M. Sc. MICROBIOLOGY TEACHING PROGRAMME

SYLLABUS I, II, III and IV SEMESTER

As per
Choice Based Credit System

SESSION 2018-20

FINAL REVISED VERSION

Microbiology
School of Biosciences and Biotechnology
Baba Ghulam Shah Badshah University
Rajouri
J & K

M. Sc. MICROBIOLOGY SYLLABUS

SUMMARY OF CREDIT DISTRIBUTION AS PER CBCS

SEMESTER	COURSES								Total Credits
	CORE				ELECTIVE		Dissertation	FOUNDATION	
	Theory	Practical	Seminar / Journal Club	Open (OE)	Discipline Centric (DCE) (Theory)	Discipline Centric (DCE) (Practical)		Compulsory (CF)	
Semester-1	14	6						4	24
Semester-2	12	6	2	4					24
Semester-3	14	6			2	2			24
Semester-4	10	4			2		8		24
TOTAL									96

Dr. Arif Tasleem

(Saima)

(Dr. Rajiv Aman)

Rakeeb Ahmad

(Tanvir)

(Dr. A. A. Shaikh)

M. Sc. MICROBIOLOGY SYLLABUS

LIST OF PAPERS ALONG WITH CREDIT DISTRIBUTION AND MARKS AS PER CBCS

FIRST SEMESTER									
PAPER					CREDITS	MARKS			Page No.
S. No.	Code	Title	Category	Duration [Hours]		Internal Assessment	University Examination	Total Marks	
1	Mib-1014	Foundation Course	*Compulsory Foundation*	72	4	40	60	100	
2	Mib-1024	General Microbiology	*Core*	72	4	40	60	100	
3	Mib-1034	Virology, Mycology and Protozoa	*Core*	72	4	40	60	100	
4	Mib-1042	Microbial Techniques	*Core*	36	2	20	30	50	
5	Mib-1052	Cell Biology	*Core*	36	2	20	30	50	
6	Mib-1062	Biomolecules	*Core*	*36*	2	*20*	*30*	*50*	
7	*Mib-1712*	***Laboratory I:** General Microbiology, Virology, Mycology and Parasitology*	*Core*	*72*	*2*	*25*	*25*	*50*	
8	*Mib-1722*	***Laboratory II:**Biomolecules and Cell Biology*	*Core*	*72*	*2*	*25*	*25*	*50*	
9	*Mib-1732*	***Laboratory III:**Microbial Techniques*	*Core*	*72*	*2*	*25*	*25*	*50*	
Sub-total			**Core**	Theory	**14**	**140**	**210**	**350**	
				Practical	*6*	*75*	*75*	*150*	
			Foundation		**4**	**40**	**60**	**100**	
TOTAL					**24**	**255**	**345**	**600**	

SECOND SEMESTER									
PAPER					CREDITS	MARKS			Page No.
S. No.	Code	Title	Category	Duration [Hours]		Internal Assessment	University Examination	Total Marks	
1	Mib-2014	Microbial Genetics and Molecular Biology	Core	72	4	40	60	100	24
2	***2514***	***The Microbial World #***	***Elective***	***72***	***4***	***40***	***60***	***100***	
3	Mib-2024	Microbial Diversity	Core	72	4	40	60	100	26
6	Mib-2034	Enzymology and Metabolism	Core	72	4	40	60	100	28
7	***Mib-2514***	***Open Elective (OE)****	***Elective***	***72***	***4***	***40***	***60***	***100***	**30**
8	Mib-2642	Seminar/Journal Club (JC)	Core	36	2	50		50	31
9	*Mib-2712*	***Laboratory IV:*** *Microbial Genetics and Molecular Biology*	*Core*	72	2	*25*	*25*	*50*	32
10	*Mib-2722*	***Laboratory V:****Microbial Diversity*	*Core*	72	2	*25*	*25*	*50*	33
11	*Mib-2732*	***Laboratory VI:****Enzymology and Metabolism*	*Core*	72	2	*25*	*25*	*50*	34
Sub-total			**Core**	Theory	**12**	**120**	**180**	**300**	
				Practical	**6**	***75***	***75***	**150**	
				Seminar/JC	**2**	**50**		**50**	
			Elective (Open)		**4**	**40**	**60**	**100**	
TOTAL					**24**	**285**	**315**	**600**	

*** Open Elective Course:** Candidate has to opt 1 course out of 15 courses offered. The courses are separately listed.
 # MIB-2514 is the **Open Elective Course** offered to Students of discipline ***OTHER THAN MICROBIOLOGY.***

THIRD SEMESTER

PAPER					CREDITS	MARKS			Page No.
S. No.	Code	Title	Category	Duration [Hours]		Internal Assessment	University Examination	Total Marks	
1	Mib-3014	Immunology	Core	72	4	40	60	100	
2	Mib-3024	Industrial Microbiology and Fermentation Technology	Core	72	4	40	60	100	
3	Mib-3032	Microbial Ecology	Core	36	2	20	30	50	
4	Mib-3042	Environmental Microbiology and Toxicology	Core	36	2	20	30	50	
5	Mib-3052	Food Microbiology	Core	36	2	20	30	50	
6		***Discipline Centric Elective (DCE)#***	***Elective***	***36***	***2***	***20***	***30***	***50***	
7	Mib-3512	Viral and Parasitic Infections#	DCE	36	2	20	30	50	
8	Mib-3522	Biofertilizers and Biopesticides#	DCE	36	2	20	30	50	
9	Mib-3532	Analytical Techniques#	DCE	36	2	20	30	50	
11	*Mib-3712*	***Laboratory VII:*** *Immunology*	*Core*	*72*	*2*	*25*	*25*	*50*	
12	*Mib-3722*	***Laboratory VIII:*** *Industrial Microbiology and Fermentation Technology*	*Core*	*72*	*2*	*25*	*25*	*50*	
13	*Mib-3732*	***Laboratory IX:*** *Environmental Microbiology, Toxicology and Food Microbiology*	*Core*	*72*	*2*	*25*	*25*	*50*	
	Mib-3742	***Laboratory X:*** *Discipline Centric Elective Lab*	*DCE*	*72*	*2*	*25*	*25*	*50*	
Sub-total			**Core**	Theory	**14**	**140**	**210**	**350**	
				Practical	**6**	*75*	*75*	*150*	
			Elective (DCE) (Theory)		**2**	**20**	**30**	**50**	
			Elective (DCE) (Practical)		**2**	**20**	**30**	**50**	
TOTAL					**24**	**285**	**315**	**600**	

Discipline Centric Elective: Candidate has to opt 1 course out of 3 courses offered. The courses are separately listed.

FOURTH SEMESTER									
PAPER					CREDITS	MARKS			Page No.
S. No.	Code	Title	Category	Duration [Hours]		Internal Assessment	University Examination	Total Marks	
1	Mib-4014	Medical Microbiology	Core	72	4	40	60	100	56
2	Mib-4024	Agricultural Microbiology	Core	72	4	40	60	100	58
3	Mib-4032	Bioinformatics	Core	36	2	20	30	50	60
4		***Discipline Centric Elective (DCE)#***	***Elective***	***36***	***2***	***20***	***30***	***50***	62
5	Mib-4512	Genetic Engineering#	DCE	36	2	20	30	50	63
6	Mib-4522	Bacterial Diseases of Humans#	DCE	36	2	20	30	50	65
7	Mib-4531	Signal Transduction and Cancer Biology#	DCE	36	2	20	30	50	67
8	*Mib-4712*	***Laboratory X:*** *Medical Microbiology and DCE Lab*	*Core*	*72*	*2*	*25*	*25*	*50*	*69*
9	*Mib-4722*	***Laboratory XI:*** *Agricultural Microbiology and Bioinformatics*	*Core*	*72*	*2*	*25*	*25*	*50*	*70*
10	Mib-4808	Dissertation	Core	288	8		200	200	71
Sub-total			**Core**	Theory	**10**	**100**	**150**	**250**	
				Practical	**4**	*50*	*50*	*100*	
				Dissertation	**8**		**200**	**200**	
			Elective (DCE)		**2**	**20**	**30**	**50**	
TOTAL					**24**	**170**	**430**	**600**	

Discipline Centric Elective: Candidate has to opt 1 course out of 3 courses offered. The courses are separately listed.

LIST OF OPEN ELECTIVES

SECOND SEMESTER			
S. No.	Paper Code	Paper Title	Course Type
1	Math-201	Mathematical Tools for Real World Problems	OE
2	IT-202	Soft Skills in Information Technology	OE
3	Comp-203	Computer Applications and Operations	OE
4	Bio-2541	Fundamentals of Biotechnology	OE
5	Bot-205	Mysteries of Green Plants	OE
6	Bot-206	Botany in Rural Development	OE
7	Zol-207	Nutrition, Health and Hygiene	OE
8	Arab-208	Fundamentals of Arabic Language	OE
9	Eng-209	Applied English	OE
10	Edu-210	Higher Education	OE
11	Eco-211	Principles of Banking	OE
12	HT-212	Basics of Tourism and Travel Agencies	OE
13	HT-213	Tourism Resources of J&K	OE
14	Mgt-214	Business Communication and Soft Skills	OE
15	Edu-215	Instructional Technology	OE

LIST OF DISCIPLINE CENTRIC ELECTIVES

THIRD SEMESTER			
S. No.	Paper Code	Paper Title	Course Type
1	Mib-3512	Viral and Parasitic Infections	DCE
2	Mib-3522	Biofertilizers and Biopesticides	DCE
3	Mib-3532	Analytical Techniques	DCE

FOURTH SEMESTER			
S. No.	Paper Code	Paper Title	Course Type
1	Mib-4512	Genetic Engineering	DCE
2	Mib-4522	Bacterial Diseases of Humans	DCE
3	Mib-4532	Signal Transduction and Cancer Biology	DCE

Paper Code Nomenclature:

Mib-ABCD

Mib: Microbiology

A: Semester (1=Ist; 2=2nd; 3=3rd; 4=4th)

B: 0 = Theory; 5 = Elective Course; 6 = JC; 7 = Practical; 8=Dissertation;

C: Paper No.

D: 2 = 2 Credit; 4 = 4 Credit

Program Outcomes (PO's) of M.Sc. Microbiology Program

PO1: ***Knowledge Acquisition***

Acquisition of knowledge of the subject to understand the basics and to cope with the advancement in the field.

PO2: ***Deeper Understanding***

To have a deeper understanding of the subject by the student enabling them to address societal and scientific issues.

PO3: ***Research and Development***

Development of scientific temperament and to prepare students for research and development in respective areas.

PO4: ***Problem Solution***

Development of critical thinking among students, enabling them to solve problems by applying reasoning and technical inputs.

PO5: ***Evolution of new ideas***

Emergence of new ideas based on the acquired knowledge and critical thinking.

PO6: ***Lifelong Learning***

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO7: ***Leadership and Self-reliance***

Development of leadership abilities among the students to lead and excel in their respective fields. Also, the training provided will make the students self-reliant.

Program Specific Outcomes (PSO's) of M.Sc. Microbiology Program

PSO1: Refurbishing the basics of Physics, Chemistry, Biology, Computers and Biostatistics for better understanding of the syllabus.

PSO2: General understanding about various microbes, mainly bacteria, their growth and control.

PSO3: Development of understanding about viruses, fungi and protozoa.

PSO4: Development of understanding about various techniques employed in studying and manipulating microbes.

PSO5: Development of understanding in the area of Cell Biology (glance of cell structure, function, cell cycle and cell signaling).

PSO6: Development of understanding about various biomolecules.

PSO7: Development of understanding in the area of Molecular Biology and Microbial Genetics (glace gene structure, replication, transcription, translation, regulation of gene expression, genetic variation and inheritance).

PSO8: Development of understanding about the diversity of microbial world.

PSO9: Understanding about the biological catalysts, enzymes, and the cellular metabolism.

PSO10: Development of scientific oratory skills through seminar presentations.

PSO11: Development of the understanding about the Immune System, an essential component of host-microbe relation.

PSO12: Development of understanding about the microbial ecology, role of microbes in the environment and pollution.

PSO13: Development of understanding about the role of microbes in the development of food and dairy products as well as their spoilage.

PSO14: Development of understanding of fermentation technology utilizing various microbes for the production of alcohol, antibiotics and other organic compounds.

PSO15: Development of understanding about the role of microbes in causing infections and diseases in humans.

PSO16: Development of understanding about the role of microbes in agriculture, including nutrient recycling, plant diseases and storage of agricultural products.

PSO17: Acquisition of hands on training trough Research Project Dissertation.

SEMESTER - 1

FOUNDATION COURSE

Mib-1014
Compulsory Foundation
Credits: **4**
Duration: **72** Hours

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit – 1 Cellular Foundations

1.1 The Origin of Life: Chemical evolution of biomolecules; RNA world: First gene and Catalyst; Biological evolution; Evolution of initial eukaryotic cells.

