Sri Dev Suman Uttarakhand University, Badshahithaul, Tehri (Garhwal), Uttarakhand-249199

NATIONAL EDUCATION POLICY-2020

Syllabus for

Sri Dev Suman Uttarakhand University Campusand

All Affiliated Colleges

STRUCTURE OF UG - MICROBIOLOGY SYLLABUS

NATIONAL EDUCATION POLICY-2020

B.Sc. Microbiology

(2022-23)

DEPARTMENT OF

MICROBIOLOGY

FACULTY OF SCIENCE

SRI DEV SUMAN UTTARAKHAND VISHWAVIDYALAYA, BADSHAHITHAUL, TEHRI GARHWAL

S. No.	Name	Designation	Signature
01	Prof. G. K. Dhingra	Dean Science & HOD Microbiology	
02	Dr Prabhat Kumar Singh	Subject Expert	
03	Prof. Pushpa Negi	PG Principal	
04	Prof. Pankaj Pant	PG Principal	
05	Prof. Kuldeep Singh Negi	PG Principal	11.7.2023
06	Prof. Anita Rawat	Director USERC	11.07.23
07	Dr Neelam Negi	Member Expert	11/07/23
08	Shalini Kotiyal	Member	11/07/23

SCHEME OF EXAMINATION
AND
COURSE OF STUDY AS PER NEW EDUCATION POLICY (NEP 2022)

IN

MICROBIOLOGY

Bachelor of Science
I, II, III, IV

(w.e.f. Session 2022-23 onward)

DEPARMENT OF MICORBIOLOGY
SRIDEV SUMAN UTTRAKHAND UNIVERSITY
TEHRI GARHWAL
AUGUST, 2022

COURSE STRUCTURE

NOTE: Questions of theory paper are to be set under two sections i.e., A and B. In section A, the student has to answer any six out of ten **short answer questions** (150 words) uniformly distributed from the entire syllabus. In Section B, the student has to answer any 3 questions out of Six **long answer questions/descriptive** questions uniformly distributed from the entire syllabus are to be set for section B. Section A and B will be of 30, and 45 marks respectively. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper

Subject prerequisite

To study MICROBIOLOGY at undergraduate, a student must have Biology in Class 12.

Programme Objectives (POs)

1. The programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of Microbiology.
2. The programme includes details of important microorganisms of agricultural, medical and industrial importance, biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.
3. The practical courses have been designed to equip the students with the laboratory skills in microbiology. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data
4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas that involve microbiology, biochemistry, industrial, Pharmaceutical, Dairy, biotechnology and molecular biology and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students.
5. The students will be exposed to a wide range of careers that combine microbiology, environment, industry and medical.

Certificate Course in Microbial Techniques

B. Sc. I Programme Specific Outcomes (PSOs)

PSO1 Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.

PSO2 Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man and nature.

PSO3 Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.

PSO4 Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.

PSO5 The certificate course will enable students to apply for technical positions in government and private labs/institutes.

Diploma in Microbial Technology

B.Sc. II Programme based outcomes

PSO 1 Students will develop familiarity and understanding of the microbiology concepts as relevant to various areas such as biochemistry, microbial physiology, molecular biology and genetics.

PSO 2 Students will exhibit reasonable abilities in the utilization of instruments, advances and techniques common to microbiology, and apply the logical strategy and theory testing in the plan and execution of examinations.

PSO3 Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.

PSO4 Students will be able to describe how microorganisms obtain energy, metabolism, reproduction, survival, and interactions with their environment, hosts, and host populations.

PSO5 Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degree in Bachelor of Science

B.Sc III Programme Specific Outcomes (PSOs)

PSO1 Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate a broad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.

PSO2 Students will learn about various biotechnological applications of microorganisms as well as industrially relevant substances developed by microorganisms. They'll learn about the special role microbes play in genetic modification technologies.

PSO3 Students will learn and develop good laboratory practices in a microbiological laboratory, as well as be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.

PSO4 Students will learn about experimental methods, hypothesis creation and testing, and experiment design and execution. Students can develop their critical thinking skills as well as their ability to read and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.

PSO5 The Degree courses will enable students to go for higher studies in Microbiology and Allied subjects leading to Post Graduation and Ph.D. degrees.

BSc 4th Year Honour in Microbiology

PSO1. Students of the B.Sc. (Honours) Microbiology programme will learn to use scientific logic as they explore a wide range of contemporary subjects spanning various aspects of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Systems Biology, Immunology and Molecular biology, in addition to becoming aware of the applied aspects of microbiology such as Industrial Microbiology, Food and Dairy Microbiology, Environmental Microbiology and Medical Microbiology to name just a few.

PSO2- Students will appreciate the biological diversity of microbial forms and be able to describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host

populations. They will become aware of the important role microorganisms play in maintenance of a clean and healthy environment. They will learn of the role of microorganisms in plant, animal and human health and disease

PSO3- Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field

PSO4- Students will develop proficiency in the quantitative skills necessary to analyze biological problems (e.g., arithmetic, algebra, and statistical methods as applied to biology)

PSO5- Graduates of the B.Sc. (Honours) Microbiology programme will be informed citizens who can understand and evaluate the impact of new research discoveries in the life sciences, and will be able to pursue a wide range of careers, including biological and medical research in higher education institutions as well as careers in public and global health, scientific writing, environmental organizations, and food, pharmaceuticals and biotechnology industries.

Year/ Programme	Semester	Paper Code	Paper title	Credits	Theory /Practical	Total Number of Classes (in hours)
1st/ Certificate in Microbial Technique	I	BM-C101	DSC-1: General Microbiology	4	Theory	60
		BM-PC102	DSC-P1: Experiments in General Microbiology	2	Practical	60
	II	BM-C201	DSC-2: Environmental and Agriculture Microbiology	4	Theory	60
		BM-PC202	DSC-P2: Experiments in Environmental and Agriculture Microbiology	2	Practical	60
2nd/ Microbial Technology	III	BM-C301	C-3: Microbial Physiology and Metabolism	4	Theory	60
		BM-PC302	C-3 Experiments in Microbial Physiology and Metabolism	2	Practical	60
	IV	BM-C401	C-4Molecular biology and Microbial Genetics	4	Theory	60
		BM-PC402	C-4: P Experiments in Molecular biology and Microbial Genetics	2	Practical	60

Year/ Programme	Semester	Paper Code	Paper title	Credits	Theory /Practical	Number of Classes (in hours)
3rd/ Degree in Bachelor of Science in Microbiology	V	BM-D501	D-5: Medical Microbiology and Immunology	4	Theory	60
		BM-S 502	D S-6: Pharmaceutical Microbiology	4	Theory	60
		BM-503	D P-7 Experiments in Medical Microbiology and Immunology and Pharmaceutical Microbiology	2	Practical	60
	VI	BM- D601	D -6: Industrial Microbiology	4	Theory	60
		BM-S602	DS -4: Food and Dairy Microbiology	4	Theory	60
		BM-D 603	D P-6 Experiments in : Industrial Microbiology and Food and Dairy	2	Practical	60

			Microbiology			
Year/ Programme	**Semester**	**Paper Code**	**Paper title**	**Credits**	**Theory /Practical**	**Total Number of Classes (in hours)**
BSc Honor /M.Sc I Year In Microbiology	B.Sc7thSem/M.Sc. Ist Semester	BMH T 701	Microbiological Tools and Technique	4	Theory	60
		BMH T 702	Microbial Diversity- Prokaryotes and Viruses	4	Theory	60
		BMH T 703	Algal and Fungal Biology	4	Theory	60
		BMH T 704	Biostatistics, Computer Applications and Bioinformatics	4	Theory	60
		BMH T 705	Practical	4	Practical	60
		BMH DS T 706	History and scope of microbiology	4	Theory	60
	B.Sc8th Sem/M.Sc.IInd Semester	BMH T 801	Microbial Biochemistry	4	Theory	60
		BMH T 802	Techniques of Microbial Genetics and Molecular Biology	4	Theory	60
		BMH T 803	Microbial Environmental Technology	4	Theory	60
		BMH T 804	Recombinant DNA Technology	4	Theory	60
		BMH DS T BMH806	Food borne diseases and food preservation	4	Theory	60
		BMH T 805	Practical	4	Practical	60

Detail Syllabus of
B.Sc. I Year
or
Certificate in Microbial Technique

B.Sc. I Year **Semester – I**

BM -C101
BMDSC-1 GENERAL MICROBIOLOGY

MM : 100
Time : 3 hrs
L Credit
4 4
Total Hours: 60

Sessional : 25
ESE : 75
Pass Marks : 40

Learning objectives:

- To understand the Microorganism in which there is description of different information related to microorganisms and also they will know how earth evolved and also know the landmarks discoveries of microbiology
- To acquire knowledge of different technique to stain microorganism and how they can visualize the microorganisms in different types of microscope.
- To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.
- To become familiar with general characteristic of prokaryotic and Eukaryotic microbes and also acquire Knowledge of cellular organization, life cycle and economic importance of prokaryotic

Learning outcomes:

At the end of course student will be able

- To know the different milestones in the history of microbiology, importance of Vedic microbiology and scope of microbiology
- To understand and know the application of techniques used in the field of Microbiology.
- Identify key constituent prokaryotes cell and their function.
- To classify the prokaryotic cell by conventional as well as modern methods.
- To stain the bacteria with simple, differential and special stain.

