposons)

Theory (1 credit)

Mutation, DNA repair: Base excision, Nucleotide excision, Mismatch and SOS repair; Recombination: mechanism of homologous recombination in prokaryotes, site specific recombination, , transposons, tumor suppressor genes, protein folding and degradation.

Practicals(0.25 credit)

Sr. no.	Name of practical
1	To isolate genomic DNA from cheek cells. (i) Reagent preparation. (ii) Separation and lysis of cells. (iii) Precipitation of DNA.
2	To isolate RNA from bacteria. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate RNA from E.coli.
3	To determine the concentration of RNA.

Recommended text Books:

1. Lehninger Principles of biochemistry by Nelson and Cox.

Reference books

1. Gene VII by Benzamin Lewin.

References/Correlation with Ancient Indian Literature:

1. Rig-Veda 1-163, 1,2,3,4 Figure 7 <http://xn--j2b3a4c.com/rigveda/1/163/1>
2. The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi. <http://voiceofdharm.org/books/rig/>
3. Hindi translation of Rigveda by RamgovindTripath <http://literature.awgp.org/book/rigveda/v1>

Course Name: Environmental Microbiology

Total 4(3T+1P)

Course Outcome:This course develops concepts in Environmental Microbiology (microbial diversity, community structure and role of microorganisms in biogeochemical cycles, role of microorganisms in sustainable development and bioremediation of pollutants using microorganisms.)

Unit I (Microorganism in Environment)

Theory (1credits)



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Aeromicrobiology: Microorganisms in outdoor atmospheric environment, nature of bioaerosols, their fate and transport. Aeromicrobiology: Microorganisms in indoor environment - buildings, spaceflights, hospitals and laboratories.

Practical (0.5 Credit)

1	Monitoring of pollution indicating microbe communities in case of hydrocarbon-polluted soil/groundwater systems.	Practical
2	Effect of Abiotic Stress on bacterial growth (i) Media preparation and standard stock preparation (ii) Effect of unusual condition on MO	Practical
3	Comparison of BOD and methane production techniques.	Practice

Unit II (Soil & Aquatic Microbs)

Theory (1 credits)

Microorganisms in soil-environments: Surface, subsurface and deep soil conditions.

Microorganisms in various aquatic environments: Freshwater, brackish-water, marine-water and subterranean conditions.

Practical (Credit 0.5)

1	Clean water analysis by standard methods	Practical
2	Microbial ecology of composting: Nucleic Acid Microbial Community Analysis	Practical
3	Preparation of Chemical Competent E. Coli Cells	Practice

Unit III (Microbs of Different Habitat)

Theory (Credit 1)

Detailed Introduction to thermophiles, barophiles, acidophiles, alkalophiles and psychrophiles.



Recommended Text Books:

1. Microbiology – L. M. Prescott
2. A Textbook Of Basic And Applied Microbiology - Aneja K.R.
3. Environmental Microbiology (Second Edition): Ian L. Pepper, Charles P. Gerba, Terry Gentry and Raina M. Maier

Industrial Visit

Outcome: It is to develop concepts in knowledge about the ongoing research in various national research institutes and functioning of microbiology- related industries and industrial processes.

III Semester

Course Name: Food Microbiology & Agricultural Microbiology

Total 4(3T+1P)

Course Outcome: This course focuses on the understand and know various aspects of food quality in terms of microbes and the significance of microbes in food and human health. Study effects of microorganisms in development of various diseases with understand food safety and associated hazards.

UNIT-I: Microbiology of foods

Theory (1 Credit)

Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses. Microbiological examination of foods- microscopic techniques and cultural techniques. Direct microscopic examination, total colony counts and differential enumeration. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

Practical (0.5)



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S.No.	Practical
1	Microbiological examination of milk & milk products.
2	Preparation of Yoghurt
3	Microbiological examination of fresh & canned foods
4	Microbiological quality testing of milk (MBRT test)
5	Isolation of yeasts from grapes

UNIT-II: Food processing & preservation

Theory (1 Credit)

Food processing & preservation: Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals – organic acids, nitrates, nitrites and cresols; Radiation – UV light, Y-irradiation.

Fermented foods – preparation of Yogurt, streptococcus species, Lactobacillus bulgaricus; Manufacture of cheese; Pencilliumroqueforti. Fermented soybean products.

Microorganisms as food – single cell protein, yeast, algae and fungal biomass production.