1.2 Cells as structural and functional units of life. The three domains of life: Bacteria, Archaea and Eukarya. Typical and distinguishing features of Bacteria and Archaea.

1.3 Eukaryotic Cells: Membrane, Cytoplasm and Organelles; Photosynthetic Plant Cells and Animal Cells: Common and distinguishing features. Unicellular and Multicellular organisms.

1.4 Genetic Information and its storage: Concept of gene and genome; Flow of genetic information.

Unit – 2 Chemical and Physical Foundations

2.1 Chemical Elements, Atoms and Molecules; Molecular interactions: Strong Interactions (Covalent, Coordinate covalent, Ionic and Metallic bonds), Weak interactions (Hydrogen bonding, Salt bridge, Vander Waal Interaction and Hydrophobic Interactions).

2.2 Stereochemistry: Definition, Classification of Isomerism in Organic compounds: structural isomerism, stereoisomerism – geometrical and optical isomerism.

2.3 Laws of thermodynamics; Free energy change (ΔG); Relationship between free energy change and equilibrium constant; Exergonic and Endergonic reactions; Coupled reactions and addition of ΔG.

2.4 Enthalpy and Entropy and its relation with free energy change. Redox reactions: redox potential and its relation to free energy change.

Unit – 3. Introduction to computer and its applications

3.1 Computer Fundamentals and Organization: Central Processing Unit-Control Unit, Arithmetic Unit, Instruction Set, Register, Processor Speed, Memory Units, Storage Evolution Criteria, Memory Organization, Capacity, RAM, ROM, Secondary Storage.

3.2 Operating systems and data base management system: Introduction to MS-Office, MS-Word, and MS-Excel. Statistical Data analysis through MS-Excel, Storage of data, filing, retrieving, and reproduction.

3.3 Application of computers in current biological research: Internet: definition and practical utility; Introduction of digital computers.

3.4 Computer programming: Data types: Constants, variables, expressions, operations, functions, flow charts, commands, simple programs and their execution- scope and limitations.

Unit – 4. Introduction to Biostatistics

4.1 Concepts of statistical population and sample from a population; qualitative and quantitative data; discrete and continuous data; Primary data; designing a questionnaire and a schedule; secondary data and sources of secondary data.

4.2 Presentation of data: Diagrammatic and graphical representation of data; frequency distributions and cumulative frequency distributions; histogram and frequency polygon. Descriptive statistics: concepts of central tendency.

4.3 Brief description and tabulation of data and its graphical representation: Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance.

4.4 Introduction to probability and laws of probability: Random Events, Events-exhaustive, mutually exclusive and equally likely (with simple exercises)

Unit – 5 . Application of Biostatistics

5.1 Tests of significance: T-test, F-test and χ^2 test.

5.2 Binomial, Poisson and Normal distribution; Deviation, properties and applications of normal distribution.

5.3 Correlation: types, methods; Karl Pearson's coefficient and regression (linear) analysis and their uses.

5.4 Principles of experimental designs: Completely Randomised Designs (CRD) and Randomised Block Designs (RBD)

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. E. H. Segel. *Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry*, 2nd Edition, John Wiley Publications.
2. Nelson, D. D. L., Lehninger, A. L. and Cox, M. M. (2013). *Lehninger: Principles of Biochemistry*. W.H. Freeman Publishers.
3. Tanford, C. (1961). *Physical Chemistry of Macromalocules*. John Wiley and Sons.
4. Voet, D., & Voet, J. G. (2016). *Biochemistry* (5th ed.). Hoboken, NJ: J. Wiley & Sons.
5. Sinha, P.K. and Sinha, P. (2005). Computer Fundamentals, BPB Publication.
6. Rajaraman, V. (2004). Fundamentals of Computers, Prentice-Hall of India Pvt. Ltd., New Delhi.
7. Jaype Brothers, (2011), Methods in Biostatistics for Medical Students and Research Workers (English), 7th Edition.
8. Norman T.J. Bailey, (1995), Statistical Methods in Biology, 3rd Edition, Cambridge University Press.
9. P. N. Arora and P. K. Malhan, (2006), Biostatistics, 2nd Edition, Himalaya Publishing House.
10. Jerold Zar, Biostatistical Analysis, 4th Edition, Pearson Education.
11. Biostatistics: A Foundation for Analysis in the Health Sciences, 7th Edition, Wiley and Sons.

SEMESTER - 1

Mib-1024
Core Course
Credits: **4**
Duration: **72** Hours

GENERAL MICROBIOLOGY

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit – 1 Introduction to Microbiology

1.1 Introduction, history and scope of microbiology. Discovery of microscope and microbes, Theory of abiogenesis & biogenesis, Koch's postulates, River's postulate, concept of kingdom- prokaryote and eukaryotes.

1.2 General characteristics and composition of Prokaryotes and Eukaryotes.

1.3 Classification of Microorganisms: Haekel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese, classification and salient features of bacteria according to Berger's Manual of Determinative Bacteriology.

1.4 Nomenclature and modern methods of Bacterial taxonomy.

Unit – 2 Prokaryotic Cell Structure and Function

2.1 An overview of prokaryotic cell structure; Morphology and ultra-structure of bacteria: size, shape, and arrangement of bacteria, ultra-structure of eubacteria and archeabacteria. Protoplast and spheroplast formation.

2.2 Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule-types, composition and function, slime layers, S-layers.

2.3 Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeabacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid.

2.4 Protein secretion in prokaryotes; Microbial response to external stimulus: Chemotaxis and phototaxis; formation and germination of bacterial endospore.

Unit – 3 Microbial Nutrition and Growth.

3.1 Microbial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.

3.2 Microbial media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.

3.3 Cultivation of microbes: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.

3.4 Microbial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.

Unit – 4 Control of Microorganisms by Physical and Chemical Agents

4.1 Control of microorganisms: Microbial death curve, concept of bio-burden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents.

4.2 Control of microorganisms by physical agents: heat (moist and dry), filtration and radiation.

4.3 Chemical control of microorganisms: Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

4.4 Antibiotics: classification, mode of action and development of antibiotic resistance in bacteria.

Unit – 5 General features of Fungi, Viruses and Acellular infectious agents

5.1 General morphological, cultural and biochemical properties of *Chlamydia, Rickettsia, Mycoplasma* and *Actinomycetes.*

5.2 Fungi – Distinguished characteristics of fungi, general account on morphology, reproduction, physiology and classification.

5.3 Viruses - General properties, morphology and reproduction mechanisms of viruses. General characteristic features of plant, animal and bacterial viruses.

5.4 Acellular Infectious agents: Viroids; Virusoids and Prions.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
3. R.Y. Ingraham, J.L. Wheels, M.L. Painter. *General Microbiology;* Thess Macmillan Press Ltd.
4. M.T. Martinko, J.M. Parker, *Brock Biology of Microorganism*; Prentice-Hall.
5. M.J. Pelczar, E.C.S Chan and N.R. Kreig, *Microbiology;* Tata MacGraw Hill.
6. Breed and Buchanan. *Bergey's Manual of Systematic Bacteriology*. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).
7. R. Y. Stanier, E. A. Adelberg, J. L. Ingraham, *General Microbiology,* 4th edition, Mac Millan Press, London.

SEMESTER - 1

Mib-1034
Core Course
Credits: **4**
Duration: **72** Hours

VIROLOGY, MYCOLOGY AND PROTOZOA

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit – 1 Viruses: Introduction and General Characteristics

1.1 Brief outline of discovery and origin of viruses; General properties of viruses.

1.2 Structure of viruses, size, capsid and their arrangements, viral envelopes and enzymes, viral genome and their types.

1.3 Viral reproduction; Cultivation of viruses; Purification of viruses and Virus Assays.

1.4 Classification and general properties of major families of viruses including detail account of their mode of replication.

Unit – 2 Viruses of Bacteria and Archaea

2.1 Bacterial and Archaeal viruses: Classification, morphology and ultra-structure.

2.2 Virulent double stranded DNA phages: One step growth (latent period, eclipse period, and burst of size).

2.3 Life cycle: lytic and lysogenic life cycle of bacteriophages.

2.4 Single stranded DNA phage, RNA phage; Brief account of M13, Mu, T4, ϕx174 and lambda phage.

Unit – 3 Eukaryotic Viruses

3.1 Taxonomy of Eukaryotic Viruses.

3.2 Reproduction of vertebrate viruses: Adsorption of virions, Penetration and Uncoating, Genome replication and transcription in DNA and RNA viruses and protein synthesis, Assembly of virus capsids and virion release.

3.3 Cytocidal Infections and cell damage; Persistent, latent and slow virus infections; Virus and Cancer.

3.4 Plant viruses and their classification; Structure and pathogenicity of TMV; Viruses of Fungi, Protist and Insects.

Unit – 4 Fungi

4.1 Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.

4.2 Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.

4.3 Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.

4.4 Ecology of fungi: concept of fungistatic, fungicidal.

SEMESTER - 1

Unit – 5 Protozoa

5.1 Occurrence and Ecology of Protozoa: Free-living, symbiotic and parasitic protozoa.

5.2 Importance and Morphology of protozoa: Intracellular structures and locomotor organelles.

5.3 Reproduction of Protozoa: Asexual and Sexual Reproduction; Regeneration.

5.4 Classification of protozoa; Characteristics of some major groups of Protozoa: Flagellates, Amoebas, Sporozoa and the ciliates.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
3. M.J. Pelczar, E.C.S Chan and N.R. Kreig, *Microbiology;* Tata MacGraw Hill.
4. Renato Dulbecco and Harold S. Ginsberg, *Virology;* Fourth edition, J.B. Lippincott Company, USA
5. S. B. Biswas and Amita Biswas. *An Introduction to viruses,* Forth edition, Vikas Publishing House Pvt Ltd New Delhi.
6. Ananthnarayanan and Paniker's, *Textbook of Microbiology,* eighth edition, Universities Press.
7. Alexopoulos, C. Jr, *Introductory Mycology,* Second edition, Wiley, New York.

SEMESTER - 1

Mib-1042
Core Course
Credits: **2**
Duration: **36** Hours

MICROBIAL TECHNIQUES

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Microscopy

1.1 Microscopy: Light microscopy- Simple, Compound and Stereomicroscopy.

1.2 Electron microscopy: Principles, construction and mode of operation of Scanning and Transmission electron microscopy

1.3 Preparation of specimens for electron microscopic studies.

1.4 Confocal microscope: Principle, working and applications; other advanced techniques in microscopy.

Unit – 2 Staining Techniques, Culturing and Sterilization

2.1 Microbiological stains and staining techniques: Types of stains and principles of staining; Stains for bacteria, fungi, algae and protozoa, spirochetes, stains for mycoplasma.

2.2 Preparation of bacterial smears for light microscopy: Fixation, simple staining; Differential staining, Structural staining (Capsule, Flagella, Cell wall and Endospore of bacteria), and nuclear staining.

2.3 Culture media for Microbes; Types of media- general-purpose media, special purpose media; selective, elective, diagnostic, resuscitation media; Pure culture techniques: Different types of inoculation techniques - Spread plate, Pour plate and Streak plate methods.

2.4 Sterilization techniques: Principles, types of Sterilization, and their mode of action, Physical methods: Heat-dry heat, Incineration, Moist heat, Tyndalization (Fractional Sterilization), Radiation methods; Filtration-Types of filters, Working of Laminar airflow.

Unit – 3 Microbes in Cloning and Expression

3.1 Host and vectors: Microbial host for cloning and expression; bacteria, fungi as hosts; Vectors for cloning and expression based on plasmids, phagemids, cosmids, bacterial and yeast artificial chromosomes.

3.2 Tools employed in molecular cloning: Plasmid purification; Restriction endonucleases, types, cleavage pattern; Sticky and blunt ends; DNA ligases; DNA polymerases; DNA modifying enzymes commonly used in cloning.

3.3 PCR; Principle, types and variations; Applications of PCR; Site directed and random mutagenesis; cDNA cloning; DNA sequencing: Maxam Gilbert method; Sanger's method, Next generation sequencing techniques.

3.4 Microbes for protein overexpression: Uses of different microbes (bacteria and fungi) for protein overexpression.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

SEMESTER - 1

Recommended Textbooks and References:

1. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Pelczar. (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. *Microbiology*. McGraw Hill, New York
3. Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. *Microbiology*, International edn. 4th edn.WCB Mc Graw-Hill.
4. Cappuccino, J. G. and Sherman, N. 1999. *MICROBIOLOGY A Laboratory Manual* 4th Edn. Addison – Wesley.
5. Madigan M.T., Martinko M. J. and Parker, J. 2003. *Brock Biology of microorganisms*. Pearson education, New Jersy.
6. Brown, T. A (2010) *Gene cloning and DNA Analysis: An Introduction*, Wiley-Blackwell Publication
7. Clark, D. P (2005). *Molecular Biology: Understanding the Genetic Revolution.* Academic press
8. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Pattten. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. 4th Ed. ASM press.