UNIT–I

History, scope, spontaneous generation vs biogenesis, golden age of microbiology branches of microbiology and relevance of microbiology; germ theory of disease Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman,. 5 kingdom classification of Whittaker and 3 Domain System Classification .

(8 Lectures)

UNIT-II

Bacterial morphology Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid,. General features of Archeobacteria, Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria.

The viruses General properties nomenclature, Classification and Morphology structure of animal viruses: Influenza, HIV; plant viruses: TMV; bacterial viruses: Lambda Phage and T4 bacteriophage; general features of Prions and Viroids. Fungi General characteristics, classification & reproduction of Saccharomyces, Aspergllus. Protozoa General characteristics, classification & reproduction of Giardia, Entamoeba. **(14lecture)**

UNIT III

Techniques in microbiology Principles of microscopy, construction and application ofCompound Microscope Bright field Microscopy, Dark field Microscopy , Electron Microscopy- TEM and SEM, Principles, and application of Autoclave; BOD Incubator & Incubator, ; Laminar flow; Oven & Spectrophotometer (UV&Vis) **(14 Lectures)**

UNIT-IV

Sterilization techniques and control of microorganisms Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure(autoclave), pasteurization, Use of dry heat- hot air oven, Filtration- membrane filter, HEPA filter; Radiation- Ionizing and non- ionizing; Chemical methods- (Alcohols, aldehydes, phenols, ethylene oxide). Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique, Serial dilution and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure culture. Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Structural staining capsule, endospore and flagella staining. **(14 Lectures)**

UNIT-V

Biostatistics Introduction to biostatistics – definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic bio diagrams. Student T Test **(10 Lectures)**

BMDSC102P Experiments in Basic Microbiology Credit 2

1. Good laboratory practice in Microbiology and safety measures.
2. Cleaning and sterilization of glassware and equipments
3. Study of aseptic technique- preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum
4. Principles and applications of microbiology laboratory instruments (Autoclave, Laminar Air Flow, Incubator, Hot Air Oven, and Light Microscope).
5. Perform simple and Gram staining of bacteria.
6. Perform Endospore staining of bacteria.
7. Perform Capsule staining by negative staining technique of bacteria.
8. Perform Flagella staining of bacteria.
9. Perform Negative staining of bacteria.
10. Isolation of microorganisms from soil by pour plate method.
11. Isolation of microorganisms from air , water , and soil
12. Effect of radiation.
13. Cultivation of bacteriophages.
14. To prepare the Nutrient Agar Medium.
15. To prepare the Potato Dextrose Agar Medium. **(Lecture-60)**

Suggested Reading

1. Dubey, R.C. 2021. *Vedic microbiology- A Scientific Approach* (English Version), Motilal Banarasidas International, Delhi– 110007.
2. Dubey, R.C. 2020. *Vedic microbiology- Ek Vaijnanik Drishti*(Hindi Version), Aastha Prakashan, Delhi-110053
3. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
4. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2
5. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
6. Cappachino. Microbiology- A laboratory Manual, Pearson Education India ISBN: 978-9332535190
7. Powar and Daginawala. General Microbiology Vol1 and Vol2, Himalaya Publishing House,**ISBN-13:** 978-9350240892
8. . Suggestive digital platforms web links-
   • https:/www.classcentral.com/tag/microbiology
   • https://cmp.berkeey.edu/bacteria/bacteria.html
   •https://www.livescience.com/53272-what-is-a-virus.html
   https://www.slideshare.net/sardar1109/algae-notes-1
   •https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
   https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
   •https://microbenotes.com/laminar-flow-hood
   • https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf
   Lab Virtual links-
   https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32196 •
   https://www.labster.com/microbiology-virtual-labs/
   •https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinicalpharmacology-of-antimicrobials

B.Sc. I Year **Semester – II**

BM -C201

BM DSC-2 Environmental and Agriculture Microbiology

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4

Total Hours: 60

Learning objectives:

- To understand how microorganism adapt to different environment and their interaction with different habitat and also the spread of microorganism from the environment.
- To know different techniques of detection of air , soil and aquatic
- To acquire knowledge of treating sewage and industrial water through different means.
- Students will learn about positive or negative interaction of microorganisms with soil.
- To impart in-depth information on soil and agriculture.
- To know the importance of biofertilizers and biopesticides.
- To make the students to know about various techniques involved in biofertilizers and biopesticides production

Learning outcomes:

At the end of course student will be able to

- Isolate and identify pathogenic microorganism from air, soil and water habitat
- Characterize the waste water and also explain the method that can be utilized in waste water treatment
- Explain or suggest different biocontrol methodto control pests.
- Develop biofertilizer or biopesticide in lab conditions .
- Isolate *Rhizobium* from the root nodule of leguminous plants.

UNIT - I

Microorganisms in different habitats: brief account of heterogeneous group of microorganisms, different habitats such as soil, water, air; factors affecting microbial population in nature. Water microbiology: type of water, parameters of aquatic environment (temperature, light, pressure, pH, turbidity and organic constituents); Microflora of aquatic environmental, Treatment and safety of drinking water; Methods to detect potability of water sample: Standard qualitative procedure- SPC, MPN test, Presumptive, confirmed and completed test for faecal-coliforms, Membrane filter technique, **(12 Lectures)**

UNIT – II

Microbiology of domestic and waste water: sewage/waste water (physical, chemical and microbiological analysis), BOD and COD; Waste water treatment, Solid waste management: solid waste processing (landfills, composting and anaerobic sludge digestion), Effect of solid waste on public health; Regulation for disposal of bio hazardous materials,
(14 Lectures)

UNIT - III

Principle of Bioremediation, decomposition and degradation of common organic Matter inorganic matter, biosurfactants. **(10 Lectures)**

UNIT – IV

Microbial Interactions Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza types and its applications
(12 Lectures)

UNIT -V

Biofertilizer Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative; Mode of application; Advantages and Disadvantages of Biofertilizer. Introduction and definition and Types of biopesticides; **(12 Lectures)**

BMDSC102P Experiments in Environmental and Agriculture Microbiology Credit 2

1. Determination of biological oxygen demand (BOD) of water.
2. Determination of chemical oxygen demand (COD) of water.
3. Water analysis for total bacterial population by standard plate count.
4. Bacterial examination of water by multiple-tube fermentation test or multiple tube tests.
5. Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28o C & 45o C)
6. Isolation of bacteria and fungi from rhizosphere and rhizoplane.
7. Isolation of bacteria & fungi from air environment by exposure plate method.
8. Isolation of Rhizobium sp. from leguminous root nodule.
9. Bacteriological examination of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test.
10. Isolation and identification of fungi by using Rose Bengal agar Media from Soil and Air,
11. Isolation of root modulating bacteria from leguminous plant.
12. isolation of bacteria inhibiting phytopathogenic fungi 60 **Lectures)**