UNIT-III: Agricultural Microbes

Theory (1 Credit)

Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, role of Microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins)

Bio-geo chemical cycles – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, de-nitrification, sulphur, iron and phosphorus cycles. Rhizosphere – Rhizosphere Microorganisms, Biochelators (Siderophores).

Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes

Practical (0.5)

S.No.	Practical
1	Isolation of Rhizobium from root nodules
2	Isolation of Azotobacter from soil
3	Microbiological Assay of antibiotics.

RECOMMENDED BOOKS FOR MB 403:

1. Food Microbiology: Fundamentals & Frontiers, 2nd edition, by M.P. Dayle et al, ASM press, 2001.
2. Food Microbiology by Adams, M.R. and Moss M.O. (1995), Royal Society of Chemistry Publication, Cambridge.
3. Food Microbiology by Frazier W.C. and West haff D.C. (1988), Tata Mc.Graw Hill Publishing Company Limited, New Delhi.

Course Name: Microbial Genetics

Total 4(3T+1P)



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Course Outcome: This course develops concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Unit I (Genetic Material maintenance Mechanisms)

Theory (1 credits)

Gene Transfer Mechanism : Bacterial transformation- mechanism of transformation, transfection and competence; Transduction- Generalized transduction, specialized transduction and abortive transduction; Conjugation- Conjugation method, the F factor, conjugal transfer by effective contact and pili, high frequency recombination (HFr) strains, formation of F' (F prime)

Mapping by using transformation, transduction and conjugation, Horizontal gene transfer.

Practicals: (0.5 Credits)

1	Plasmid DNA isolation From E.coli	Practical
2	Isolation of Genomic DNA from a Pure E. coli Culture	Practical
3	DNA Identification by Agarose gel electrophoresis	Practice

Unit II (Viral Genetics and Transposons)

Theory (1 credits)

Viral Genetics- Viral Genome, their types and structure, Virus Replication: RNA Viruses: General strategies, replication of plus stranded RNA virus (polio), negative strand RNA viruses (VSV and Influenza) Other RNA Viruses

Transposition: Structure of transposons, replicative and non-replicative transposition, transposon mutagenesis. Genetic recombination; Molecular models and mechanism, Gene conversion.

Practicals: (0.25 Credits)

1	PCR: Amplification of 16S Rna Gene from E. coli DNA by Domain Specific Primers	Practical
2	Amplified DNA Identification by Agarose gel electrophoresis	Practical



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Unit III (Regulation of Gene Expression)

Theory (1 credits)

Mutation- Spontaneous and induced mutation, base pair change, frameshift mutation, deletion, inversion, tandem duplication, insertion, Physical and Chemical mutagen, Outline of DNA damage and repair mechanism

Gene expression and regulation: Operons and regulons, repression and activation of Lac operon, feed back inhibition and regulation of virulence genes in pathogenic bacteria. Signal transduction in microbes. Use of microbes in genetic engineering.

Practicals: (0.25 Credits)

1	Foreign DNA Transformation into E.Coli Competant Cells	Practical
2	Confirmation of Transformation by Blue White coloy Selection	Practical
3	Ligation method	Practice

Recommended Text Books:

4. Microbiology – L. M. Prescott
5. A Textbook Of Basic And Applied Microbiology - Aneja K.R.

Recommended Reference Books:

4. Biotechnology – Fundamentals of Microbial Genetics and Genetic Engineering (Vol. 12) by R.H. Rehm and G. Reed, Veriag Press, NY, 1992.
5. Gene Cloning by T.A. Brown, Van Nesterland and Rainold, NY, 1996.
6. Genes VII by B. Lewin, John Wiley & Sons, NY,
7. Genetic Fundamentals & Genetic Engineering by H.R. Rehm and G. Reed, Vol-12 VCH, 1993.
8. Genetics for Microbes by A. Brainbridge, Balckkis& Sons Ltd. New York, 1987

Course Name: Fermentation Technology

Total 4(4T)

Course Outcome: This course aims on the development of concepts in the processes, instruments, management, quality etc being used in industries to produce the products using microorganisms.

Unit-I: fermentation processes

Theory (1 Credit)



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An introduction to fermentation processes – the range of fermentation processes. Microorganisms used in industrial microbiological processes – the isolation, preservation and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants. Media and materials required for industrial microbiological processes – Antifoams.