SEMESTER - 1

Mib-1052
Core Course
Credits: **2**
Duration: **36** Hours

CELL BIOLOGY

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Structure of Cells and Its Organelle

1.1 Structure and diversity of prokaryotic and eukaryotic cells; characteristics that distinguish prokaryotic and eukaryotic cells. An outline of their ultra-structure.

1.2 Subcellular fractionation: concept, principle and isolation of plasma membrane, nuclei, mitochondria, microsomes and cytosol, applicability of the technique in contemporary researches in cell biology. Chemical organization of the cell- a general account.

1.3 Structure and functions of mitochondria, Golgi complex, vacuoles, lysosomes, microbodies, nuclear envelope and nucleolus.

1.4 Cytoskeleton: structure, composition and functions of microtubules, microfilaments, cilia and flagella.

Unit – 2 Cell Membrane: Structure and Functions

2.1 Basic structural elements of membrane- lipid bilayer, micelles and vesicles; characteristics and composition of cell membrane; membrane turnover.

2.2 Membrane structure and assembly: fluid mosaic model; membrane proteins-integral, peripheral and lipid anchored; membrane lipids- structure and asymmetry.

2.3 Membrane dynamics: ordering of acyl group in bilayer; transbilayer movement of lipids-catalysed and uncataysed movement.

2.4 Membrane transport: passive mediated- ionophores, porins, ion channels, aquaporins; active transport- Na^{+}-K^{+} ATPase, Ca^{2+} ATPase, and ABC transporters.

Unit – 3 Cell Cycle and Signaling

3.1 Signal transduction: General features, role of effector proteins and secondary messengers in signaling, structure of G-protein coupled receptors (GPCR), trimeric G-protein; classes and functions.

3.2 Signaling pathway that regulate ion channels: Rhodopsin signaling pathway in Rod cells of the eye. Gene controlling signaling pathways: tyrosine kinase pathway and Ras/MAP kinase pathway.

3.3 Cell cycle: mitosis, meiosis (general account); control of cell cycle, role of kinases and kinase inhibitors, checkpoints: concept and role.

3.4 Programmed cell death (Apoptosis)- pathways involved, role in normal and diseased state, various markers of apoptosis. Role of FAS ligand.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question

will carry 8 marks.

Recommended Textbooks and References:

1. Albert B; Bray D; Raff M; Roberts K and Watson JD. (2004). *Molecular Biology of the Cell*, Garland Publishing Inc., New York. 6th Ed.
2. Cooper, G. M. and Hausman R.E. (2006). *The Cell: A Molecular Approach*, ASM Press, Washington DC. 4th Ed.
3. Evans, J. and Manson, A. L. (2008). *Cell Biology and Genetics*. Mosby Publishers.
4. Karp, G. (2007). *Cell and Molecular Biology*, John Wiley and Sons Inc. 5th Ed.
5. Kleinsmith L. J. and Kish V. M. (1995). *Principles of Cell and Molecular Biology*, Harper Collins College Publishers, New York, USA. 2nd Ed.
6. Lodish H; Berk A; Zipursky SI; Matsudaira P; Baltimore D and Darnell J. (2004). *Molecular Cell Biology*, W. H. Freeman and Company, 5th Ed
7. Nelson, D. D. L., Lehninger, A. L. and Cox, M. M. (2013). *Lehninger Principles of Biochemistry*. W.H. Freeman Publishers.
8. Sako, Yasushi, Ueda, Masahiro (Eds.) (2011). *Cell Signaling Reactions*. Springer.

SEMESTER - 1

Mib-1062
Core Course
Credits: **2**
Duration: **36** Hours

BIOMOLECULES

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit-1 Introduction to Biomolecules and Proteins

1.1 Water: structure and properties, ion product, dipolar structure and dielectric constant; concentration of solution- Molarity, Normality, Molality and Strength.

1.2 Chemical foundations of biology: pH, pK, acids, bases, buffers- composition, preparation, Henderson-Hasselbalch, buffer capacity and strength.

1.3 Amino acids: structure and classification; Proteins: characteristics of peptide bond and Ramachandran map; Hierarchy in structure: primary, secondary, tertiary and quaternary structures

1.4 Protein folding- Anfinsen's experiment, Levinthal paradox, chaperons, protein sequencing (N-terminal sequencing, C-terminal sequencing, Edmann degradation)

Unit – 2 Carbohydrates and Lipids

2.1 Carbohydrates: classification, basic chemical structure, monosaccharides – aldoses and ketoses; Configuration and conformation of monosaccharides (pyranose and furanose), stereoisomerism, anomers, epimers and mutarotation

2.2 Polysaccharides: structural polysaccharides - cellulose and chitin; storage polysaccharides - starch and glycogen; glycoproteins: N- and O-glycosylation; Glycosaminoglycans; Glycoproteins

2.3 Lipids – classification of lipids: oils, fats, and waxes, occurrence and properties of fatty acids, esters of fatty acids, phosopholipids, glycolipids, sphingolipids, cerebrosides and gangliosides.

2.4 Lipoproteins, steroids and cholesterol; Eicosanoids, prostaglandins and leukotriene's.

Unit – 3 Nucleic acids, Vitamins and Pigments

3.1 Nucleic acids: purines, pyrimidines, nucleosides, nucleotides: structure of DNA and RNA.

3.2 Vitamins and Co-enzymes: classification, water-soluble and fat-soluble vitamins, dietary requirements, deficiency conditions, coenzyme forms.

3.3 Porphyrins and porphyrin ring system: chlorophyll, hemoglobin and myoglobin.

3.4 Secondary metabolites: isoprenoids, polyphenols and flavonoids.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Stryer, L. (2015). *Biochemistry* (8th ed.). New York: Freeman.

SEMESTER - 1

2. Lehninger, A. L. (2012). *Principles of Biochemistry* (6th ed.). New York, NY: Worth.
3. Voet, D., & Voet, J. G. (2016). *Biochemistry* (5th ed.). Hoboken, NJ: J. Wiley & Sons.
4. *Biochemistry* by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc., 2008
5. Horton, H.R., Moran, L. A., Scrimgeour, K.G. Perry, M.D and Rawn, J.D. 2006. *Principles of Biochemistry*, IVth Edition. Pearson Education Internationl. London.
6. Dobson, C. M. (2003). *Protein Folding and Misfolding.* Nature, 426(6968), 884- 890. doi:10.1038/nature02261.
7. Richards, F. M. (1991). *The Protein Folding Problem.* Scientific American, 264(1), 54-63. doi:10.1038/scientificamerican0191-54.

SEMESTER - 1

Mib-1712
Core Course
Credits: **2**
Duration: **72** Hours

LABORATORY – I
GENERAL MICROBIOLOGY AND VIROLOGY

Total Marks: **50**
Internal Assessment: **25**
University Examination: **25**

General Microbiology

1. Good Microbiology laboratory practices: Laboratory safety (Do's and Don'ts), hazard from chemicals, handling of cultures and chemicals, disposal of chemicals and cultures.
2. Introduction to different Glass wares used in Microbiology Laboratory.
3. To learn handling of different instruments and Equipments used for culture and Sterilization.
4. To prepare basic liquid (Nutrient broth) and basic solid media (Nutrient Agar and Potato Dextrose Agar) for cultivation of bacteria and fungi.
5. To prepare selective, differential media and enriched media (MacConkey Agar and Blood Agar).
6. To learn pure culture techniques used for isolation and purification of microorganisms by:
    a. Streak plate method.
    b. Pour plate method.
    c. Spread plate method.
7. Isolation and Enumeration of microorganisms from Air (plate exposure method), Soil and Water (serial dilution method).
8. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi.
    a. Gram Staining.
    b. Acid fast staining.
    c. Fungal staining (Lacto-phenol cotton blue).
    d. Spore staining.
    e. Flagella staining.
    f. Capsule staining.
    g. Negative staining.

SEMESTER - 1

Mib-1722
Core Course
Credits: **2**
Duration: **72** Hours

LABORATORY – II BIOMOLECULES AND CELL BIOLOGY

Total Marks: **50**
Internal Assessment: **25**
University Examination: **25**

Biomolecules

1. Preparing various stock solutions and working solutions that will be needed for the course.
2. To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
3. Overview of Spectrophotometer and validating the Beer- Lambert's Law.
4. To detect the presence of carbohydrate in the given sample by Molish test.
5. To detect the presence of reducing sugar in the given sample by Fehling's test
6. To detect presence of reducing sugar using Benedict's test.
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test).
8. Tests for amino acids: Ninhydrin test, Xanthoproteic test, Lead sulphide test, Hopkin'test
9. To determine Saponification value of given fat sample.
10. Separation of amino acids by Paper Chromatography/TLC
11. Separation of plant pigments by Paper Chromatography/TLC

Cell Biology

1. Lab demonstration of light and fluorescence microscopic techniques.
2. *Study the process of somatic cell division in root tips of *Allium sativum* (garlic)/ *Aillum cepa* (onion)/*Aillum tuberosum.*
3. *Study the structure of somatic chromosomes of *Allium cepa/ Vicea faba,* describe the salient features of the karyotype and preparation of ideogram.
4. *Study meiotic behaviour of chromosomes of *Phlox drumondii, Allium sp or Eremurus persicus.*
5. Lab demonstration of microtomy technique.
6. Preparation of plant and animal tissue sections for microtomy and their staining.
7. Isolate chloroplasts from leaf tissues of spinach; study the variation in chloroplast shape in spinach, *Ulothrix* and *Spirogyra.*
8. Study the diversity in cell structure in a given sample of plant and animal tissue. (Onion peel, pulp of banana, xylem cells, liver of sheep)
9. Study transport across the semi permeable membrane by using potato osmoscope.

*Depending upon the availability, only one material will be used.

SEMESTER - 1

Mib-1732
Core Course
Credits: **2**
Duration: **72** Hours

LABORATORY – III
MICROBIAL TECHNIQUES

Total Marks: **50**
Internal Assessment: **25**
University Examination: **25**

Microbial Techniques

1. Lab demonstration of light microscopic technique.
2. Isolation of pure microbial culture from soil/water/human sample by streak plate method.
3. Culturing of microbes on small and medium scale.
4. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi.
    a) Gram Staining.
    b) Acid fast staining.
5. To check motility of bacteria by hanging drop and semi-solid agar methods.
6. Antimicrobial activity of Antibiotics by disk diffusion method.
7. Determination of MIC of Antibiotics.
8. Effect of alcohol and detergents on microbial growth.
9. Isolation of plasmid DNA from bacteria.
10. Restriction digestion of plasmid DNA.

Mib-2014
Core Course
Credits: 4
Duration: 72Hours

MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Duration: 72HoursTotal
Marks: 100
Internal Assessment: 40
University Examination: 60

Unit – 1 Gene Structure, Replication and Repair

1.1 Nucleic acid as genetic information carriers: experimental evidence; Concept of gene and genome; Organization of genetic material in prokaryotes and eukaryotes.
1.2 Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
1.3 DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands; Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polymerases, DNA ligase, primase.
1.4 DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine dimers), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.

Unit – 2 Transcription And Its Regulation

2.1 Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA.
2.2 Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.
2.3 Control of Transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination; Rho dependent and Rho independent.
2.4 Posttranscriptional modification, maturation and splicing of RNA transcripts, catalytic RNA.

Unit – 3 Translation

3.1 Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
3.2 Protein synthesis: steps, details of initiation, elongation and termination.
3.3 Inhibitors of protein synthesis: signal hypothesis.
3.4 Post translational modification: covalent modification, phosphorylation, glycosylation, methylation; Protein targeting.

Unit – 4 Regulation of Gene Expression

4.1 Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter, repressor, induction and repression, positive and negative control.
4.2 *Lac*-operon, *ara*-BAD operon, *trp*operon, attenuation, mechanism of regulation of transcription.
4.3 Regulation at the level of translation.
4.4 Global regulatory systems; Catabolite Repression and Quorum Sensing

Unit – 5 Microbial Genetics: Mechanisms of Genetic Variation

5.1 Mutations and their chemical basis: Spontaneous mutations, Induced mutations, Effects of mutations (Silent, Missense, Nonsense and Frame shift mutations); Detection and Isolation of Mutants, Carcinogenicity testing.

5.2 Creating genetic variability: Recombination in eukaryotes, Horizontal gene transfer in prokaryotes, recombination at molecular level; Transposable genetic elements and bacterial plasmids.