Suggested Reading

1. N.S. SubbhaRao, Soil Microbiology, Science Publisher, ISBN: 9781578080700
2. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
3. P.D. Sharma, Microbiology, Rastogi Publication ISBN:978-8171339358.
4. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
5. Suggestive digital platforms web links-
   - https://www.classcentral.com/tag/microbiology
   - https://www.mooc-list.com/tags/biotechnology
   - https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
   - https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health
6. Virtual Lab Links-
   - https://vlab.amrita.edu/?sub=3&brch=73
   - https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
   - https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/

Detail Syllabus of
B.Sc. II Year
or
Diploma in Microbial Technology

B.Sc. II Year **Semester – III**

BM -C301
BM C-3 MICROBIAL PHYSIOLOGY AND METABOLISM

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4
Total Hours: 60

Learning objectives:

- To understand different phases of bacterial growth and its kinetics
- To understand how microbes do catabolism to get energy to build structure.
- To understand different metabolic pathways and enzymes involved by which energy will be generated
- To acquire knowledge of classifying enzymes and how they functions.
- To understand how the nitrogen is fixed by symbiotic and non-symbiotic nitrogen fixation and genes involved in nitrogen fixation

Learning outcomes:

At the end of course student will be able to

- Calculate generation time and number of generation.
- Explain principles and mechanism of aerobic and anaerobic respiration in microorganisms.
- Explain the concept nitrogen metabolism, assimilation of nitrates, ammonia assimilation. and fixation of nitrogen
- explain the bacterial photosynthesis and also the differentiation between oxygenic and anoxygenic photosynthesis bacteria
- Classify enzymes and demonstrate the mechanism of enzymes and their functions.

UNIT I

Bacterial Growth- Curve Synchronous growth; growth-generation time, microbial growth kinetics in batch cultures; growth measurement: by cell mass, cell count and cell turbidity; factor affecting the growth of microorganism. **(10 lecture)**

Unit II Enzymes: characteristics, nomenclature, classification and application of enzymes; Factors influencing enzymatic activity;Mechanism of enzyme action; Allosteric enzymes. Enzymes kinetics : Michaelis Menton equation for simple enzymes . **(12 lecture)**

Unit III General concepts of respiration and fermentation: aerobic and anaerobic respiration, Autotrophy, Heterotrophy, chemolithotrophy, fermentation; alcoholic fermentation, lactic acid fermentation . **(12 lecture)**

Unit IV Microbial metabolism: General strategy of metabolism, anabolism, catabolism, ATP, Phosphorylation, Oxidative phosphorylation and substrate level phosphorylation, primary metabolic pathway, secondary metabolic pathway, metabolism of carbohydrates glycolysis,PPP, ED, TCA cycle and electron transport chain **(18 lecture)**

Unit V Nitrogen Fixation Nitrogen fixation in symbiotic and free-living microorganisms, root nodule formation, leghaemoglobin, nitrogenase enzyme; Physiology of nitrogen cycle Photosynthetic bacteria and their classification.(Lecture 08)

BM 301 P Experiments in Microbial Physiology and Metabolism Credit-2

1. Determination of growth curve of bacteria.
2. Bacterial population count by turbidimetry method
3. Amylase production, H2S production, Urease production test, IMViC test
4. Cellulase production test.
5. Demonstration of carbohydrate fermentation, indole production, catalase test,
6. oxidase test.Demonstration of enzyme activity in given mocroorganism.

7. Detection of number of bacteria in milk by standard plate count technique.
8. Determination of quality of milk sample by MBRT (methylene blue reductase test).
9. Laboratory preparation of sauerkraut.
10. Effect of ultraviolet radiation on bacterial growth.
11. Effect of dyes on bacterial growth.
12. Separation of leaf pigments through paper chromatography on bacterial growth. **(Lecture- 60)**

Suggested Reading

1. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
2. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2
3. Casida, L.E.J.R. Industrial Microbiology, New Age International Publisher,
4. A.H.Patel, Industrial Microbiology, Laxmi Publication, **ISBN-10:** 9385750267
5. Prescott and Dunns.Industrial Microbiology, CBS Publishers and Distributers, ISBN-10**:** 8123910010
6. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
7. **Suggestive digital platforms web links-**
   • https://lipidnanostructuresgroup.weebly.com
   •https://www.labster.com/microbiology-virtual-labs
   •https://www.microbiologybook.org
   •https://www.cpe.rutgers.edu/courses/current/lf0401wa.html https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy https://www.futurelearn.com/courses/introduction-to-microbiology
8. **Digitallinks**
   •http://www.mooc.list.com/tag/molecular-biology
   •http://www.mooc.list.com/course/microbiology.sayloro https://lipidnanostructuresgroup.weely.com
   •http://www.mooc.list.com/microbial
   • https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

B.Sc. II Year **Semester – IV**

BM –C 401
BM C-4 MOLECULAR BIOLOGY AND MICROBIAL GENETICS

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4
Total Hours: 60

Learning objectives:

- To know the Genetic constituents of bacteria with special emphasis on inheritance and mutations
- To know the mechanism of genetic transfers in microbes
- To know the different techniques used to study the microbial genetics and utilizing the microbial phenomenon in different biotechnological applications.

Learning outcomes:

At the end of course student will be able to

- Explain why DNA is the genetic material of bacteria.
- Explain the application of genetic engineering techniques in basic and applied experimental biology.
- Use Plasmids as cloning vector and its applications.

UNIT - I

Experimental evidence of Nucleic acid , DNA structure, Salient features of double helix, Types of DNA, RNA Types and Structure; Replication of DNA, Mechanism of DNA replication and Enzymes and proteins involved in DNA replication **(15 Lectures)**

UNIT - II

Transcription: Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription. Translation-Genetic code, Translational machinery, charging of tRNA, aminoacyl tRNAsynthetases, Mechanisms of initiation, elongation and termination of polypeptides. **(15 Lectures)**

UNIT - III

Regulation of gene Expression Principles of transcriptional regulation, Operon-operator theory with examples from *lac* and *trp*operons; Mutations-: Definition and types of Mutations; Physical and chemical mutagens; Uses of mutations, **(12 Lectures)**

UNIT - IV

Mechanisms of Genetic Exchange: Transformation - Discovery, mechanism of natural competence Conjugation – Discovery and mechanisms, Hfr and F' strains; Transduction- Generalized transduction, specialized transduction. Plasmids and Transposable Elements: Property and functions of plasmids, Types of plasmids. **(09Lectures)**

UNIT – V

Mutations, mutagenesis and repair Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism **(09 Lectures)**

BM 402 P C 3 Experiments in MOLECULAR BIOLOGY AND MICROBIAL GENETICS

1. Isolation of genomic DNA from E. coli and analysis by agarose gel electrophoresis.
2. Estimation of DNA using diphenylamine reagents.
3. Resolution of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) and visualization using coomassie dye.
4. Replica plating method: Preparation of master and replica plates. Isolation of Histidine auxotrophs
5. Isolation of plasmid DNA from E. coli. Study the different conformations of plasmid DNA through agarose gel electrophoresis
6. Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on bacterial cells.
7. Demonstration of Ames test
8. Isolation of Bacteriophage (Lecture 60)

Suggested Reading

1. David Friefelder, Microbial Genetics, Narosa Publishing House.
2. Gardner, Principle of Genetics, Wiley
3. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
4. Lehninger, Nelson and Cox. Principles of Biochemistry, WH Freeman; 7th ed, ISBN:978-1319108243
5. **Suggestive digital platforms web links-**
   - https://www.classcentral.com/tag/microbiology
   - http://www.mooc.list.com/tag/molecular-biology
   - http://www.mooc.list.com/course/microbiology.sayloro
   - https://lipidnanostructuresgroup.weely.com

- http://www.mooc.list.com/microbial
- https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

Digital links:

- https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/amestest

Detail Syllabus of
B.Sc. III Year
Microbiology

B.Sc. III Year **Semester – V**

BM –D501
BM D-9 MEDICAL MICROBIOLOGY AND IMMUNOLOGY

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4
Total Hours: 60

Learning objectives:

- Students will understand the disease caused by the bacteria, fungi, virus and protozoa.
- To know the diagnosis and treatment of bacteria, fungi and viral pathogens.

