Syllabus

For

M.Sc. MICROBIOLOGY

Under Choice based credit system

(I, II, III & IV SEMESTER COURSE)

ACADEMIC SESSION

JULY (2022-2024)

Jiwaji University, Gwalior

(NAAC accredited 'A' grade University)

JIWAJI UNIVERSITY

School of Studies in Microbiology

M.Sc. Microbiology, (Choice Based Credit System)

Course Structure, Scheme of Examination – 2022-24

Semester	Course Code	Title of the Paper	Core/ Centric/Generic	Credits			
				L	T	P	Total
First	**MB-101**	Basics in Microbiology and General Bacteriology	Core	03	-	-	03
	MB-102	Virology and Mycology	Core	03	-	-	03
	MB-103	Cell biology and Biochemistry	Core	03	-	-	03
	MB-104	Bioinstrumentation	Core	03	-	-	03
	MB-105	Lab Course I	Core	-	-	03	03
	MB-106	Lab Course II	Core	-	-	03	03
	MB-107	Seminar	AE & SD	-	-	01	01
	MB-108	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	-	-	01	01
	MB-109	Comprehensive Viva Voce	Virtual	-	-	-	04
			Total Credits				**24**
Second	**MB-201**	Microbial genetics and Molecular Biology	Core	03	-	-	03
	MB-202	Immunology	Core	03	-	-	03
	MB-203	Microbial Physiology and metabolism	Core	03	-	-	03
	MB-204	Biostatics, Computer application and Bioinformatics	Core	03	-	-	03
	MB-205	Lab Course III	Core	-	-	03	03
	MB-206	Lab Course IV	Core	-	-	03	03
	MB-207	Seminar	AE & SD	-	-	01	01
	MB-208	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	-	-	01	01
	MB-209	Comprehensive Viva Voce	Virtual	-	-	-	04
			Total Credits				**24**

Third	**MB-301**	Medical and Pharmaceutical Microbiology	Core	03	-	-	03
	MB-302	Fermentation and Microbial Technology	Core	03	-	-	03
	MB-303	Recombinant DNA Technology	Elective-I	03	-	-	03
	MB-304	Environmental Microbiology	Elective-II	03	-	-	03
	MB-305	Lab Course V	Core	-	-	03	03
	MB-306	Lab Course VI	Elective	-	-	03	03
	MB-307	Seminar	AE & SD	-	-	01	01
	MB-308	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	-	-	01	01
	MB-309	Comprehensive Viva Voce	Virtual	-	-	-	04
			Total Credits				**24**
Fourth	**MB-401 A** **MB-401 B**	Agriculture Microbiology (A) Food Microbiology (B)	Generic Elective	03	-	-	03
	MB-402	Lab course VII A/ B	Generic Elective	-	-	03	03
	MB-403	Seminar	AE & SD	-	-	01	01
	MB-404	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	-	-	01	01
	MB-405	Project Work	Core	-	-	12	12
	MB-406	Comprehensive Viva Voce	Virtual	-	-	-	**04**
			Total Credits				**24**
Total Credits for the Course							**96**

- **Minimum Number of credits be earned for award of degree- 96 credits [Valid credits 80 + Virtual credits 16].**
- **Elective courses shall be conducted as per availability of expert teachers.**
- **AE & SD – Ability enhancement and skill development.**

Note: The first two semesters will have core papers in general. The optional papers under Elective or Generic/ Centric category may be exercised in the last two semesters. The Schools/Centres have the option with regard to number of theory papers either under Elective and/ or Generic category in 3rd and 4th semesters.

NOTE: Lecture (L): 1 hr = 1 Credit: Tutorial (T): 2 hr = 1 Credit . Practical (P): 2 hr = 1 Credit 25 percent of course curriculum shall be covered by online teaching.

Course to be selected/ opted from UGC-SWAYAM portal, students may select/ opt one Moocs-swayam course available at UGC portal in lieu of one paper from the existing curriculum of the course in consultation with Head during I, II and III semester.