5.3 Bacterial Conjugation: F^+xF^- Mating; Hfr Conjugation; F' Conjugation; DNA Transformation; Transduction: Generalized Transduction, Specialized Transduction

5.4 Genome mapping; Recombination and genome mapping in viruses.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
3. Stryer, L. (2015). *Biochemistry* (8th ed.). New York: Freeman.
4. Lehninger, A. L. (2012). *Principles of Biochemistry*(6th ed.). New York, NY: Worth.
5. Voet, D., &Voet, J. G. (2016). *Biochemistry* (5th ed.). Hoboken, NJ: J. Wiley & Sons.
6. Brown, T.A (Ed.) (1991). *Molecular Biology*. Bios Scientific Publishers Ltd, Oxford.
7. Clark, D. P. (2005). *Molecular Biology: Understanding the Genetic Revolution*. Elsevier Academic Press, UK.

SEMESTER - 2

Mib-2024
Core Course
Credits: 4
Duration: 72Hours

MICROBIAL DIVERSITY

Total Marks: 100
Internal Assessment: 40
University Examination: 60
Duration of Exam: 3 Hours

Unit – 1 Bacterial Classification and Diversity

1.1 Microbial World: Concepts and Scope: Types of diversity: Morphological, Structural, Metabolic, Biological, Ecological and Evolutionary diversity (Genetic diversity) of microbial world.
1.2 Classifying and Naming Microorganisms: Classification systems, ICBN Rules, Major Characteristics used to Classify Microorganisms.
1.3 Bacterial Diversity:Archaebacteria, Photosynthetic Eubacteria, Chemoautotrophic and Methophilic Eubacteria, Gliding Eubacteria, Spirochetes, Rickettsiae and Chlamydiae, Actinomycetes, Mollicutes, Protists.
1.4 Classification based on Bergey's manual (Determinative & Systematic).

Unit – 2 Viruses and Sub-Viral Particles

2.1 Viral Diversity: Classification of viruses, Group I – T2 Bacteriophage, Group II – Banana bunchy top virus.
2.2 Group III – Reovirus, Group IV- TMV, Group V – Rhabdovirus, Group VI – HIV, Group VII –Hepatitis virus.
2.3 Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus
2.4 Virusoids, Viroids and Prions.

Unit – 3 Fungal Diversity

3.1 Eukaryotic microbes: algae, fungi, slime molds and protozoa; extremophiles and unculturable microbes.
3.2 Fungal Diversity: Classification, Distribution and Importance.
3.3 Structure, reproduction and general characteristics of the fungal divisions: Zygomycota (*Rhizopus*), Ascomycota (*Neurospora*), Basidiomycota (*Agaricus*),
3.4 Structure, reproduction and general characteristics of the fungal divisions: Deuteromycota (*Penicillium*), Chytridiomycota (*Allomyces*), Myxomycota and Yeast.

Unit – 4 Importance of Microbial Diversity

4.1 Importance and Conservation of Microbial Diversity: Importance of microbial diversity in agriculture, forestry, environment, industrial & food biotechnology, animal & human health.
4.2 Metagenomics and its importance.
4.3 Importance of conservation. *In situ* conservation and *Ex situ* conservation.
4.4 Role of culture collection centers in conservation.

Unit – 5 Host-Microbe Interaction and Microbial Control

5.1 Host-pathogen interaction, ecological impacts of microbes; symbiosis (Nitrogen fixation and ruminant symbiosis).
5.2 Microbes and nutrient cycles; microbial communication system; bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics; Chemotaxis.
5.3 Sterilization, disinfection and antisepsis: physical and chemical methods for control of microorganisms.
5.4 Antibiotics, antiviral and antifungal drugs, biological control of microorganisms.

Note for the paper setter:
The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. *Microbiology.* McGraw Hill, New York

2. Presscott, L. M., Harley, J. P. and Klein, D. A. 1999. *Microbiology.* 4th edn. WCB Mc Graw- Hill, New Delhi.
3. Alcomo, I.E. 2001. *Fundamentals of Microbiology.* VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
4. Alexopoulos, C. J. and Mims, C. W. 1979. *Introductory Mycology.* III edition, Wiley Eastern, New Delhi.
5. Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2001. *Introduction to Modern Virology.* 5th edn. Blackwell publishing, USA.
6. Perry, J.J. and Staley, J.T. 1997. *Microbiology. Dynamics and Diversity.* 4th edn. Wesley Longman pub. New York.
7. Satyanarayana, T. and Johri, B. N. 2005. *Microbial Diversity – Current Perspectives and Potential Applications.* I K Int. Pvt. Ltd. New Delhi.
8. Stanley J.T. and Reysenbach A.L.1977. *Biodiversity of microbial life.* John Wiley & Sons Inc. Publication. New York.

SEMESTER - 2

Mib-2034
Core Course
Credits: 4
Duration: 72Hours

ENZYMOLOGY AND METABOLISM

Total Marks: 100
Internal Assessment: 40
University Examination: 60
Duration of Exam: 3 Hours

Unit 1--Enzyme Kinetics

1.1 Nomenclature and classification of enzymes: Enzyme Commission's system of classification, six main classes of enzymes; co-factors and coenzyme.
1.2 Factors affecting enzyme activity: pH, temperature, substrate and enzyme concentration; ribozymes and abzymes.
1.3 Reaction kinetics: chemical kinetics- Michaelis-Menten equation using steady state kinetics, significance of- Kcat, Km and Kcat/Km.
1.4 Enzyme inhibition: competitive, noncompetitive, uncompetitive and mixed inhibitions; allostery of enzyme action: MWC model, KNF model.

Unit 2--Enzyme Catalysis

2.1 Mechanism of catalysis: acid-base catalysis and covalent catalysis (examples of enzyme catalysis using chymotrypsin and ribonuclease)
2.2 Multi-enzyme complex: fatty acid synthase, allosteric regulation of aspartate transcarbamylase
2.3 Mapping of active site: Affinity labeling and chemical modification methods of active site determination.
2.4 Immobilization of enzymes, properties and application of immobilized enzymes. Isoenzymes-application and significance

Unit 3-- Bioenergetics and Carbohydrate metabolism

3.1 Principles of bioenergetics: Energy transformation, laws of thermodynamics, spontaneity of a process, life and thermodynamics.
3.2 Carbohydrate metabolism: aerobic and anaerobic pathways, glycolysis, citric acid cycle, oxidative phosphorylation and electron transport chain.
3.3 Alternate pathways of glucose metabolism-pentose phosphate pathway, glyoxalate cycle, and glucuronic acid cycle.
3.4 Gluconeogenesis, glycogen synthesis and breakdown.

Unit –4 Lipid metabolism

4.1 Oxidation of lipids: beta oxidation, oxidation of unsaturated and odd chain fatty acids and formation of ketone bodies.
4.2 Biosynthesis of fatty acids: carbon sources, acetyl CoA carboxylase and reactions of fatty acid synthase complex, synthesis of odd chain and unsaturated fatty acids.
4.3 Lipoproteins: Low density lipoproteins (LDL), Very low density lipoproteins (VLDL), High density lipoproteins (HDL) and Chylomicrons.
4.4 Biosynthetic pathway of cholesterol.

Unit 5--Nitrogen metabolism

5.1 Oxidative degradation of amino acids: transamination, oxidative deamination, urea cycle and ammonia excretion.
5.2 Biosynthesis of essential (leucine, isoleucine and valine) and non-essential (alanine, asparagine and glutamine) amino acids.
5.3 Regulation of amino acid biosynthesis, genetic defects in amino acid metabolism.
5.4 Biosynthesis of purine and pyrimidine nucleotides, regulation of nucleotide synthesis, Nitrogen fixation: nitrogenase system and nitrate reductase.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Price & Stevens. (1999). *Fundamentals of Enzymology*
3. Palmer, T. (2001). *Enzyme; Biochemistry, Biotechnology*, Clinical Chemistry. Horwood Ltd.
4. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
5. Stryer, L. (2015). *Biochemistry* (8th ed.). New York: Freeman.
6. Lehninger, A. L. (2012). *Principles of Biochemistry*(6th ed.). New York, NY: Worth.
7. Voet, D., &Voet, J. G. (2016). *Biochemistry* (5th ed.). Hoboken, NJ: J. Wiley & Sons.

SEMESTER - 2

Paper Code 2514
Open Elective
Credits: **4**
Duration: **72**Hours

OPEN ELECTIVE

LIST OF OPEN ELECTIVES

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

S. No.	Paper Code	Paper Title	Course Type	Credits
1	Math-201	Mathematical Tools for Real World Problems	OE	4
2	IT-202	Soft Skills in Information Technology	OE	4
3	Comp-203	Computer Applications and Operations	OE	4
4	Bio-204	Fundamentals of Biotechnology	OE	4
5	Bot-205	Mysteries of Green Plants	OE	4
6	Bot-206	Botany in Rural Development	OE	4
7	Zol-207	Nutrition, Health and Hygiene	OE	4
8	Arab-208	Fundamentals of Arabic Language	OE	4
9	Eng-209	Applied English	OE	4
10	Edu-210	Higher Education	OE	4
11	Eco-211	Principles of Banking	OE	4
12	HT-212	Basics of Tourism and Travel Agencies	OE	4
13	HT-213	Tourism Resources of J&K	OE	4
14	Mgt-214	Business Communication and Soft Skills	OE	4
15	Edu-215	Instructional Technology	OE	4

Note: Candidate has to opt only 1 course out of the 15 courses offered.

SEMESTER - 2

Mib-2514
Open Elective
Credits: 4
Duration: 72 Hours

THE MICROBIAL WORLD

Total Marks: 100
Internal Assessment: 40
University Examination: 60
Duration of Exam: 3 Hours

Unit 1: Introduction to microbiology and microbial diversity

1.1 Brief history and development of microbiology as discipline.

1.2 Theory of spontaneous generation vs. biogenesis, Germ theory of diseases.

1.3 General characterization of viruses, bacteria, algae, fungi and protozoa.

1.4 Scope of microbiology.

Unit 2: Microbial techniques to understand microbial world

2.1 Microscopy: Simple, compound and Electron microscope.

2.2 Nutritional requirements in bacteria and nutritional categories.

2.3 Culture media: components of media, natural and synthetic media.

2.4 Microbial Control: heat (moist and dry), filtration and radiation; Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

Unit 3: Importance of microbial world for humankind

3.1 Brief introduction to human gut microbial flora and their benefit.

3.2 Importance of nitrogen cycle and role of bacteria in nitrogen cycle.

3.3 Microbial significance in waste management, Microbial indicators of climate change

3.4 Antibiotics: classification, mode of action and development of antibiotic resistance in bacteria.

Unit 4: Microbiology and Food Industries.

4.1 Water potability: treatment and safety of drinking water, faecal coliforms.

4.2 Natural flora and source of contamination of food.

4.3 Physical and chemical methods of food preservation: Temperature (low, high and drying), salt, sugar and antibiotics.

4.4 Probiotics: heath benefits, types of microorganism used, and probiotic food available in market.

Unit 5: Common communicable diseases caused by microbes and their prevention.

5.1 Flu, Hepatitis, Tuberculosis, measles and AIDS: cause and symptoms.

5.2 Types of transmission (Direct and Indirect) and control measures.

5.3 Personal hygiene and its significance

5.4 Social hygiene and control of communicable diseases.

17/1/19
Dr. Shoeb Ahmad
Academic Coordinator
MICROBIOLOGY

Note for the paper setter:

This is an 'OPEN ELECTIVE' paper and is meant for students of other discipline than microbiology. The paper setter must keep this in view while selecting the 'level' of questions in the examination.

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
3. M.T, Martinko, J.M. Parker, *Brock Biology of Microorganism*; Prentice-Hall.
4. M.J. Pelczar, E.C.S Chan and N.R. Kreig, *Microbiology;* Tata MacGraw Hill.

14/1/19
Dr. Shoeb Ahmad
Academic Coordinator
MICROBIOLOGY

SEMESTER - 2

Mib-2642
Core Course
Credits: 2

SEMINAR / JOURNAL CLUB

Total Marks:
Internal Assessment: 5

- Topics of Seminar/Research Article be allotted to every student along with a supervisor / mentor.
- Students should make a 30 min. PowerPoint presentation of the same, which all the faculty of the department and students should attend.
- The seminar should be followed by a small quiz (5 questions; MCQ based), prepared by the concerned faculty on the topic, which all the students should attempt.
- Assessment of the students should be based on their seminar presentation [25 %], as assessed individually by all faculty members, as well as their accumulated averaged performance in the quiz [75 %].