Learning outcomes:

At the end of course students will be able to

- Understand the development and contribution of different scientist in the field of medical microbiology.
- Describe etiology, pathogenicity, epidemiology and laboratory diagnosis of disease caused by microorganism.
- To isolate and detect the pathogens from the clinical samples.
- Suggest different antimicrobial agent for the treatment of bacterial infections.

UNIT–I

Historical background of medical microbiology, Classification of medically important microorganisms, Normal microflora of the human body and its importance, normal microflora of skin, throat, gastrointestinal tract, and respiratory tract; Disease cycle, transmission of pathogen and its routes. Infection and its type. Host parasite relationship, pathogenicity and virulence in relation with bacteria, Virus fungi **(10 Lectures)**

UNIT -II

Bacterial diseases: symptoms, mode of transmission, prophylaxis, treatment and control of: Respiratory Diseases: *Streptococcus pyogenes*, *Mycobacterium tuberculosis;* Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Staphylococcus aureus* **Viral diseases:** Symptoms, mode of transmission, prophylaxis and control of Polio, Herpes, Hepatitis-B, Rabies, Dengue and AIDS **(12 Lectures)**

UNIT –III

Fungal diseases: transmission, symptoms and prevention of cutaneous mycoses: Tineapedis (Athlete's foot); Systemic mycoses: Histoplasmosis; opportunistic mycoses: candidiasis.

Prevention of Microbial Diseases: General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents, antibiotic substances, Major antimicrobial agents, Mode of action of chemotherapeutic and antibiotic substances. Mechanism of antibiotic resistance. **(12 Lectures)**

UNIT–IV

Immunology- Historical background: Humoral and Cellular components of the immune system Concept of Innate and Adaptive immunity; **Antigens and antibodies;** Characteristics of an antigen Haptens; Epitopes Adjuvants; T-cell and B-cell, Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies, Monoclonal and Chimeric antibodies, **(14 Lectures)**

UNIT–V

Antigen- Antibody reactions(Precipitation, Agglutination, RIA and ELISA, Vaccines: Importance, types of vaccines, Major Histocompatibility Complex**;** Structure and Functions of MHC I & II molecules; Antigen processing and presentation, Complement System-Components of the Complement system, Biological consequences of complement Activation. **(14 Lectures)**

Suggested Reading

1. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
2. Mackie and McCartney. Practical Medical Microbiology, Elsevier
3. CKJ Paniker. Test Book of Microbiology, Orient Longman
4. D.R.Arora. Medical Mycology, CBS Publisher and Distributors
5. Janis Kubey, Immunology, W.H.Freeman
6. Peter J Delves, S.J. Martins, D.R. Burtons, Roitts Essential Immunology, Wiley Blackwell
7. C.V.Rao , An Introduction to Immunology, Alpha Science International Ltd , **ISBN** 978-1842650356
8. **Digital Links**
   - https://www.mcgill.ca/microimm/undergraduate-programs/courses
   - https://oline.creighton.edu/program/medical-microbiology-and-immunology-ms
   - http://www.vlab.co.in
   - http://www.vlab.iitb.ac.in
   - http://www.onlinelabs.in
   - http://www.vlab.amrita.edu
   - http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

   https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-ofantimicrobials
   https://vlab.amrita.edu/?sub=3&rch=73
   https://www.mooc-list.co/tags/pathology
   https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms

B.Sc. III Year **Semester – V**

BM -S502

BM C-3 PHARMACEUTICAL MICROBIOLOGY

MM : 100
Time : 3 hrs

L	Credit
4	4

Total Hours: 60

Sessional : 25
ESE : 75
Pass Marks : 40

Learning objectives:

- Students will learn about the basics of pharmaceutical microbiology and important microorganism playing role in pharmaceutics.
- To understand different products of microbial origin playing key role in pharmaceutical applications.
- To understand role of secondary metabolites in pharmaceutical industry.
- To understand good practices and regulation involved in utilizing microbial product for pharmaceutical applications

Learning outcomes:

At the end of course students will be able to

- Describe how antibiotic work and resistance develop in microorganisms.
- Suggest good practices and regulation involved in utilizing microbial product for pharmaceutical applications.
- Design microbiology laboratory and explain the safety measures used in microbiology laboratory.
- Determine antibiotic sensitivity, MIC, MBC and other quality parameter of microbiology laboratory.

UNIT - I

Pharmaceutical industries types Sterile and non sterile, Pharmaceutical premises: selection of area for a pharmaceutical premise, different components of a premise, Govt. norms for a premise. Inspectional Guidance **of microbiology lab** Good manufacturing practices (GMP) and its organization, good laboratory practice (GLP), cGMP; Operation of quality control (QC) and quality assurance (QA) of company. **(10 Lectures)**

UNIT - II

Introduction Principal , Calibration, Validation and Function of different instrument in Microbiology Lab, sterilization of glassware, preparation, validatin and sterilization of media, Discarding Methods, Documents Preparation SOP, COA , Specification, log book. **(12 Lectures)**

UNIT - III

Sterile area and its maintenance, environmental monitoring, types of environmental monitoring, methods of sterilization in pharma, disinfectants and antiseptics, evaluation of disinfectants Fumigation process and its schedule .Water used in pharma, properties, types, specification, microbial limits , Techniques of water testing used in pharmaceutical company . **(16 Lectures)**

UNIT - IV

Microbial limit test (MLT), pyrogen tests, pathogens test for confirmation Bacterial Endotoxin Testing, Antibiotic assay , vitamin B12 Assay , preservative efficacy test. Sterility testing, Antimicrobial Effectiveness Testing, Microbial Examination of sterile and Non-Sterile Products. (16 Lectures)

UNIT - V

Safety and working in microbial laboratory: Biosafety cabinets ; Occurrence of laboratory infections, Microbiology Laboratory Biosafety Guidelines, section in microbiology lab , Disposal of contaminated waste **(10 Lectures)**

Suggested Reading

1. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
2. SS Purohit and AK Saluja. Pharmaceutical Microbiology, Agrobios (India), ISBN-13-9788177541939
3. CKJ Paniker. Test Book of Microbiology, Orient Longman
4. Indian Pharmacopeia , USP, BP

1. **Digital Links**
   - https://www.mcgill.ca/microimm/undergraduate-programs/courses
   - https://oline.creighton.edu/program/medical-microbiology-and-immunology-ms
   - http://www.vlab.co.in
   - http://www.vlab.iitb.ac.in

- http://www.onlinelabs.in
- http://www.vlab.amrita.edu
- http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

BM 503 P C Experiments in Medical Microbiology and Immunology & Pharmaceutical Microbiology

1. Blood group determination by slide agglutination method.
2. Preparation of chocolate agar, and other media required for medically important microorganisms
3. Isolation and characterization of skin normal microflora
4. Isolation of bacteria from teeth crevices
5. Demonstration of α and β haemolysis on blood agar medium.
6. Demonstration of serological tests: blood groups, Rh factor determination, pregnancy test, Widal, VDRL, ELISA
7. Demonstration of pathogenic fungi in mycoses lesion
8. Antibiotic sensitivity test and MIC determination
9. Demonstration of antibiotic resistance transfer from resistant to sensitive microorganism
10. Demonstration of bacterial plasmid isolation.
11. Vitamin B12 Assay .
12. Microbial Limit test of Products
13. Determination of nitrate production in nitrite broth soil cultures.
14. Isolation of antibiotic resistant bacteria by gradient plate technique.
15. Water Testing,
16. Determination of preservative efficacy test
17. Fumigation
18. Predict the microorganism on the basis of reaction on TSI slant
19. Perform citrate utilisation test.
20. Determination of titre by slide agglutination method.

B.Sc. III Year **Semester – VI**

BIM –C601
BM D INDUSTRIAL MICROBIOLOGY

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4

Total Hours: 60

Learning objectives:

- To understand the scope and applications of industrial microbiology.
- To understand fermentation technologies used for the production of industrially important products.
- To understand how different fermentation product are produced, purified and recovered.

Learning outcomes:

At the end of course student will be able to

- Screen and isolate industrially important microorganisms.

- Make use of fermentor to produce alcoholic beverages and other fermentation products.
- Explain the different method of disinfection used in industry and also how to maintain quality of product.