- The generic credits may be obtained from other departments/faculties/Institutes.
- Elective credits may be obtained from same or other departments of the faculty
- Minimum credits be earned for award of degree - 96 Credit (Valid credits -80 + Virtual Credits - 16)
- Minimum credits for promotion to next semester - 12 valid credits/semester
  (Explanation: Student will have to pass in theory or lab course or seminar or assignment totaling 12 credits in a given semester for promotion to next semester).
- For internal assessment three tests of 20 marks each (one test may be in form of quiz/debate etc. if desired so), will be conducted out of which the best two will be taken into consideration.
- As part of skill development new product development will be practiced
- Every student would deliver minimum one seminar in a semester which would be evaluated.
- Comprehensive viva is based on all papers of given semester.
- The grading will be made on 10-point scale as described below:

Letter Grade	Grade Points	Description	Range of Marks (%)
O	10	Outstanding	90-100
A+	9	Excellent	80-89
A	8	Very good	70-79
B+	7	Good	60-69
B	6	Above Average	50-59
C	5	Average	40-49
P	4	Pass	35-39
F	0	Fail	0-34
Ab	0	Absent	Absent

- The Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) will be calculated as weighted average of valid and virtual credit points secured by the student, except the credits of additional courses, if any. The SGPA and CGPA shall be rounded off up to 2 decimal places and reported in the grade sheet.
- SGPA is a measure of performance of the student in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester, i.e.

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course in a semester and Gi is the grade point scored by the student in the ith course.

- CGPA is a measure of overall cumulative performance of a student over all the semesters completed. The CGPA is the ratio of total credit points secured by a student in various courses in all the semesters completed and the sum of the total credits of all courses in all the semesters completed, i.e.

$$\mathbf{CGPA} = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in the semester.

- On completing all requirements for award of the degree, the CGPA will be calculated and this value will be indicated on the degree along with Division. The Final degree should also indicate the Division obtained as per follows:

Division	Criterion
First division with distinction	The candidate has earned minimum number of credits required for the award of the degree in first attempt with CGPA of 8.00 or above
First division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 6.50 or above
Second division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 5.00 or above but less than 6.50
Pass division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 4.00 or above but less than 5.00

- The student will be promoted to the next semester if he/ she secures at least 12 valid credits in a semester. In case the student secures less than 12 valid credits in any semester, then the student will be asked to repeat the entire semester and that semester will be treated as zero semester.
- The student should not carry more than 5 courses (combining theory and practical) in Ist year, IInd year or IIIrd year to be promoted to the next year.
- Repetition of a theory / practical course is allowed only to those candidates who get F or Ab in the course. The student has to pay the prescribed fee for repeating the course.
- On account of valid reasons, a student may withdraw from a semester. In such case the semester will be treated as zero semester.
- In case of zero semesters, the student will not be promoted to the next semester till he/ she clears that semester. The UTD may allow such a student to register in the subsequent semester whenever it is offered by the concerned UTD. The student has to pay semester fee again in such cases. If the student withdraws within one month from starting of the semester then semester fee will not be charged again.
- The practical course can be repeated as and when it is offered.
- Dissertation / project report/ internship of 3-6 credits will be assessed by the internal supervisor, in general, however, UTD may get it assessed by an internal supervisor and an external expert.
- The dissertation report of 12-18 credits will be assessed by the external examiner to be appointed by the Vice-Chancellor from the panel of examiners.
- A comprehensive viva-voce of 4 virtual credits will be conducted at the end of each semester of the programme by a board of four examiners, at least ONE of whom shall be external. The grades awarded in the viva-voce shall be shown separately in the grade-sheet.
- The conversion of CGPA in to percentage will be as follow to facilitate its application in other academic matters: Equivalent Percentage = CGPA x10

JIWAJI UNIVERSITY, GWALIOR MP
School of Studies in Microbiology

School of Studies in Microbiology came into existence in 1995 under the self supporting programs. The Two year/ four semesters M.Sc. program in Microbiology is based on the semester system under Choice based credit system (CBCS) with the objective to produce manpower in applied areas. Students who have completed M.Sc. from Department have been absorbed in various laboratories, industries and other organizations. Some of the students have qualified NET/ GATE examinations as well.