SEMESTER - 2

lib-2712
Core Course
Credits: 2

LABORATORY – IV
MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Microbial Molecular Biology and Genetics

1. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
2. To isolate and produce UV induced auxotrophic mutants by replica plating method.
3. To perform Ames test for detecting carcinogen or mutagen.
4. Isolation of Plasmid DNA from bacteria.
5. To isolate genomic DNA from Gram positive and Gram Negative bacteria.
6. To check purity and quantity of DNA by Spectrophometeric method.
7. To isolate total RNA and mRNA from bacteria
8. Quantification of DNA by DPA method.
9. Quantification of RNA by Orsinol method
10. Transformation of chemically competent *E. coli*.
11. Demonstration of genetic recombination in bacteria by conjugation.
12. Demonstration of transduction and production of bacteriophages
13. To perform SDS-PAGE for separation of proteins in given sample.

SEMESTER - 2

Mib-2722
Core Course
Credits: **2**
Duration: **72**Hours

LABORATORY – V
MICROBIAL DIVERSITY

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Microbial Diversity

1. Isolation and identification of Bacteria from food and water.
2. Isolation and identification of Bacteria various soil samples
3. Isolation and identification of air microflora.
4. Isolation of microbes from external human normal microflora.
5. Isolation and identification and study of *Actinomycetes* from soil.
6. Isolation and identification and study of Cyanobacteria from soil / paddy field.
7. Isolation and study of Bacteriophages from sewage.
8. Preparation of basic solid media agar slants and agar deep tubes for cultivation of fungi.
9. Isolation and identification of fungi from soil/cereals/water by serial dilution technique.

Mib-2732
Core Course
Credits: 2
Duration: 72Hours

LABORATORY – VI
ENZYMOLOGYAND METABOLISM

Total Marks: 50
Internal Assessment: 25
University Examination: 25

1. Biochemical calculations and reagent preparation
2. Estimation of proteins by Lowery's method.
3. Estimation of proteins by Biuretic method.
4. Effect of pH and temperature on enzyme activity
5. Biochemical Tests for sugars (any one):
    a. Molish's test
    b. Fehling's test
6. Biochemical Tests for amino acids (any one):
    a. Ninhydrin test
    b. Xanthoproteic test
7. Biochemical Tests for lipids (any one):
    a. Solubility test
    b. Saponification test
8. To study catalase activity of given microbial culture.
9. To study oxidase activity of given microbial culture.
10. To study ability of microorganisms to hydrolyse casein
11. To demonstrate phenylalanine deaminase activity of given bacterial culture.
12. To demonstrate L-lysine decarboxylase activity of bacterial culture.
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 bacteria

Mib-3014
Core Course
Credits: **4**
Duration: **72** Hours

IMMUNOLOGY

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit 1--Introduction to immunology

1.1 lTypes of immunity, innate and adaptive, hematopoiesis. The host-microbe relationship: Normal body flora; Pathogen and their abilities to cause disease. Host defense barriers and its breach for the establishment of infection and disease; Virulence factors and ability of pathogen to escape host to spread disease.

1.2 Cells and organs of immune system: B and T cells, macrophages, dendritic cells, NK cells, eosinophills, neutrophills and mast cells, organs; thymus, bursa of fabricus, spleen, lymph nodes and lymphatic system.

1.3 Immunoglobulin: structure, classes and subclasses; Nature and biology of antigens, immunogenicity versus antigenicity, epitopes, antigen- antibody interactions and heptans.

1.4 Generation of antibody diversity; Basis of self and non-self-discrimination.

Unit 2--Humoral and cell mediated immunity

2.1 Major histocompatibility complex and HLA system, recognition of antigens by T-cells and role of MHC; implication of linkage disequilibrium and disease association.
2.2 Antigen processing and presentation: endogenous and exogenous antigens; super antigens.
2.3 Complement fixing antibodies and complement pathways; ADCC.
2.4 Cytokines, types and functions, cell adhesion molecules, cytokine related diseases; therapeutic uses of cytokines.

Unit 3--Clinical Immunology

3.1 Type I, type II, type III and type IV hypersensitivity reactions.
3.2 Autoimmune disorders: Systemic lupus erythematosus (SLE), Multiple sclerosis (MS) and Arithritis
3.3 Cancer: oncogenes and proto-oncogenes, tumor antigens, tumor evasion of immune system. Organ transplantation: Role of CD4+ T cells; immunological basis of graft rejection and immunosuppressive therapy.
3.4 AIDS, HIV infection of Target Cells and Activation of Provirus. Infectious disease epidemiology: Reservoirs of infectious diseases; Modes of transmittance of infectious diseases; Mode of occurrence of disease in the population; Nosocomial Infections; Infectious diseases and Public Health Organizations.

Unit 4-- Immunodiagnostic Procedures

4.1 Techniques: flow cytometry, ELISA, RIA (principles, properties and applications). Serological reactions and techniques: Neutralization; Precipitation; Agglutination; Complement fixation test
4.2 Immunofluorescence and Fluorescence microscope; Western Blotting
4.3 Immunodiffusion: Mancini and Ouchterlony methods; immunoelectrophoresis.
4.4 Separation of immunoglobulin from serum.

Unit 5—Immunobiotechnology and Transplantation

5.1 Monoclonal antibodies: production, detection and applications; chimeric and hybrid monoclonal antibodies.
5.2 Active and passive immunization: live, killed, attenuated; conventional vaccines. Vaccine technology: recombinant DNA and peptide vaccines.

5.3 Stem cells: overview of stem cells, functions and medical applications.

5.4 Transplantation of tissues and organs; Allograft Rejection and role of Immunosuppressive Agents; HLA-matching; Transplant survival and immunotherapy; Xenotransplantation; Role of transgenic animals as organ donors.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Lansing M Prescott, John P. Harley, Donald A Klein, *Microbiology;* Sixth edition, Mc Graw Hill Higher education.
2. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
3. Coleman, R.M.,Lombard, M.F. and Sicard, R.E. 1992. *Fundamental Immunology*, 2nd ed, Dubuque, Iowa: Wm. C. Brown.
4. Janeway, C.A., and Travers, P. 1997, *Immunobiology: The immune system in health and disease*, 3rd ed. New York, Garland Publishing.
5. Kuby, J. 1997, *Immunology*, 3rd ed. New York, W.H. Freeman.
6. Male, D., Champion, B., Cooke, A. and Owen, M. 1991. *Advanced Immunology*. Mosby Publication, Baltimore.

Mib-3024
Core Course
Credits: **4**
Duration: 72 Hours

INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit – 1 Introduction to Fermentation

1.1 General concept of microbial fermentation; Definition of primary and secondary metabolites, and screening of new metabolites.

1.2 Industrially important strains of bacteria, fungi, and *Actinomycetes*. Isolation and screening of the industrially important strain from diverse ecosystem.

1.3 Methods of Strain development for industrial purposes: mutation, recombination, protoplast fusion, regulation and gene technology.

1.4 Substrates used as carbon and nitrogen source for industrial fermentation.

Unit – 2 Fermentation Technology

2.1 Fermentation technology: Processes of fermentation, Methods of fermentation, Growth Kinetics of microorganism during fermentation.

2.2 Fermenter and bioreactors: monitoring and control of parameters, designing, operation and application.

2.3 Concept and importance of gas exchange and mass transfer and scale-up in microbial fermentation.

2.4 Basic concept of cell and enzyme immobilization and reactors used for immobilized enzymes. Production of yeast and yeast derived products.

Unit – 3 Types Of Fermentations And Their Industrial Uses

3.1 Batch, fed batch and continuous fermentations. Direct, dual or multiple fermentations.

3.2 Fermentation type reactions, alcoholic, lactic acid

3.3 Mixed acid, propionic acid, butanediol and acetone-butanol types

3.4 Detection and assay of fermentation products. Scale-up of fermentations.

Unit – 4 Microbial products: Alcohols, Solvents, Organic acids and Antibiotics

4.1 Microbial production of alcohols: vinegar, wine and alcohol.

4.2 Microbial production of solvents-glycerol, acetone, and butanol.

4.3 Microbial production of citric acid and glutamic acid.

4.4 Fermentation of antibiotics (Penicillin and Streptomycin).

Unit – 5 Microbial products, Product Recovery and Effluent treatment

5.1 Microbial production of enzymes and proteins of industrial importance: Amylase, Protease; Interferon and Insulin

5.2 Microbial production of Vitamin B2 and B12; Flavors and fragrances.

5.3 Downstream processing: introduction, removal of microbial cells and solid matter, foam separation,

precipitation, filtration, centrifugation, cell disruption and liquid-liquid extraction, Chromatography, membrane filtration, drying and crystallization.

5.4 Effluent treatment: B.O.D and C.O.D treatment and disposal of effluents; Sterilization and pasteurization of products, canning, packing, preservation and hygiene.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Crueger, W. and Crueger, A. (2002) Biotechnology: *A Textbook of Industrial Microbiology*. Science Tech Inc. Publishers.
2. Stanbury, P. F., & Whitaker, A. (1984). *Principles of Fermentation Technology*. Oxford: Pergamon Press.
3. Casida, L.E. 1997. *Industrial Microbiology*. New Age International Publishers.
4. Demain, A. L. 2001. *Industrial Microbiology and Biotechnology* IInd Edition. ASM Press, Washington.
5. El-Mansi, E.M.T. and Bryce, C.F.A. 2004. *Fermentation Microbiology and Biotechnology*. Taylor and Francis Group.
6. Julian E Davies and Arnold L Demain 2009 *Manual of Industrial Microbiology and Biotechnology* ASM Publisher
7. Maheshwari, D.K., Dubey, R.C. and Saravanamtu, R. 2010. *Industrial Exploitation of Microorganisms*. I.K. International Publishing House. New Delhi.

Mib-3032
Core Course
Credits: 2
Duration: 36 Hours

MICROBIAL ECOLOGY

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Introduction to Microbial Ecology

1.1 Biogeochemical Cycles: Carbon cycle and Nitrogen cycle.

1.2 Biogeochemical Cycles: Phosphorus cycle and Sulfur cycle.

1.3 Physical Environment: Microbial habitat and Niche; Biofilms; Microorganisms and Ecosystem and their movement between ecosystems; Extreme Environment.

1.4 Microbial Ecology and its Methods: Examination of microbial population; Examination of microbial community structure; Metagenomics; Microbial activity and turnover.

Unit – 2 Microorganisms In Marine, Freshwater And Terrestrial Environment

2.1 Marine and Freshwater Environments: Microbial habitat and nutrient cycling in marine and freshwater; Microbial adaptations to aquatic environment.

2.2 Microorganisms in marine environment: Costal Marine System (Estuaries and Salt Marshes); Open oceans and benthic marine environments. Microorganisms in Freshwater: Glaciers and permanently frozen lakes; Streams, rivers and lakes.

2.3 Microorganisms of soil; Microbial association with vascular plants: Phyllosphere and Rhizosphere Microbes; *Mycorrhizae*; Nitrogen Fixation; Fungal and bacterial endophytes and *Agrobacterium.*

2.4 Soil Microbes and Atmosphere: Microbial production of greenhouse gasses (CO_2 and Methane); Microorganisms of subsurface.

Unit – 3 Microbial Interactions

3.1 Microbial Interactions: Mutalism, Cooperation, Commensalism and Predation.

3.2 Microbial Interactions: Parasitism, Amensalism and Competition.

3.3 Normal microbiota of human body: Skin, Nose and Nasopharynx, Respiratory tract, eye, ear and mouth.

3.4 Normal microbiota of human body: Stomach, small and large intestine and Genitourinary tract; Relationship between normal microbiota and host.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Prescott, L. M., Harley, J. P. and Klein, D. A. 1999. *Microbiology.* 4th edn. WCB Mc Graw- Hill, New Delhi.

2. Pelczar (Jr.) M. J., Chan. E. C. S. and Kreig, N. R.1993. *Microbiology.* McGraw Hill, New York
3. *Microbial Ecology: Fundamentals and Application* (4th edition) Ronald M. Atlas and Richard Bartha. Pearson Education International (1998)
4. *Microbiolgy Ecology: Fundamental & Applications* by Atlas & Bartha (2005)
5. *Soil microbiology Ecology* and Biochemistry by EA Paul Academic press, IIIrd Edition (2007)
6. *General Microbiology* by Stainier *et. al.* MacMillan Press Ltd.(2005)
7. *Microbiology* by Davis *et. al.* Harper & Row Publishers (1980)
8. *Plant-microbe interactions.* Volume 1 by Gary Stacey and Noel T. Keen
9. *Plant-microbe interactions and biological control* Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall

Mib-3042
Core Course
Credits: **2**
Duration: **36** Hours

ENVIRONMENTAL MICROBIOLOGY AND TOXICOLOGY

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Microbiology of Air and Water

1.1 Microbiology of air and aquatic environments including sea water - Bacteriological indicators of pollution.

1.2 Bacteriological examination of water, nuisance bacteria in water systems. Chemical and microbiological characteristics.