UNIT – I

Isolation of industrially important microbial strains, strain improvement, preservation and maintenance of industrial microbes, scale-up. Metabolite: Primary and secondary screening, strain development strategies, principal of exploitation of microorganism and their products, **(14 Lectures)**

UNIT – II

Fermentation: Media, Raw material, Antifoaming agents, Buffers. Equipments, Fermenter design. Types of fermentation – Single, Batch, Continuous. Down-stream processing steps: Detection and assay of the product, Recovery and Purification **(10 Lectures)**

UNIT – III

Industrial production of antibiotics : Fermentation and recovery process of penicillin, streptomycin, β – lactam and rifamcyin and tetracycline. **(10 Lectures)**

UNIT - IV

Industrial production of Enzymes and Amino acids: Microbial production and applications of amylases, lipase, protease; pectinase, and cellulases Amino acids: production of L-glutamic acid and L-lysine. **(14 Lectures)**

UNIT - V

Microbial production of Vitamin B-12; Vitamin B2 (riboflavin), Vitamin C; Organic acids: Lactic acid and citric acid (fermentation and recovery). **(08 Lectures)**

Suggested Reading

1. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
2. Casida, L.E.J.R. Industrial Microbiology, New Age International Publisher,
3. A.H.Patel, Industrial Microbiology, Laxmi Publication, ISBN-10: 9385750267
4. Prescott and Dunns.Industrial Microbiology, CBS Publishers and Distributers, ISBN-10: 8123910010

Suggestive digital platforms web links

- http://foodhaccp.com/foodsafetymicro/onlineindex.html
- http://www.cpe.rutgers.ed/courses/current/If0401wa.html

B.Sc. III Year **Semester – VI**

BM –S 602
BM D FOOD AND DAIRY MICROBIOLOGY

MM : 100
Time : 3 hrs
L Credit
4 4
Total Hours: 60

Sessional : 25
ESE : 75
Pass Marks : 40

Learning objectives:

- To know the different types of fermented foods available in markets.
- To know about the vegetable and grain based fermented products.

Learning outcomes:

At the end of course student will be able to

- Prepare the fermented foods from milk, grain and vegetables.
- Prevent and control the bacterial infection through various techniques.

UNIT-I

Microorganisms important in food microbiology- Molds,Yeasts and Bacteria- general characteristics, classification and importance. Principles, physical methods of food preservation: temperature (low, high, canning and drying), irradiation, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins. Fermented Foods: Definition, types, advantages and health benefits of fermented foods. **(10 Lectures)**

UNIT- II

Microflora of raw milk ; Sources of contamination of milk; Nutritional and therapeutic benefits of fermented milk products; Dahi/Yogurt, Buttermilk (Chhach), Shrikhand and Cheese: Preparation of inoculum and production process. Probiotic foods; Spoilage of fermented dairy products; Quality control in dairy industry.

(16 Lectures)

UNIT-III

Food fermentations; bread, vinegar, fermented vegetables; prevention and spoilage of cereals, vegetables, fruits, meat and meat products fish and sea products. Industrial enzymes and their uses in food industry – amylases, proteases, cellulases; Oriental foods – Mycoprotein, Tempeh, soya sauce; Traditional foods

(16 Lectures)

UNIT–IV

Microbial cells as food single cell proteins, Mushroom cultivation, Probiotic Foods: History, definition, types, microorganisms and health benefits in supply of vitamins, Immunomodulation, control of pathogenic bacteria

(08 Lectures)

UNIT–V

Food borne infections and intoxifications; Bacterial diseases with examples of infective and toxic types – Brucella, Bacillus clostridium, Escherichia, Pseudomonas , Salmonella, Shigella, Staphylococcus, Vibrio, fungi Aflatoxins - structures and functions; Food borne out breaks – laboratory testing procedures; Preventive measures – Sanitation in manufacture; Food control agencies and its regulations, HACCP, ISO standards and FSSAI .

(10 Lectures)

Suggested Reading

1. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
2. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2
3. Doyle et al., Food Microbiology: Fundamentals and Frontier, American Society of Microbiology
4. William C Frazier, Food Microbiology, MacGraw Hills Education.

5. Adam and Moss, Food Microbiology, Royal Society of Chemistry
6. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.

BM 603 P C Experiments in Industrial and Food and Dairy Microbiology. **Credit 4**

1. Isolation of antibiotic producing microorganisms from soil.
2. Laboratory production of alcohol from Grape Juice/Sugarcane Juice.
3. Demonstration of vinegar production in laboratory.
4. Bioassay of vitamin B_{12}.
5. Fat hydrolysis (lipase activity) by a given bacterial culture.
6. Demonstration of fermentation by yeast.
7. Isolation of *Azotobacter* from garden soil.
8. Isolation of VAM (Vascular ArbuscularMycorrihizal spore from soil.
9. Isolation of phosphate solubilising microorganisms from soil.
10. Antibiotic sensitivity of UTI causing bacteria.
11. Slide agglutination reaction of unknown bacterial culture.
12. Demonstration of antigen-antibody reaction.
13. Study of Bioreactor & its essential parts
14. Necessity & procedure of writing SOPs for instruments used in large scale production
15. Isolation and characterization of microorganism used in Dairy industry
16. Isolation and characterization of Yeast used in Bakery/distillery/winery
17. Bacteriological analysis of food products
17. Preservation methods

Suggested Reading

1. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VII**

BM –E701

BMH-701 Microbiological Tools and Technique

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Learning objectives:

- To get the knowledge of sophisticated and common instruments used in the microbiology laboratory
- To know aseptic techniques to keep the instrument and media sterile.

Learning outcomes:

At the end of course students will be able to

- Maintain the sterility of glassware, utensils and medium by different physical and chemical procedure.
- Operate the different sophisticated instruments available in the laboratory.

Unit I:

Principle , Calibration and Application of different instruments of microbiology Lab such as microscopes, hot air oven, autoclave, laminar air flow and BOD incubator , pH Meter, Analytical Balance. Staining Technique Specimen preparation and principles of Simple, Gram's stain, Capsule, Endospore, Flagella, Acid fast and Geimsa's staining.

Unit II:

Aseptic technique: contamination, sterilization (steam sterilization, tyndallization, dry heat, chemicals, radiation sterilization, filter sterilization), sterilization of air. Evaluation of antimicrobial agent effectiveness, evaluation of efficacy of disinfectants, determination of phenol coefficient)

Unit III:

Isolation of industrially important microorganisms, Primary screening (crowded plate technique, enrichment culture technique, streak plate, Serial dilution plate and spread plate), Importance of screening. maintenance of pure cultures; methods of preservation. Maintenance and Cultivation of anaerobic bacteria.

Unit IV:

Principles and applications of Chromatography techniques: paper chromatography, thin layer chromatography, adsorption column chromatography, gas liquid chromatography, HPTLC Principle and Function of UV-Vis spectrophotometry,

Unit V

Principles and applications of Electrophoresis for protein, RNA and DNA; Centrifugation; Ultracentifugation; Lyophilization and Fumigation

Suggested Readings

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.
2. Wilson K. and Walker J. (2013). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
4. Upadhyaya and Nath (2015) Biophysical chemistry, Himalaya pub. House.
5. T.A.Brown (2016). Gene cloning and DNA analysis, an introduction,Wiley Blackwell pub.
6. B.D.Singh (2015). Biotechnology, Kalyani publication.
7. Dubey R.C. and Maheshwari, D.K. *A Textbook of Microbiology*. 3rd ed., S. Chand & Co, Ram Nagar, New Delhi, p. 1034. ISBN 81-219-2620-3
8.Prescott's Microbiology, 10th Edition, McGraw Hill Publication
9. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2

Experiments in Microbiological Tools and Technique

16. Good laboratory practice in Microbiology and safety measures.
17. Cleaning and sterilization of glassware and equipments

18. Principles and applications of microbiology laboratory instruments (Autoclave, Laminar Air Flow, Incubator, Hot Air Oven, and Light Microscope).
19. Perform simple and Gram staining of bacteria.
20. Perform Endospore staining of bacteria.
21. Perform Capsule staining by negative staining technique of bacteria.
22. Perform Flagella staining of bacteria.
23. Perform Negative staining of bacteria.
24. Isolation of microorganisms from soil by pour plate method.
25. Isolation of microorganisms from air , water , and soil
26. Effect of radiation. on microbial growth
27. Cultivation of bacteriophages.
28. Calibration of Different instruments.
29. To prepare the Potato Dextrose Agar Medium.
30. Separation of DNA by Electrophoresis
31. Separation of Pigments By Chromatography
32. Determination of Environmental Microorganisms
33. . Isolation of Microbial colony from soil, water, air and milk.
34. To determine total viable cells in a bacterial culture by plate count method or serial dilution method.
35. . To carry out thin layer chromatography (mixture of amino acids).
36. Isolation of plasmid DNA from E. coli.
37. . TLC separation of amino acids.