Unit-II: Microbial growth kinetics

Theory (2 Credit)

Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations. Inoculum development for large-scale processes. Design of fermentor: Construction and maintenance of aseptic conditions. Control of various parameters. Sterilization of media. Types of fermentors. Computer application in fermentation technology. Recovery and purification of fermentation products. Fermentation Economics.

Unit-III: Fermented Products

Theory (1 Credit)

Production of ethyl alcohol, beer & wine. Enzyme probe biosensors, biochips, biofilms, biosurfactants, Biotransformation, Petroleum Microbiology. Microbial leaching role of microorganisms in the recovery of minerals (uranium, copper) from ores.

RECOMMENDED BOOKS:

1. Solid State fermentation in Biotechnology by Pandey.
2. Industrial Microbiology by Waiter.
3. Fermentation Microbiology and Biotechnology by Mansi.

Course Name: Bioinformatics

Total 4(3T+1P)

Course Outcome: This course focuses on the knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics; existing software effectively to extract information from large databases and to use this information in computer modelling.

UNIT-I (Databases & Alignment)

Theory(1 Credits)

Introduction; Databases - sequence, structure, non-redundant; Sequence alignment - pairwise and multiple; phylogenetics; ORFinder;

Practical (0.5Credits)

Sr. no.	Name of practical	Nature
1	To study about the different biological databases in variable formats i) Study about the NCBI ii) Review of the variety of entities of NCBI	Practical
2	To study about the different biological databases in variable formats iii) Study of Genbank.	Practical



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	iv) Study of Format.	
3	To study about the different biological databases in variable formats v) Study of SWISS PROT. vi) Study of Format.	Practical

UNIT-II(Prediction and Structure)

Theory(1 Credits)

Structure prediction methods – high-accuracy, template based, free modeling (new folds); Secondary structure prediction;

Practical (0.5 Credits)

Sr. no.	Name of practical	Nature
1	To study about the sequence similarity in different molecules through BLAST i) Find the similarity between Protein sequences from the available protein domains ii) Learn the storage of the Protein sequence for the further proceeding work	Practical
2	To study about the sequence similarity in different molecules through BLAST iii) Find the similarity between Gene sequences from the available resources iv) Learn the storage of the Protein sequence for the further proceeding work	Practical
3	To study about the sequence similarity in different molecules through FASTA v) Find the similarity between Protein sequences from the available protein domains vi) Learn the storage of the Protein sequence for the further proceeding work	Practical

UNIT-III(Pattern recognition)

Theory(1 Credits)

Pattern recognition – PSSMs, weight matrices; hidden Markov models

Recommended Text Books:

Bioinformatics. Keith, J. Humana Press, 2008



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Computer methods for macromolecular sequence analysis. R.F.Doolittle, Academic Press, 1996.

Suggested Readings:

- 1 Bioinformatics. Sequence and genome analysis. D.W.Mount. Cold Spring Harbor Lab. press. 2004.
- 2 Bioinformatics and functional genomics. J. Pevsner. Wiley-Liss, 2003.

References/Correlation with Ancient Indian Literature:

1. Atharva Vedas <http://www.sacred-texts.com/hin/av.htm>
2. Vishnudharmottara <https://ayushnanda.com/vishnudharmottara-purana>

Course Name: Microbiology of Wastewater

Total 4

Course Outcome: This course focuses on the various characteristics of environments including the physico-chemical variables, climate events, microbial habitats, the different marine microorganisms found in seawater and their metabolic diversity, detection and enumeration methods.

Unit I (Role of Microorganism in waste water treatment)

Theory (2credits)

Role of microorganisms for biomonitoring of various quality-parameters related to water and wastewater - Indicator organisms, single species laboratory bioassays and biosensors.

Unit II (Waste water treatment)

Theory (1credits)

Detailed introduction to various stages of wastewater treatment: Primary, secondary and tertiary treatment. Batch and continuous reactor-systems: Attached growth and suspended culture systems, stabilization ponds.

Unit III (Removal of Toxins)

Theory (1credits)

Control of pathogens in water and wastewater. Use of microorganisms for removal of various toxins and metallic ions from wastewater.

Pre-Dissertation Training (60 Days) (After II Sem during summer vacation)

Outcome: This Pre-Dissertation Training focuses on the develop the skills of preparing and conducting independent research.

IV Semester

Details of Training/Visit/Dissertation/Internship: Dissertation

Outcome : Dissertation/ New Product Development (NPD): This Dissertation aims to introduce ability to apply the tools and techniques of Biotechnology in conducting independent research.