1.3 Biological Oxygen Demand (BOD), Microorganisms and pollution problems and interaction with human bodies.

1.4 Methods of detection of water borne pathogens.

Unit – 2 Environmental Pollution; Toxicity And Effect On Microbes

2.1 Environmental pollution: Definition, source and types of pollution (air, water and soil).

2.2 Xenobiotic toxicity/genotoxicity, Mutation detection by Ames, microsomal assay.

2.3 Microbial biotransformation/degradation of organic pollutants in soil.

2.4 Bioaccumulation and bioremediation, Biosensors; DNA probes and their environmental applications, Toxicogenomics.

Unit – 3 Microbes In Recycling Of Nutrients

3.1 Recycling of organic waste: Major sources of recyclable material including agricultural waste.

3.2 Key technology in recycling of crop residues, human and animal wastes.

3.3 Role of microbes in composting and biogas production.

3.4 Municipal solid waste treatment and management.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Bhatia, A.L., 2010. *Textbook of Environmental Biology*. . I.K. International Publishing House. New Delhi
2. Gregory, P.H. 1973. *The Microbiology of the Atmosphere*. Cambridge Univ. Press. London.
3. Lesinger, T. *et al.*, 1985. *Microbial Degradation of Xenobiotic and Recalcitrant compounds*. Academic Press. New York.

4. Mohapatra, P.K. 2008. *Textbook of Environmental Microbiology*. 2008. I.K. International Publishing House. New Delhi.

5. Suresh, G. 2007. *Environmental Studies and Ethics*. I.K. International Publishing House. New Delhi.

6. Tiwari, M., Khulbe, K. and Tiwari, A. 2007. *Environmental Studies*. I.K. International Publishing House. New Delhi.

7. Abbasi, S.A. 1998. *Environmental pollution and its control*. Cogent International publishers, Pondicherry.

SEMESTER - 3

Mib-3052
Core Course
Credits: **2**
Duration: 36 Hours

FOOD MICROBIOLOGY

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Food Spoilage And Its Preservation

1.1 Foods and its composition: Food spoilage - Causes of spoilage, classification of foods by ease of spoilage.

1.2 Factors affecting the growth of microorganisms in foods; Types of microbes, which grow on food; Chemical changes caused by microorganisms.

1.3 Microbial flora and spoilage of meat, fish, fish products, eggs, milk and milk products, fruits, vegetables, juices and bakery products.

1.4 Methods of food preservation - General principles, preservation by use of chemicals, high temperature, low temperature and irradiation; Drying processes and aseptic poeolcoging materials.

Unit – 2 Food Quality And Its Control

2.1 Detection of microorganisms in foods. Food sanitation, Indicator organism; Food quality and assurance; Quality control parameters of various foods with special reference to microbiological quality.

2.2 Importance of microbiological quality during food processing and packaging; Food borne diseases, their causative agents and control measures.

2.3 Methods of quality assessment of foods: Sampling, qualitative and quantitative microbiological analysis.

2.4 Bacteriological examination of fresh and canned foods; Screening and enumeration of spoilage microorganisms; Food poisoning and food infections.

Unit – 3 Dairy Microbiology

3.1 Dairy Microbiology - Types of microorganisms in milk, significance of microorganisms in milk, microbiological examination of milk, control of microbial flora of milk.

3.2 Microbial products of milk- Acidophilus Milk, Bifidus Milk, Bulgarian milk, Kefir, Kumiss.

3.3 Microbiology of cheese, butter, yogurt.

3.4 Probiotics and Prebiotics: Properties and beneficial effects of probiotics and prebiotics; Screening methods of Probiotics; Genetically Modified Probiotics.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Adams M. R. and Moss M. O. 2000 *Food Microbiology*. Royal Society of Chemistry. Cambridge, U.K.
2. Thomas J. Montville, Karl R. Matthews 2008. *Food Microbiology: An Introduction*.ASM Press, U.S.A.
3. Barbara M. Lund, Baird-Parker, Gould G.W., 2000. *The Microbiological Safety and Quality of Food*. An Aspen publication, Maryland, U.S.A.
4. Bibek Ray 2004 *Fundamental Food Microbiology*. CRC Press, Florida.
5. Bohrer and Parihar 2006 *Food Microbiology*. Agrobios, Jodhpur, India.
6. Doyle M.P. and Beuchat L.R. 2007 *Food Microbiology Fundamentals and Frontiers*. ASM Press, U.S.A.
7. Frazier W.C. and Westhoff C.D. 2008 *Food Microbiology*. Tata Mc Graw Hill Publishing Company Limited, New Delhi.
8. James M. Jay, Martin J. Loessner, David A. Golden 2005. *Modern Food Microbiology*. Springer Science, U.S.A.
9. Neelima Khetarpaul 2006. *Food Microbiology*. Daya Publishing House, Delhi.

Paper Code
Discipline Centric Elective
Credits: 3
Duration: 36 Hours

DISCIPLINE CENTRIC ELECTIVE

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

LIST OF DISCIPLINE CENTRIC ELECTIVES (DCE)

S. No.	Paper Code	Paper Title	Course Type	Credits
1	Mib-3512	Viral and Parasitic Infections	DCE	2
2	Mib-3522	Biofertilizers and Biopesticides	DCE	2
3	Mib-3532	Analytical Techniques	DCE	2

Note: Candidates has to opt only 1 course out of the 3 courses offered.

Mib-3512
Discipline Centric Elective
Credits: **2**
Duration: **36** Hours

VIRAL AND PARASITIC INFECTIONS

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Introduction To Viruses – I

1.1 Diagnostic virology – Cultivation of pathogenic viruses in lab animals and tissue culture.

1.2 Identification of pathogenic viruses and establishment of viral etiology.

1.3 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of air borne viral infections – Influenza virus, Rhinovirus, Corona virus, Rubella virus.

1.4 Adeno virus (type 2), Mumps virus and Measles virus.

Unit – 2 Introduction To Viruses – II

2.1 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of viruses transmitted by water - Hepatitis (HAV), Polio myelitis

2.2 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of contact and sexually transmitted viral diseases – Small pox, Herpes (Herpes simplex virus),

2.3 Hepatitis viruses and related diseases

2.4 Acquired immunodeficiency syndrome (AIDS): Symptoms and Control measures.

Unit – 3 Introduction to parasites and worms

3.1 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of Malaria; Amoebiasis

3.2 Trichomoniasis, Helmithic infections (Round worms, Hook worms).

3.3 Structure, cultivation, pathogenicity, lab diagnostics, prevention and control of viruses transmitted by Zoonosis – Rabies, Japanese encephalitis

3.4 Medical Mycology – Dermatomycosis, Systemic mycosis.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. 1999. *Microbiology*. 4th edn. WCB Mc Graw- Hill, New Delhi.
3. Dimmock N.J., Easton,A.J., and Leppard,K.N. 2001. *Introduction to Modern Virology*. 5th edn. Blackwell publishing, USA.

4. Madigan M.T., Martinko M. J. and Jack Parker. 2003. *Brock Biology of microorganisms*. Pearson education, New Jercy.
5. Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. *Microbiology*. McGraw Hill, New York

Mib-3522
Discipline Centric Elective
Credits: 2
Duration: 36 Hours

BIOFERTILIZERS AND BIOPESTICIDES

Total Marks: 50
Internal Assessment: 20
University Examination: 30
Duration of Exam: 2 Hours

Unit - 1 Introduction To Biofertilizers

1.1 Definition and status of biofertilizer, types of biofertilizers. Nitrogenous and phosphatic biofertilizers - Rhizobium, Azotobacter, Azospirillum, PSB/PSF (*Pseudomonas striata*, *Bacillus polymyxa*, *Bacillus megaterium*, *Aspergillus awamori* and *Penicillium* spp.)

1.2 Technologies for the production of biofertilizers, Quality control of biofertilizers.

1.3 Methods of inoculation on seed and in soil, BIS standards of biofertilizers and its economics.

1.4 Field programme of biofertilizers.

Unit – 2 Algae As Biofertilizer

2.1 Blue-green algae (Cyanobacteria) and their phages.

2.2 Algae as biofertilizers in rice cultivation, Azolla as biofertilizer, mass cultivation of algae, algal single cell protein.

2.3 Role of algae in municipal sewage waste treatment.

2.4 Vermiculture and vermicomposting.

Unit – 3 Biopesticides

3.1 Mycorrhizas-VAM, synthesis of growth promoting substances. Role of biofertilizers in plant nutrition and integrated plant nutrient management (IPNM).

3.2 Isolation, characterization and mass propagation of VAM fungi, Problems and prospects.

3.3 Microbial pesticides - *Bacillus thuringensis*, mode of action and use.

3.4 Fungal and viral based biopesticides. Advantages and limitations of biopesticides.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Gregory, P.H. 1973. *The Microbiology of the Atmosphere*. Cambridge Univ. Press. London.
2. Lesinger, T. *et al.*, 1985. *Microbial Degradation of Xenobiotic and Recalcitrant compounds*. Academic Press. New York.
3. Mohapathra, P.K. 2008. *Textbook of Environmental Microbiology*. 2008. I.K. International Publishing House. New Delhi.
4. Suresh, G. 2007. *Environmental Studies and Ethics*. I.K. International Publishing House. New Delhi.

5. Tiwari, M., Khulbe, K. and Tiwari, A. 2007. *Environmental Studies*. I.K. International Publishing House. New Delhi.

6. Abbasi, S.A. 1998. *Environmental pollution and its control*. Cogent International publishers, Pondicherry.

7. Bhatia, A.L. 2010. *Textbook of Environmental Biology*. . I.K. International Publishing House. New Delhi.

Mib-3532
Discipline Centric Elective
Credits: 2
Duration: 36 Hours

ANALYTICAL TECHNIQUES

Total Marks: 50
Internal Assessment: 20
University Examination: 30
Duration of Exam: 2 Hours

Unit – 1 Chromatography and Spectroscopic Techniques

1.1 Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques.

1.2 Protein structure, purification and characterization. Chromatographic techniques: Principle and applications of Adsorption, Partition, Ion-exchange, Size exclusion and Affinity chromatography; HPLC and FPLC.

1.3 ***Overview and Applications of Spectroscopic Techniques***: Ultraviolet and visible light spectroscopy; Fluorescence spectroscopy; Light Scattering and Circular dichroism spectroscopy.

1.4 ***Overview and Applications of Spectroscopic Techniques***: Infrared and Raman spectroscopy; Surface Plasmon Rasonance; NMR and X-ray diffraction

Unit – 2 Electrophoretic, Centrifugation and Immunotechniques (*Overview and Applications only)*

2.1 Electrophoretic Techniques; Electrophoresis of proteins and nucleic acids; Capillary electrophoresis and Microchip electrophoresis.

2.2 Centrifugation: Basic principle of centrifugation; Preparative and Analytical Centrifugation; Mass spectrometry; MALDI-TOF; ESI-MS; Proteomics.

2.3 Radioisotopes and its usage in biochemical techniques. Immunochemical techniques: Production of Antibodies; Immunoassay and Immunoelectrophoresis formats; Immunomicroscopy; Epitope mapping; Immunoblotting;

2.4 Fluorescence Activated Cell Sorting (FACS); Immunocapture PCR; Immunoaffinity chromatography; Biosensors and Antibody-based biosensors.

Unit – 3 Molecular Biology Techniques (*Principles and Applications only)*

3.1 Nucleic acid hybridization: Blotting techniques; Chemical Synthesis of DNA; DNA amplification by PCR; DNA libraries. DNA transfer into Eukaryotic Cells and Mammalian Embryos; Transgenic Animals; Determination of eukaryotic gene function by Gene Silencing or knockout.

3.2 PCR and its modifications: Nested PCR; Quantitative Real-time PCR; RT-PCR; Inverse PCR; Anchored PCR; RACE; Touchdown PCR; RAPD and AFLP; Labeling of Nucleic Acids: Isotopic and Non-Isotopic labeling; Molecular beacons; FISH; Colony hybridization; Phage display; Yeast-two hybrid assay.

3.3 Transcript Analysis; DNA Microarray; Electrophoretic mobility shift assay; Footprinting assay; Site-directed mutagenesis; Cassette mutagenesis; Primer extension method; Overlap extension method; Megaprimer PCR; Random mutagenesis.

3.4 DNA Sequencing; Chain termination method; Automated sequencing; Chemical degradation method; Pyrosequencing. Next generation sequencing technologies: Illumina (Solex) sequencing; Ion torrent Sequencing. Chromatin Immuno precipitation. (ChIP).