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VII**

BMH -702 Microbial Diversity- Prokaryotes and Viruses

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the microbes diversity and their role .

To understand the basic concept of prokaryotes, their taxonomy,their differentiation from eukaryotes and biosafety regulatory framework for prokaryotes.

Learning outcomes:

At the end of course students will be able to explain the role of prokaryotes and their role in Microbiology development and what is the scope of the various branches of the subject and other beneficial roles.

- Cultivate viruses , Cyanobacteria in laboratory by different methods

Unit I:

Discovery of microbial world; Introduction to microbial biodiversity distribution, abundance, ecological niche of bacteria and archaea.

Unit II:

Microbial evolution; classification of microorganisms: Haeckel's three kingdoms, Whittaker's five kingdoms, three domains of Carl Woese, ribosomal RNA in microbial taxonomy, concept of microbial species; classification and salient features of bacteria on the basis of *Bergey's Manual of systemic Bacteriology*. General features of important groups of bacteria Protobacteria, Firmicutes , Actinobacteria, Spirochaetes, Rickettisia and Archaebacteria and cyanobacteria .

Unit III:

Extreme environments and extremophiles; Microbial diversity in different ecosystems thermophiles, halophiles, mesophiles, hyper thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles) and their biotechnological applications

Unit IV:

General characters, nomenclature, classification, morphology and ultra-structure of viruses; Capsid and their arrangement; Cultivation of viruses using embryonated eggs, experimental animals and cell cultures , viroids– host range, genome and origin of viroids;); prions- spread of prions and diseases.

Unit V

: Bacteriophages- Structural organization, multiplication cycle; one step growth curve lytic and lysogenic cycle, bacteriophage typing, M13, Mu, T4, Φx174, phage λ; application of bacteriophages in health- bacteriophage therapy. cyanophages- morphology, growth cycle, mycoviruses- replication and types of mycoviruses

Suggested Readings (Latest Editions):

1. Bergey's manual systematic Bacteriology(2011) 2nd edition
2. Prakash S. Bisen (2012). Microbes-concepts and applications, Wiley-Blackwell.
3. J.D.S.Panwar (2012)-Fundamentals of Microbilogy-S.R.S Pub
4. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hil
5. Bisen, P.S. (2014). Microbes in Practices, I K international publication house pvt Ltd.
6. Sharma P.D. (2015-16). Microbilogy, 3rd edn, Rastogi publications
7. J.G.Black(2015) –Microbiology, 9th edition, Wiley publication

Experiments in Microbial Diversity- Prokaryotes and Viruses

1. Preparation of various models based on History of Microbiology.
2. Determination of growth of bacteria by spectrophotometrically.
3. Demonstration of pour plate, spread plate and streak plate methods.
4. Preparation of bacterial growth curve.
5. Isolation and characterization of thermophiles.
6. Isolation and characterization of psychrophiles.
7. Isolation and characterization of osmophiles.
8. Isolation and characterization of acidophiles.
9. Isolation and characterization of alkalophiles.

10. Isolation and characterization of halophiles.
11. Isolation and characterization of cyanobacteria.
12. Demonstration of bacteriophage typing.
13. Preparation of various models based on structure of viruses.
14. Study of virus infected plant material
15 Starch hydroloysis
16. Protein degradation-casein degradation
17. Carbohydrate fermentation (different sugars)
18. IMViC Tests: Indole, Methyl red, Vogus Prausker, Citrate utilization test.

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VII**

BMH -703 **Algal and Fungal Biology**

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the microbes diversity and their role of Fungi and Algae in Ecosystem
- To understand the basic concept of prokaryotes, their taxonomy their differentiation from Prokaryotes and bio safety regulatory framework for Eukaryotes .

Learning outcomes:

At the end of course students will be able to explain the role of Fungi and Algae and their role in Microbiology development and what is the scope of the various field of the subject and other beneficial roles.

- Cultivate Fungi and Algae in laboratory by different methods

Unit 1

Algae: General account of habitat, cell structure, pigments, flagellum, reserve food. . taxonomic position of cyanobacteria. Algal growth and reproduction. Cultivation of algae in laboratory. Nittrogen fixation. Biological and economic aspects of algae, algal biotechnology. Algal blooms and eutropication.

Unit II

Mycology: Thallus morphology and modifications in fungi. Nutrition and physiology of fungi. Reproduction (asexual, sexual and parasexual) characteristics of fungi. Major taxonomic group of fungi with focus on structure, reproduction, life cycle and significance of the following: representatives: i) Gymnomycota (Cellular slime moulds), ii) Mastigomycota (*Phytophthora*), iii) Amastigomycota: a) Zygomyocotina (*Mucor/Rhizopus*), b) Ascomycotina (*Saccharomyces*), c) Basidiomycotina (*Agaricus*), d) Deutromycotina (*Fusarium*).

Characteristics and importance of Deuteromycetes. Yeasts: General characteristic, structure, classification, life cycles (important forms), sexual and asexual reproduction of yeast (Saccharomyces cerevisiae)

Unit III

Nutrition and reproduction in fungi, Mycorrhiza, Lichens, Heterothallism, sex hormones in fungi. Evolutionary tendencies in lower fungi. Economic importance. Fungi in ecosystem: contribution of fungi to ecosystems, breakdown of hemicellulose, cellulose, pectins, chitin, starch and glycogen, lignin degradation; flow of nutrients-transport and translocation, secretion of colonizers on a substrate.

UNIT – IV

Fungal pathogens: occurrence, classification, morphology, characteristics features and life cycle of, *Fusarium oxysporum, Alternaria solani*, . Mycoses- superficial , cutaneous, subcutaneous opportunistic and systemic diseases

UNIT – V

Fungal metabolites of industrial importance– industrial alcoholic beverages and organic acids; Fungi as bioinoculant agents, mycotoxins- Aflatoxin ,Rubratoxin, Ochratoxin; fungal enzymes of commercial importance-amylases and cellulases, mycoprotein .

Suggested Readings (Latest Editions):

1. Chatterjee K.D. (2015). Parasitology, Calcutta publication.
2. David Greenwood (2015). Medical Microbiology, 18th edition.
3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
4. J.G. Black(2015) –Microbiology, 9th edition, Wiley publication
5. Lee. R. E. (Latest Edition). Phycology, Cambridge University Press, Cambridge.
6. Talaro K.P. & Talaro A. (Latest Edition). Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.
7. Sharma, P.D. (2016). Mycology and Phyotopathology, Rastogi Publications, Meerut

Experiments in Algal and Fungal Biology

1. Preparation of moist chamber for fungal isolation.
2. Isolation of fungi from soil.
3. Isolation of fungi from rhizospehere.
4. Isolation of fungi from different food sources.
5. To isolate fungi present in soil samples and calculate their relative abundance and frequency of occurrence
6. To study the fungal morphology by lactophenol cotton blue staining.
7. To study the fungal morphology by potassium hydroxide mounting.
8. Preparation of permanent fungal mounts.
9. Collection of different types of lichens.
10. Study of dimorphism in yeast.

11. Isolation of various algae from different habitat

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VII**

BMH 704

BMH 704 Biostatistics, Computer Applications and Bioinformatics

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the statics role in biological and Research industry
- To understand the basic concept biostatics and computer.

Learning outcomes:

At the end of course students will be able to explain the role of computer and statics in Microbiology development and what is the scope of the various field of the subject and other beneficial roles.