Over the past twenty years, School of Studies in Microbiology has built up a worthwhile teaching/ research base. In addition to routine laboratories, the Department has a well equipped instrumentation facility, a rich library and computer facility accessible to the students under the guidance of worthy teachers. The major instruments include: Thermal cycler, Gel-Electrophoresis systems, UV-visible spectrophotometer, Cooling centrifuge, Deep freezer and Laminar air flow etc. The Department has successfully completed a few research projects sponsored by Department of Biotechnology, University Grant Commission and MOEF, New Delhi. The post graduate Course in Microbiology offers excellent opportunities for carrier advancement and students can look forward for being absorbed in private/public sectors/autonomous organizations. It is needless to emphasize the scope of microbiology; both the private and public sectors have profuse interest in the industrial applications of microbial technology like synthesizing new drugs, proteins, enzymes, antigens and diagnostic materials.

Programmes:

M.Sc. Microbiology
Ph.D.

Programme Outcomes (POs)

The program of Microbiology is designed in such a way to provide the students a broad spectrum of knowledge and laboratory resources so that it will help them in career building in microbiology and related fields. The faculty is committed to provide a conducive environment that addresses the needs of every student and encourages them to develop their potential, skills of competition and explore themselves.

Distinguishing features are:

- Broad spectrum of knowledge about various disciplines of Microbiology
- Diverse knowledge about the bioinstrumentation used in Microbiology and gain hands on experience
- On Completion of this course the students should have a sound knowledge about the use of microbes for various industrial processes.
- Facilities provided for carrying out dissertation and projects in various fields of Microbiology

Programme Specific Outcomes (PSOs)

The post graduate course is designed to achieve the following program specific outcomes

PSO1: An ability to develop microbial processes for industries, restoration and sustainability of environment at social and commercial level.

PSO2: Application of microbial techniques in various industries like pharmaceutical, chemical, food, Dairy, beverage and agriculture.

PSO3: To explore and create innovative ideas for research and development processes among the students, and find solutions to the existing problems.

PSO4: Reinforcement of theoretical knowledge at practical and ground level for human welfare and environment.

PSO5: Display their potential and ability to qualify competitive exams (NET/ BARC/ TIFR/ GATE/ SLET/ ICMR/ARS/UPSC) at national and global level.

PSO6: Entrepreneurship ventures such as career consultancy and training centres, farms can be opened and to develop lifelong learning skills.

PSO7: Moreover, there are several career opportunities for students of Microbiology background abroad where Microbiology is a rapidly developing field.

SEMESTERWISE SCHEME IN DETAIL
Semester - 1

Code	Title of Course	Core / Generic / Centric	T	P	Total Credits	Marks					
						Internal		External		Total	
						Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
MB-101	Basics in Microbiology and General Bacteriology	Core	3	0	3	40	14	60	21	100	35
MB-102	Virology and Mycology	Core	3	0	3	40	14	60	21	100	35
MB-103	Cell biology and Biochemistry	Core	3	0	3	40	14	60	21	100	35
MB-104	Bioinstrumentation	Core	3	0	3	40	14	60	21	100	35
MB-105	Lab Course I	Core	0	3	3	40	14	60	21	100	35
MB-106	Lab Course II	Core	0	3	3	40	14	60	21	100	35
MB-107	Seminar	AE & SD	1	0	1	100	35	-	-	100	35
MB-108	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-109	Comprehensive Viva Voce	Core	-	-	4			100	35	100	35

Total Credit Value: # 24 (20 + 4 virtual credits)

***AE & SD- Ability Enhancement and Skill development.**

MB: 101 (Core) BASICS IN MICROBIOLOGY AND GENERAL BACTERIOLOGY

Outcome of paper MB-101-

- *Students will be able to know about the basic knowledge of bacterial microflora present in the environment and the scope of microbiology.*
- *Students will be able to classify the bacteria on the basis of their growth, morphology and nutrition characteristics.*
- *In addition to the basic knowledge, the course includes the laboratory techniques that include various methods which will help the students to isolate the bacteria and identify them.*
- *Students will also be able to know about the nutritional requirements for the growth and culture of the various types of bacteria.*
- *It also includes the methods of physical and chemical control of bacteria*

UNIT-I

1. Introduction, history and scope of Microbiology.
2. General characteristics and composition of Prokaryotes and Eukaryotes.
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.
4. Nomenclature and modern methods of Bacterial taxonomy.

UNIT-II

1. Morphology and ultra structure of bacteria: size, shape, and arrangement of bacteria, ultra structure of bacterial cell wall of eubacteria and archeabacteria. Protoplast and spheroplast formation and L-form.
2. Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule- types, composition and function, slime layers, S-layers.
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.
4. Bacterial response to external stimulus and bacterial endospores: Chemotaxis and phototaxis structure, formation and germination of bacterial endospore.