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer

type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. E. H. Segel. *Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry*, 2nd Edition. John Wiley Publications.
2. Branden, C. and Tooze, J. (1999). *Introduction to Protein Structure*. Garland Publishing New York.
3. Tanford, C. (1961). *Physical Chemistry of Macromalocules*. John Wiley and Sons.
4. Wilson, K and Walker, J. (2011). *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University press.
5. Friefilder, D. (1987). *Essentials of Molecular Biology*. Jones and Bartlett Publications.
6. Clark, D. P. (2005). *Molecular Biology: Understanding the Genetic Revolution*. Academic Press.
7. Nelson, D. D. L., Lehninger, A. L. and Cox, M. M. (2013). *Lehninger Principles of Biochemistry*. W.H. Freeman Publishers.

Mib-3712
Core Course
Credits: 4
Duration: 144 Hours

LABORATORY – VII
IMMUNOLOGY

Total Marks: 100
Internal Assessment: 50
University Examination: 50

Immunology

1. To prepare soluble antigen by different methods.
2. To demonstrate various routes of immunization in mice.
3. To prepare serum and plasma from blood.
4. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
5. To determine Blood group and Rh factor by slide agglutination test.
6. To determine Total Leukocyte Count (TLC) for given blood sample.
7. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain.
8. To perform Widal agglutionation test (slide and tube) for diagnosis of typhoid.
9. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
10. To perform Redial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
11. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction
12. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction
13. To perform ELISA for assay of antibodies in serum sample against given antigen.

Mib-3722
Core Course
Credits: 2
Duration: 72 Hours

LABORATORY – VIII
INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Industrial Microbiology and Fermentation Technology

1. Physical and chemical control of microbes: Sterilization.
2. Determination of thermal death point (TDP) of an Organism.
3. Determination of thermal death time (TDT) of an Organism.
4. Measurement of bacterial growth/growth curve.
5. Isolation of amylase producing microorganisms from Soil.
6. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
7. Isolation of lipase producing microorganisms from butter.
8. To isolate antibiotic producing microorganisms form soil.
9. To isolate Penicillium species producing penicillin.
10. Production of penicillin and to evaluate it activity.
11. To demonstrate handling and sterilization of Fermenter.
12. Production of wine from grapes.
13. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.

Mib-3732
Core Course
Credits: 2
Duration: 72 Hours

LABORATORY – IX
ENVIRONMENTAL MICROBIOLOGY, TOXICOLOGY & FOOD MICROBIOLOGY

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Environmental Microbiology and Toxicology

1. Determination of Total Dissolve Solids (TDS) of given water sample.
2. Determination of chemical oxygen demand (COD) of given water sample.
3. Determination of Dissolved oxygen (DO) of given water sample.
4. Determination of BOD of given water sample.
5. Determination of total bacterial population by standard plate count technique.
6. Determination of the most probable number (MPN) of coliform bacteria in water
7. Microbiological analysis of water by membrane filter method.
8. Microbiological analysis of air for presence of (pathogenic) microorganisms in air.
9. Microbiological analysis of water for presence of (pathogenic) microorganisms.

Food Microbiology

1. Microbiological examination of water, milk and milk products.
2. Enumeration of food borne bacteria.
3. Enumeration of food borne fungi
4. Detection and quantification of Aflatoxin-B1.
5. Detection of food-borne bacteria by immunoassays.
6. Detection and enumeration of microorganisms present on utensils.
7. Enumeration and quantification type of microorganisms present on fruit and vegetables.
8. Isolation and identification of pathogenic microorganisms from canned food.
9. Enumeration of bacteria in raw and pasteurized milk by SPC method.
10. Determination of quality of a milk sample by MBRT.
11. Detection of number of bacteria in milk by breed-count method.
12. Litmus milk test.
13. Microbiological examination of Ice cream and Dairy products.

Mib-3742
Core Course
Credits: 2
Duration: 72 Hours

LABORATORY – X
DISCPILINE CENTRIC ELECTIVE LAB

Total Marks: 50
Internal Assessment: 25
University Examination: 25

1. To prepare an Acetic-Na Acetate Buffer system and validate the Henderson-Hasselbach equation.
2. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
3. Preparation of TLC plates and separation of amino acids using Thin Layer Chromatography.
4. Separation of carbohydrates through Thin Layer Chromatography (nectar of flowers).
5. Separation of amino acids by Paper Chromatography.
6. Use of UV-Visible spectroscopy for the estimation of protein and DNA concentration.
7. Monitoring structure perturbation by solvent using UV-Visible spectroscopy.
8. Separation of Plasmids using Agarose gel electrophoresis.
9. Separation of Proteins by PAGE.
10. Gene amplification by PCR.
11. Protein purification by metal chelate chromatography.

Mib-4014
Core Course
Credits: 4
Duration: 72 Hours

MEDICAL MICROBIOLOGY

Total Marks: 100
Internal Assessment: 40
University Examination: 60
Duration of Exam: 3 Hours

Unit-1 Introduction To Medical Microbiology

1.1 Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.

1.2 Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.

1.3 Normal microflora of human body: normal flora of skin, respiratory, gastrointestinal, genital tract, role of resident flora, concept of probiotics.

1.4 Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

Unit – 2 Infections and Diagnosis

2.1 Properties of pathogenic microorganisms. Factors that influence pathogenicity.

2.2 Type of infections, source of infections, different modes/means of infections.

2.3 Diagnostic microbiology – Types of specimen, specimen collection, transportation of specimen, processing, laboratory investigations, specific lab tests, non-specific lab tests, diagnosis and report.

2.4 Use of lab animals in diagnostic microbiology.

Unit – 3 Bacterial Infections

3.1 Infections caused by Gram positive cocci and Gram negative cocci: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Staphylococcus, Streptococcus* and *Neisseria* (meningitis, gonorrhea)

3.2 Infections caused by Gram-negative bacteria of family Enterobacteriaceae: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *E. coli, Klebsiella, Proteus, Pseudomonas, Shigella dysenteriae* and *Salmonella typhi.*

3.3 Infection caused by Gram Positive bacilli: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Corynebacterium diphtheriae, Bacillus anthracis, Clostrodium tetani, Vibrio cholerae.*

3.4 Disease caused by acid-fast bacteria and intracellular bacteria: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Mycobacterium tuberculosis, Mycobacterium leprae, Rickettsia* and *Chlamydia.*

Unit – 4 Viral Infections

4.1 Viral infections of the upper respiratory tract: Rohinovirus and Adenoviral infections.Viral infections of the lower respiratory tract: Influenza and Paramyxovirus infections.

4.2 Viral infections of Skin: Herpes simplex virus, Chikenpox, Human Herpes virus 6; Rubella virus infections.

4.3 Viral infections of Blood: Herpes virus, Hepatitis virus, Flavivirus infections and that caused by members of Filoviridae.

4.4 Viral infections of GIT: Hepatitis virus A and E; Viral Gastroenteritis; Viral infections of Nervous system: Rabies virus; poliovirus infections and Arboviral Encephalitis.

Unit-5 Protozoal, Fungal and Other Infections

5.1 Important protozoal diseases: Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Plasmodium vivax, P. falciparum, P. malariae* (Malaria), *Entamoeba histolytica* & *Entamoeba coli* (amoebiasis).

5.2 Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania, Trypanosoma* and *Toxoplasma.*

5.3 Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)

5.4 Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. Alcomo, I.E. 2001. *Fundamentals of Microbiology.* VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. *Microbiology.* McGraw Hill, New York
3. Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. *Microbiology*, International edn. 4th edn.WCB Mc Graw-Hill.
4. Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. *Microbe.* ASM Press, Washington, D.C.
5. M.T, Madigan, J.M. Martinko and J. Parker, *Brock Biology of Microorganisms,* Ninth edition, Prentice Hall, Upper Saddle River, NJ.
6. Jawetz, Melnick, & Adelberg's, *Medical Microbiology:* Fifth edition, MacGraw Hills
7. Ananthnarayanan and Paniker *Textbook of Microbiology:* Eighth edition, Universities Press.

Mib-4024
Core Course
Credits: 4
Duration: 72 Hours

AGRICULTURAL MICROBIOLOGY

Total Marks: **100**
Internal Assessment: **40**
University Examination: **60**
Duration of Exam: **3 Hours**

Unit -1 Soil Microorganism, Microbial Interaction And Role In Nutrient Recycling

1.1 Microorganisms of soil.

1.2 Rhizosphere and phyllosphere microflora

1.3 Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.

1.4 Nutrient cycle: Carbon cycle, nitrogen cycle, phosphorous cycle and sulphur cycle.

Unit – 2 Plant Diseases

2.1 Role of enzymes and toxins in pathogenesis.

2.2 Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.

2.3 Bacterial diseases of plants: Citrus canker, blight of rice.

2.4 Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady's finger

Unit – 3 Physical, Chemical and Microbial Control of Plant Diseases

3.1 Physical and chemical control of plant diseases.

3.2 Bacterial control of insect pests: *Bacillus thuringiensis* as bacterial insecticide.

3.3 Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV).

3.4 Fungal control of insect pests: Entomopathogenic fungi: *Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

Unit – 4 Microbial Effects on Storage of Agricultural Product

4.1 Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects.

4.2 Mycotoxins and their effect on human being.

4.3 General idea about quarantine.

4.4 Production of biogas and alcohol from agricultural wastes.

Unit – 5 Agricultural Applications of Microbes

5.1 Biofertilizers: Types, production and application.

5.2 Mycorrhizae: Types and their application in agriculture and forestry.

5.3 Vermicomposting.

5.4 Reclamation of waste agricultural land by microorganisms.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 10 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 10 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 10 marks.

Recommended Textbooks and References:

1. *Plant-microbe interactions and biological control* Volume 63 of Books in soils, plants, and the environment by Greg J. Boland, L. David Kuykendall
2. *New Perspectives and Approaches in Plant Growth-Promoting Rhizobacteria* Research by Philippe Lemanceau, Peter Bakker & Jos Raajimakers.
3. Ghosh, A. 2003. *Natural Resource Conservation and Environment Management*. Aph Publishing Corp. Calcutta.
4. Stanley J.T. and Reysenbach A.L.1977. *Biodiversity of microbial life*. John Wiley 7 Sons Inc. Publication. New York.
5. *Biological control of crop diseases* Volume 89 of Books in soils, plants, and the environment by S.S. Gnanamanickam
6. N.S. Subba Rao, *Soil Microbiology* Fourth edition, Oxford and IBH Publishing Co. Pvt., Ltd., New Delhi
7. Alexander M. (1977) *Introduction to soil microbiology*. John Wiley & Sons, Inc., New York.

Mib-4032
Core Course
Credits: 2
Duration: 36 Hours

BIOINFORMATICS

Total Marks: 50
Internal Assessment: 20
University Examination: 30
Duration of Exam: 2 Hours

Unit - 1 Introduction to Bioinformatics

1.1 Introduction and branches of Bioinformatics. Aim, scope and research areas of Bioinformatics.

1.2 Databases in Bioinformatics: Introduction, Biological databases, Classification format of biological databases, Biological database retrieval system.

1.3 Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Nucleotide Database, Protein Database, Gene Expression Database; EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

1.4 DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, and Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and salient features.

Unit – 2 Bioinformatics Resources on Internet

2.1 Computational methods for sequence analysis: Pairwise and multiple sequence alignment for DNA and protein sequences. Local and global sequence similarity.

2.2 Tools for similarity search and sequence alignment: BLAST and types, FASTA.

2.3 Genome analysis and Gene identification: Sequencing, Assembly, Annotation, Sequencing pipelines and databases.

2.4 Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, and Consistency of Molecular Phylogenetic Prediction.

Unit – 3 Bioinformatic Tools and Applications

3.1 Application tools: Primer designing; Protein Parameters

3.2 Molecular imaging and design: CADD, QSAR.

3.3 Tools for molecular mapping: QTL, minisatellites, SNP's.

3.4 Prediction of 3 dimensional structures of proteins: protein secondary and tertiary structure prediction by using techniques: Chou-Fasman/GOR method, comparative modeling, Threading and *ab initio* structure prediction.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. A.D. Baxevanis and B.F.F. Ouellette (Eds). (2002). *Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins.* John Wiley and Sons.
2. D.W. Mount. (2001). *Bioinformatics: Sequence and Genome Analysis.* Cold Spring Harbor Laboratory Press.
3. Jones & Peuzner. (2004): *Introduction to Bioinformatics Algorithms:* Ane Books, India.
4. M Campbell A. M., Heyer L. J. (2006) *Discovering Genomics, Proteomics and Bioinformatics* II Edition. Benjamin Cummings
5. Ghosh Z. and Bibekanand M. (2008) *Bioinformatics: Principles and Applications.* Oxford University Press.
6. Pevsner J. (2009) *Bioinformatics and Functional Genomics.* II Edition. Wiley-Blackwell.
7. Web-resources and suggested reviews/ research papers.