Unit I:

Presentation of data; Frequency distributions; Graphical representation of data by histogram, polygon, frequency curves and pie diagram. Measures of central tendency: Mean, median and mode; Measures of dispersion: Mean deviation, standard deviation, coefficient of variation;

Unit II:

Correlation : properties, nature, coefficient of correlation, , significance of correlation Probability: Basic concepts related to probability theory, classical probability. Probability Distributions

Unit III:

Testing of significance: Students t-test for the significance of population mean, Chi square test for population variance, F-test for the equality of two population variance; Analysis of variance- One-way

Unit IV:

Introduction to Computers: Definition, Components of computer, Basics for operating systems Introduction to MS Office (MS-Word, MS-Excel, MS-Power Point); Introduction to Networking Computer application in Microbiological ,fermentation and Pharmaceutical Industry

Unit V:

Introduction to Bioinformatics: Definition and scope; Search engines: tools for web search; Introduction to biological databases (NCBI, EBI, DDBJ, Gen Bank,),Introduction to BLAST and FASTA studies.

Suggested Readings (Latest Editions):

1. Bailey, NT J (2000). Statistical Methods in Biology. English Univ. Press.
2. Campbell R.C (Latest Edition). Statistics for Biologist. Cambridge University Press, UK.
3. Sinha PK (Latest Edition). Fundamentals of computers. BPB Publication, New Delhi
4. Jonathan, P. 2008. Bioinformatics & Functional Genomics.
5. B.D.Singh(2015). Biotechnology, Kalyani Publication.
6. Sharma and Munjal(2015). A test book of Bioinformatics, Rastogi publication

Experiments in Biostatistics, Computer Applications and Bioinformatics

1. Representation of statistical data by 1. Histogram
2. Curves 3. Pie diagrams
2. Determination of averages or Central tendencies (Mean, Mode, Median) 3. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation)
4. Application of Tests of significance (Chi-Square test, student t-test, Standard error)
5. Applications of computers in biology using MS-office (MS-Word, Excel, Power point)
6. Introduction to LAN Networking
7. Introduction to Internet (E-Mail, File Transfer Protocol, Usenet, Telnet).
8. Introduction to different primary and secondary databases.
9. To access scientific data from Literature data bases (PUBMED, LITDB, Medline) 10. To access nucleic acid databases for retrieval of gene sequence.
11. To access protein databases for retrieval of amino acid sequence of target protein.
12. To perform multiple sequence alignment using BLAST.

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VII**

BMH 706

BMH DS 706 **HISTORY AND SCOPE OF MICROBIOLOGY**

MM : 100 Sessional : 25
Time : 3 hrs ESE : 75
L Credit Pass Marks : 40
4 4

Total Hours: 60

Learning objectives:

- To understand the statics role in biological and Research industry
- To understand the basic concept and role of microorganisms as beneficial and harmful .

Learning outcomes:

At the end of course students will be able to explain the role of Microbiology development in different field and what is the scope of the various fields of the subject and other beneficial roles.

Unit 1-

History and Development of microbiology , spontaneous generation vs biogenesis, golden age of microbiology branches of microbiology; germ theory of disease, Scope and relevance of Microbiology; Development of microbiology 20th and 21st century Golden era of Microbiology, , Development of various microbiological techniques, Establishment of fields of medical microbiology and immunology.

Unit 2-

Microbes in Human Health & Environment, Medical microbiology and immunology: List of important human diseases and their causative agents. Environmental microbiology: Definitions and examples of important microbial interactions,

Unit 3

Application of microorganisms: bio-pesticides, bio-fertilizers, biodegradation, bio-deterioration and bioremediation,

Unit 4

Role of microorganisms in fermentation, microbes producing important industrial products through fermentation. Biofuels, Microorganisms in food spoilage and food borne infections.

Unit 5

Concept of ecosystem: Types. Structure and function of ecosystems. Trophic levels: Primary and secondary production. Energy flow: ecological pyramids, food chains and food webs.

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VIII**

BMH 801

BMH 801 Microbial Biochemistry

MM : 100

Sessional : 25

Time : 3 hrs ESE : 75

L Credit Pass Marks : 40

4 4

Total Hours: 60

Learning objectives:

- To understand the statics role in biochemistry in microbiology
- To understand the basic concept of macromolecules .

Learning outcomes:

At the end of course students will be able to explain the role of macromolecules in Microbiology development and what is the scope of the various fields of the subject and other beneficial roles.

Unit I

Carbohydrates : Structure and Properties and uses of monosaccharides, oligosaccharides and polysaccharides, glycoproteins, glycolipids, proteoglycans, mutarotation, annomerisation, epimerization, stability of polysaccharides

Unit II

Structure and properties of amino acids, Structure of protein (Primary, Secondary, Tertiary and Quaternary), essential and non-essential amino acids, general reactions of amino acid metabolism, urea cycle, synthesis of various molecules via amino acid metabolism intermediates, non-standard Amino Acids

Unit III

Structure and properties of fatty acids, storage and membrane lipids, phospholipids and cholesterol, Composition and synthesis of lipoproteins and their transport in the body, oxidation of fatty acids (beta & alpha), oxidation of long chain fatty acids, Synthesis of lipids, elongation of fatty acids, desaturation of fatty acids, regulation of fatty acid synthesis, cholesterol metabolism, regulation of cholesterol metabolism.

Unit IV:

Structure, composition and properties of nucleic acids, De-Novo synthesis of purine and pyrimidine nucleotides and its regulation. Synthesis of nucleoside di- and triphosphates, deoxynucleotides and TMP and degradation of purine and pyrimidine nucleotides, salvage pathways of nucleotides synthesis...

Unit V:

Structure,and properties of vitamins, co-enzymes, biochemical action of vitamins and Fat and water soluble vitamins, Biosynthesis of vitamins, role of vitamins in the metabolism.

Suggested Readings (Latest Editions):

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.
2. Voet D and Voet JG. (2013). Principle's of Biochemistry. John Wiley and sons New York.
3. Moat AG and Foster J W (Latest Edition). Microbial Physiology. John Wiley and Sons, New York.
4. Stryer. L (2003). Biochemistry. W. H. Freeman and Co.
5. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hil
6. J.L. Jain(2015).Fundamentals of Biochemistry, S. Chand and Co.
7. U. Satyanarayan(2015). Biochemistry, Elsevier

Experiments in Microbial Biochemistry

1. To carry out qualitative analysis of Carbohydrates
2. To carry out qualitative analysis of Lipids
3. To carry out qualitative analysis of amino acids
4. To carry out qualitative analysis of Proteins
5. To perform biochemical test of starch hydrolysis.
6. To perform biochemical test of casein hydrolysis.
7. To carry out estimation of DNA by Diphenylamine method
8. To carry out estimation of RNA by Orcinol method
9. To carry out estimation of protein by Biuret method.

10. To carry out separation of amino acid by Paper Chromatography and determination of Rf value TLC of fatty acids/lipids
11. To detect presence of reducing sugar using Benedict's test.
12. Determination of absorption maxima of given sample using spectrophotometer.
13. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms
14. To demonstrate Fat hydrolysis (lipase activity) by bacteria
15. To study ability of microorganisms to hydrolyze gelatin
16. To demonstrate degradation of sulphur containing amino acids by bacteri

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VIII**

BMH 802

BMH 802 Techniques of Microbial Genetics and Molecular Biology

MM : 100

Sessional : 25

Time : 3 hrs ESE : 75

L Credit Pass Marks : 40

4 4

Total Hours: 60

Learning objectives:

- To understand the Microbial technology and Molecular biology.
- To understand the basic concept genetic material;.

Learning outcomes:

At the end of course students will be able to explain the role of gene and genetic material and microbial technology and what is the scope of the various fields of the subject and other beneficial roles.

Unit I-

Nucleic acids as genetic information carriers, DNA structure, types of DNA. DNA replication in prokaryotes and eukaryotes. Structural features of RNA (mRNA, tRNA, rRNA). Transcription in prokaryotes and eukaryotes.

Unit II-

Regulation of gene expression. Basic features of the genetic code. Protein synthesis in prokaryotes and eukaryotes. Recombination: general principles. Plasmids (types of plasmids- F plasmids, R plasmids, Col plasmids and Ti plasmid). Gene transfer mechanisms: transformation, transduction, and conjugation.

Unit III-

Mutations: spontaneous mutation, Induced mutagenesis- mutagens (physical mutagens: non ionizing and ionizing radiations; chemical mutagens: Base analogues, alkylating agents, deaminating agents, intercalating agents and others), molecular mechanism of mutagenesis. DNA repair mechanism: repair by direct reversal, excision repair, recombinational repair and SOS repair.

Unit IV-

Basic steps of r-DNA technology. Restriction endonucleases. Cloning vectors: general

properties, plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast, and animal cells.

Unit V-

Molecular Techniques; Principles, methods and their applications in medical diagnosis - such as PCR, Southern Blotting, Northern Blotting, Western Blotting, DNA finger printing and DNA sequencing. DNA vaccines design and advantages. Recombinant vaccines.

Suggested Readings (Latest Editions):

1. David P Clark (2010). Cell and Molecular Biolgy
2. Robert J. Brooker (2011). Genetics, Analysis and principles, Mc Graw Hill.
3. J.E. Krebs (2011). Lewin's Genes X, Jones Pub.
4. T.A.Brown (2010). Gene cloning of DNA Analysis. Wiley Blackwell.
5. J D Watson (2008), Molecular biology
6. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith (2012). Becker's Word of the cell.
7. William. D Stans Field (2012). Molecular and cell Biolgy, Mc Graw Hill pub.
8. Gerald Karp (2014). Cell Biology, Wiley Blackwell, Pub.

Experiments in Microbial Genetics and Molecular Biology

1. Isolation of plasmid DNA from E. coli.
2. Determination of Tm of DNA and RNA.
3. Electrophoresis of isolated DNA sample.
4. Isolation of bacteria from various samples by enrichment techniques and their identification by conventional biochemical and molecular methods.
5. Restriction digestion analysis by agarose gel electrophoresis.
6. Restriction digestion analysis by polyacrylamide gel electrophoresis.
7. Isolation of plasmid from mix cultures.
8. Isolation of genomic DNA.
9. Amplification of DNA by PCR
10. RAPD analysis
11. RFLP analysis 12. Separation and analysis of proteins by SDS-PAGE

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VIII**

BMH 803

BMH 803 Microbial Environmental Technologies

MM : 100

Time : 3 hrs

L Credit

Sessional : 25

ESE : 75

Pass Marks : 40

4 4

Total Hours: 60

Learning objectives:

- To understand the Microbial technology and Environmental Microbiology
- To understand the basic concept Disposal of and Treatment of Waste .

Learning outcomes:

At the end of course students will be able to explain the role of microbes to treatment of water and microbial technology to water testing and what is the scope of the various fields of the subject and other beneficial roles.

Unit –1

Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics, structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit – 2

Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physico-chemical and biological measures to control eutrophication

Unit –3

Microbiology of wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary treatments. Anaerobic processes: Anaerobic digestion, anaerobic filters, and upflow anaerobic sludge. Treatment schemes for effluents of dairy, distillery, tannery, sugar and antibiotic industries Bioconversion of Solid Waste and utilization as fertilizer. Bioaccumulation of heavy metal ions from industrial effluents .

Unit – 4

Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behaviour, biomagnification and degredative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its
environmental impact assessment and ethical issues.

Unit – 5

Microbes and water potability. Purification of potable water; Sanitary analysis of water Standards (tolerable levels) of water quality of fecal contamination., Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

Experiments in Microbial Environmental Technology

1. To measure the D.O. of the given water samples.
2. To measure the BOD of the given water samples.
3. To measure the COD of the given water samples.
4. To determine the effect of temperature on microbial growth.
5. To determine the effect of pH on microbial growth.

6. To determine the effect of oxygen on microbial growth.
7. To study the production of lignocellulolytic enzymes (cellulases, hemicellulases and lignin degrading enzymes such as Lip, Mnp and Laccase.
8. To study the fungal degradation of lignocellulosic biomass (Crop byproducts).
9. To study the use of cellulases in saacharification of cellulosic material.
10. To study the microbiological quality of water samples from different sources.
11. To study the decolorization of distillery or textile industrial waste.
12. Determination of potability of water by MPN method

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VIII**

BMH 804

BMH 804- RECOMBINANT DNA TECHNOLOGY

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit 44	Pass Marks : 40

Total Hours: 60

Learning objectives:

- To make students understand about the structure and function of biologically important molecules.
- To know the historical background of DNA structure and its role as genetic material.
- Become familiar with different tools and techniques used in genetic engineering and recombinant DNA technology.
- To understand the applications of DNA modifying enzymes, cloning strategies, vector types, and screening of recombinants
- Students will know how gene expresses and regulates in prokaryotic cells.

Learning outcomes:

At the end of course students will be able to

- Explain why DNA is the genetic material of bacteria.
- Explain the application of genetic engineering techniques in basic and applied experimental biology.
- Amplify the DNA using PCR for the diagnosis and DNA fingerprinting.
- Describe how protein synthesis occur in procaryotic cell and enzyme involved in it.

UNIT- I

Introduction to Genetic Engineering: Milestones in genetic engineering and biotechnology; Molecular Cloning-Tools and Strategies-Cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyltransferase, kinases and phosphatases, and DNA ligases Cloning Vectors: Definition and Properties Plasmid vectors: pBR, Cosmids, Expression vectors.

UNIT- II

Methods in Molecular Cloning:Transformation of DNA: chemical method, electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viralmediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern – blotting techniques, DNA Western blotting.

UNIT- III

DNA Amplification and DNA sequencing PCR: Basics of PCR, Real-Time PCR, Sanger's method of DNA Sequencing: traditional and automated sequencing.

UNIT- IV

Construction and Screening of Genomic and cDNA libraries: Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR.

UNIT - V

Applications of Recombinant DNA Technology: Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis.

Suggested Reading

1. Bruce Alberts. Molecular Biology of the Cells, W.W. Norton and Company, ISBN: 9780815344643
2. Dubey, R.C. *Advanced Biotechnology*. S. Chand & Co. P Ltd, New Delhi, p. 1161; ISBN: 81:219-4290-X.
3. Harvey, Lodish. Molecular Cell Biology, W.H.Freeman
4. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology*. 2nd ed., S. Chand & Co. P Ltd, New Delhi, p. 413. ISBN: 81:219-2559-2

Experiments in Recombinant DNA Technology

1. Preparation of different models based on immunology.

2. Slide agglutination test.

3. Tube agglutination test / Passive agglutination. 4. To prepare soluble antigen by different methods.

4. To seperate serum and plasma from blood.

5. To precipitate immune-globulins by ammonium sulphate and to determine total protein contents.

6. To determine Blood group and Rh factor by slide agglutination test

7. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.

8. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction

9. To perform ELISA for assay of antibodies in serum sample against given antigen.

10. Demonstration of PCR.

11. Demonstration of Gel Electrophoresis test.

B.Sc Honor Microbiology

BSc 4th Year / M.Sc. I Year **Semester – VIII**

BHM –806

BMH 805- FOOD BORNE DISEASES AND FOOD PRESERVATION

MM : 100	Sessional : 25
Time : 3 hrs	ESE : 75
L Credit	Pass Marks : 40
4 4	

Total Hours: 60

Learning objectives:

- To understand the prevalence of bacteria in food commodities.
- To understand the occurrence of food-borne diseases.
- To know the different test for the detection of food-borne infection.

Learning outcomes:

At the end of course student will be able to

- Explain the role of microorganism in food commodities.
- Explain the factor responsible for the growth of bacteria.
- Perform the different microbiological test to determine the quality of food.

UNIT – I

Food spoilage: Microbes in food, factors affecting microbial growth in foods: Extrinsic and intrinsic, microbial spoilage of foods, microbial spoilage of food – milk and milk products, fruits and vegetables, meat products, canned foods.

UNIT – II

Food preservation methods: Aseptic handling, temperature treatment, dehydration, lyophilization, osmotic pressure, radiations canning, chemical preservatives (salt and sugars, organic acids, propylene oxide, wood smoke and antibiotics), mechanism of chemical preservatives.

UNIT - III

Food-borne diseases (Bacteria and Virus): Food poisoning (food intoxication and food infections);Bacterial food poisoning (*Clostridium, Bacillus cereus* and *Staphylococcus);* Viral infections:Rotavirus, Hepatitis A & C