Paper Code
Discipline Centric Elective
Credits: **3**
Duration: **36** Hours

DISCIPLINE CENTRIC ELECTIVE

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

LIST OF DISCIPLINE CENTRIC ELECTIVES (DCE)

S. No.	Paper Code	Paper Title	Course Type	Credits
1	Mib-4512	Genetic Engineering	DCE	2
2	Mib-4522	Bacterial Diseases of Humans	DCE	2
3	Mib-4532	Signal Transduction and Cancer Biology	DCE	2

Note: Candidate has to opt only 1 course out of the 3 courses offered.

Mib-4512
Discipline Centric Elective
Credits: 2
Duration: 36 Hours

GENETIC ENGINEERING

Total Marks: 50
Internal Assessment: 20
University Examination: 30
Duration of Exam: 2 Hours

Unit – 1 Genetic Engineering Techniques - I

1.1 Definition, brief history and scope of genetic engineering; Milestones in the development of genetic engineering as technology.

1.2 Molecular tools employed in genetic engineering: restriction enzymes-types, nomenclature and cleavage patterns; concept of linkers and adapters, ligases-types and nature of action.

1.3 Cloning Vectors for prokaryotes: properties of an ideal vector, plasmid vectors- pBR322vectors, pUC8 vectors, M13 bacteriophage vectors, cosmids and shuttle vectors.

1.4 Cloning vectors for eukaryotes: Yeast integrative plasmids (YIps), Yeast artificial chromosome vectors (YAC) and bacterial artificial chromosome (BAC) vectors.

Unit – 2 Genetic Engineering Techniques – II

2.1 Gel electrophoresis: Agarose, pulsed field and PAGE, Blotting techniques: Northern blotting, Southern blotting and Western blotting (Overview).

2.2 Polymerase Chain Reaction: principle, applications and importance; variation in PCR.

2.3 Genomic/cDNA libraries – construction, screening and choice of vectors.

2.4 DNA sequencing – chemical degradation and enzymatic methods, Automatic DNA Sequencers; DNA Fingerprinting – technique and applications.

Unit – 3 Applications Of Genetic Engineering

3.1 Gene transfer in animal cells, various methods used including transfer and particle bombardment mediated gene transfer.

3.2 Transgenic animal models and their significance for human welfare.

3.3 Gene therapy; introduction and its applications in human diseases (ADA and CFTR).

3.4 Production of recombinant proteins: Recombinant insulin, Human growth hormone and Recombinant Factor VIII.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Brown, T. A (2010) *Gene cloning and DNA Analysis: An Introduction*, Wiley-Blackwell Publication
2. Brown, T. A. (2006). *Gene Cloning – An Introduction*. Blackwell Publishing. (5th edition).
3. Clark, D. P. (2005). *Molecular Biology: Understanding the Genetic Revolution*. Academic Press.
4. Davies, J. A. and Reznikoff, W.S. (1992). *Milestones in Biotechnology. Classic Papers on Genetic Engineering*. Butterworth – Hienemann, Boston.
5. Kingsman, S. M. and Kingsman, A. J. (1998). *Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes*. Blackwell Scientific Publications, Oxford.
6. Walker, M. R. and Rapley, R. (1997). *Route Maps in Gene Technology*. Blackwell Science Ltd, Oxford.
7. Williams, J., Ceccarelli, A. and Wallace, A. (2001). *Genetic Engineering: Second Edition*. Springer – Verlag, New York Inc.

Mib-4522
Discipline Centric Elective
Credits: **2**
Duration: **36** Hours

BACTERIAL DISEASES OF HUMANS

Total Marks: **50**
Internal Assessment: **20**
University Examination: **30**
Duration of Exam: **2 Hours**

Unit – 1 Airborne Bacterial Diseases

1.1 Structure and indigenous microbiota of the respiratory system.

1.2 Bacterial diseases of upper respiratory tract: Pharyngitis, Deptheria, Ear infections, acute bacterial meningitis.

1.3 Bacterial diseases of lower respiratory tract: Pertussis (Whooping Cough), Tuberculosis.

1.4 Bacterial diseases of lower respiratory tract: Infectious Bronchitis, Pneumonia.

Unit – 2 Foodborne, Waterborne, Soilborne And Arthropodborne Bacterial Diseases

2.1 Structure and indigenous microbiota of the digestive system; Bacterial diseases of the Oral cavity: Dental Caries, Periodontal disease.

2.2 Bacterial diseases of the GI tract: Intoxications and infections due to contaminated food or water; Food Intoxications: Food poisoning. Foodborne and waterborne infections: Bacterial Gastroenteritis, Gastric ulcers.

2.3 Soilborne bacterial diseases: Anthrax, Tetanus, Gas Gangrene, Liptospirosis.

2.4 Arthropodborne bacterial diseases: Plague, Tularemia, Lyme disease, Relapsing fever; Rickettsial infections, *Ehrlichia* and *Anaplasma* infections.

Unit – 3 Sexually Transmitted And Contact Transmitted Bacterial Diseases

3.1 Structure and indigenous microbiota of the female and male reproductive systems; Common vaginal infections; Sexually transmitted bacterial diseases: Chlamydial Urethritis, Gonorrhea, Syphilis and other STDs.

3.2 Structure, Indigenous microbiota and illness of the female and male urinary tract system: UTI infections.

3.3 Contact diseases caused by indigenous bacterial species: Role of Skin in infection; Acne; Biofilms formed by indigenous microbiota.

3.4 Contact diseases caused by exogenous bacterial species: Staphylococcal contact diseases; Leprosy; Bacterial eye infections.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Alcomo, I.E. 2001. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Madigan M.T., Martinko M. J. and Parker,J. 2003. *Brock Biology of microorganisms*. Pearson education, New Jersy.
3. Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. *Microbiology*. McGraw Hill, New York.
4. Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. *Microbiology*, International edn. 4th edn.WCB Mc Graw-Hill. Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington. D.C.
5. Stainer, R. Y., Ingraha, J L, Wheelis, M. L. and Painter, P. K. 1986. *General Microbiology*. McMillan Edun. Ltd. London.
6. Tortora, G.J., Funke, B.R. and Case, C.L. 2004. *Microbiology-An Introduction*. Benjamin Cummings. San Francisco.

Mib-4532
Discipline Centric Elective
Credits: 2
Duration: 36 Hours

SIGNAL TRANSDUCTION AND CANCER BIOLOGY

Total Marks: 50
Internal Assessment: 20
University Examination: 30
Duration of Exam: 2 Hours

Unit - 1 Signaling I- General Properties And Structural Diversity

1.1 General principles of signaling: overview of recognition of signaling molecules by extracellular receptors, general overview of nuclear receptors.

1.2 Signaling molecules and their mode of transmission-autocrine, paracrine, juxtacrine and endocrine signaling, secondary messengers.

1.3 Signaling receptors: general structure of G-protein coupled receptors (GPCRs), types of G proteins-trimeric and monomeric G proteins, their structure and function.

1.4 General structure of Ion Channel receptors and enzyme linked receptors: overview of Receptor Tyrosine Kinases (RTKs) and Receptor serine/threonine kinase.

Unit – 2 Signaling – II: Functional Diversity

2.1 Mechanism of action of GPCRs: GPCRs that regulate ion channels- acetylcholine receptors in heart muscles and rhodopsin receptors in rod cells of eyes.

2.2 Mechanism of action of Receptor Tyrosine Kinases (RTKs) and Ras/MAP kinase pathway- role of secondary messengers in the pathway.

2.3 Mechanism of action of signaling pathway mediated by protein cleavage and Ubiquitination: Notch/Delta pathway and Wnt pathway for control of gene expression.

2.4 Mechanism of Quorum sensing in bacteria: general account of chemotaxis in bacteria and two-component system in bacteria.

Unit – 3 Cancer Biology

3.1 General overview of cancer: benign and malignant cancers, their characteristics, properties of cancer cells, general account on Multi Hit model of cancer induction.

3.2 Genetic basis of cancer cells: oncogenes, tumor suppressor genes, gain of function mutations and loss of function mutations, inherited mutations, concept of epigenetics and cancer induction by epigenetic changes.

3.3 Cancer induction by unregulated cell cycle phases: unregulated entry of cell cycle from G1 to S phase, loss of function of p53 in DNA damage checkpoints, role of Rb (Retinoblastoma) and BRCA1 (Breast Cancer Susceptibility gene 1) in cancer induction.

3.4 Programmed cell death- apoptosis: extrinsic pathway and intrinsic pathway, role of apoptotic proteins in apoptosis, general concept of carcinogens and caretaker genes.

Note for the paper setter:

The question paper will have two Sections. Section 'A' carrying 6 compulsory, objective-cum-short answer type questions, 2 from each unit. Each question will carry 1 mark. Section 'B' will have 6 descriptive answer questions, 2 from each unit. Students will be required to answer 1 question from each unit. Each question will carry 8 marks.

Recommended Textbooks and References:

1. Albert, B., Bray, D., Raff, M., Roberts, K. and Watson, J.D. (2004). *Molecular Biology of the Cell*. Garland Publishing Inc., New York. 6th Ed.
2. Cooper, G. M. and Hausman, R.E. (2006). *The Cell: A Molecular Approach*. ASM Press, Washington DC. 4th Ed.
3. Karp, G. (2007). *Cell and Molecular Biology*, John Wiley and Sons Inc. 5th Ed.
4. Kleinsmith, L. J. and Kish, V. M. (1995). *Principles of Cell and Molecular Biology*. Harper Collins College Publishers, New York, USA. 2nd Ed.
5. Lodish, H., Berk, A., Zipursky,S.L., Matsudaira, P., Baltimore, D., and Darnell, J. (2004). *Molecular Cell Biology*. W. H. Freeman and Company, 5th Ed.
6. Raymond,W. Ruddon (2007). *Cancer Biology*. University of Michigan Medical School Ann Arbor, Michigan 4th Ed.

Mib-4712
Core Course
Credits: 2
Duration: 72 Hours

LABORATORY – X
MEDICAL MICROBIOLOGY AND DCE LAB

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Medical Microbiology

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.
2. To perform sugar fermentation tests used for identification of medically important bacteria.
3. Preparation of transport media for different clinical samples.
4. Demonstration normal microbial flora of skin, mouth and throat.
5. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
6. Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (*E. coli, Proteus, Pseudomonas, Klebsiella*)
7. Isolation and identification of enteric fever causing bacteria (*Salmonella typhi*) using suitable media and biochemical tests.
8. Isolation and identification of *Bacillus* species using suitable media, staining techniques and biochemical tests.
9. Microbiological analysis of urine specimens.
10. Microbiological analysis of sputum specimens.
11. Isolation of dermatophytes and their identification based on colony morphology and microscopic characteristics.
12. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
13. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
14. To study antibiotic resistance in bacteria.

Mib-3722
Core Course
Credits: 2
Duration: 72 Hours

LABORATORY – XI
AGRICULTURAL MICROBIOLOGY AND BIOINFORMATICS

Total Marks: 50
Internal Assessment: 25
University Examination: 25

Agricultural Microbiology

1. To study viral diseases in plants.
2. To study bacterial and fungal diseases in plants.
3. Isolation of rhizobia from root nodules of leguminous plants.
4. Testing of nodulation ability of rhizobia.
5. Inoculation of seeds with rhizobia.
6. To study pesticidal activity of *Bacillus thuringiensis*.
7. Isolation of VAM spores from soil.
8. Isolation of *Azotobacter* species from soil.
9. Isolation of microorganisms from rhizosphere.

Bioinformatics

1. Determination of protein parameters from available softwares.
2. Retrieval of nucleotide and protein sequences from suitable databases.
3. Determination of protein sequence from nucleotide sequence using available softwares.
4. Study similarity searches using BLAST.
5. Designing primers using online softwares.
6. Studying the alignment of DNA and protein sequences by using bioinformatics tools.
7. Construction of phylogenetic tree of available data (protein and DNA sequences) by using available softwares.
8. Studying the structure of different proteins to appreciate differences and similarities among them using available software's.

Mib-4708
Core course
Credits: 6
Duration: 288 Hours

DISSERTATION

Total Marks: 200
University Examination: 200

SUMMARY OF TOTAL CREDITS AND MARKS IN THE COURSE

Semester	Paper Category		Credits	Marks
Semester-1	Core Courses		14	350
		Practical	6	150
	Foundation Course		4	100
Sub-total			**24**	**600**
Semester-2	Core Courses	Theory	12	300
		Practical	6	150
		Seminar/Journal Club	2	50
	Open Elective [1/15]		4	100
Sub-total			**24**	**600**
Semester-3	Core Courses	Theory	14	350
		Practical	6	150
	Discipline Centric Elective [1/3] (Theory)		2	50
	Discipline Centric Elective [1/3] (Practical)		2	50
Sub-total			**24**	**600**
Semester-4	Core Courses	Theory	10	250
		Practical	4	100
		Dissertation	8	200
	Discipline Centric Elective [1/3]		2	50
Sub-total			**24**	**600**
Total			**96**	**2400**

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