UNIT-III

1. Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.
4. Bacterial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.

UNIT-IV

1. General concept of Prokaryotic and Eukaryotic genome. Genome of *E. coli*.
2. Genetic recombination and transformation.
3. Transduction: generalized and specialized transduction, phage conversion.
4. Plasmid: types and their significance. Conjugation and chromosomal mobilization. *E. coli* as model prokaryotes.

UNIT-V

1. Staining methods: fixation, types of dyes, simple staining, differential staining (Gram and Acid-fast staining), staining of specific structures (capsule, flagella and spore staining)
2. Control of microorganisms: Microbial death curve, concept of bio-burden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents.
3. Control of microorganisms by physical agents: heat (moist and dry), filtration and radiation.
4. Chemical control of microorganisms: Disinfection techniques, Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

Reference Books

1. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, Mc Graw Hill Higher education.
2. General Microbiology; R.Y. Ingraham, J.L. Wheels, M.L. Painter. Thess Macmillan Press Ltd.
3. Brock Biology of Microorganism; M.T, Martinko, J.M. Parker, Prentice-Hall.
4. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill.
5. Microbial Genetics, S.R. Molloy, J.E. Jr. Cronan and Frreifelder D Jones, Bartiett Publishers.
6. Breed and Buchanan. *Bergey's Manual of Systematic Bacteriology*. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003).
7. General Microbiology, R. Y. Stanier, E. A. Adelberg, J. L. Ingraham, 4th edition, Mac Millan Press, London.
8. Microbiology An introduction by Tortora Funke case.

MB: 102 (Core) VIROLOGY AND MYCOLOGY

Outcome of paper MB-102-

- *This course provides the clear understanding of viruses, their structure and functioning.*
- *Mode of reproduction and transformation in viruses.*
- *Provides insights in the various immunological and serological techniques involved in the viral assay and purification of virus.*
- *This course will help the students to acquire a vast knowledge of bacteriophages, cyanophages, plant and animal viruses.*
- *This course provides a deep knowledge about the structure, reproduction, ecology and economic importance of fungi.*

UNIT- I

1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II

1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods, plaque method, pock counting and end point method.
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA.
4. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography.

UNIT-III

1. Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.
3. Animal viruses: nomenclature and classification of animal viruses.
4. General idea about Cyanophage, and Mycophage.

UNIT-IV

1. Bacteriophage: classification, morphology and ultra structure.
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle: lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T4, Ø x174 and lambda phage

UNIT-V

1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.
4. Ecology of fungi: concept of fungistatic, fungicidal.

Reference Books

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
2. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
3. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press .
4. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, Mc Graw Hill Higher education.
5. Introductory Mycology, Alexopoulos, C. Jr : , Second edition, Wiley, New York.

MB: 103 (Core) CELL BIOLOGY AND BIOCHEMISTRY

Outcome of paper MB-103-

- *The course provides the deep knowledge of the cell organization and cell functioning in the bacteria*
- *It provides a detailed understanding of cell communication and interaction, and various pathways involved in cell signaling*
- *This course deals with the physiological processes and metabolic pathways in microbial systems like carbohydrates, lipids etc.*
- *This course provides the knowledge regarding the structure of amino acids, proteins and genetic material.*
- *It imparts knowledge of understanding the enzyme kinetics involved in microbial systems.*

UNIT-I

1. Cell: size, shape, types & chemical composition of the cell.
2. Structural organization and function of intracellular organelles of eukaryotic cell: nucleus, mitochondria, golgi body, lysosomes, endoplasmic reticulum, peroxisomes, plastids, chloroplast, vacuole, cytoskeleton.
3. Membrane structure and function: molecular organization of cell membrane, membrane models, mechanisms of intracellular transport.
4. Cellular interaction: differentiation of cell membrane and intracellular communication and Gap junction.

UNIT-II

1. Cell differentiation: general characteristics of cell differentiation and cytoplasmic factors, differential gene action.
2. Cell signaling: cell surface receptors, G-protein, signal transduction pathways.
3. Cell cycle: mitosis and meiosis and their regulation. Programmed cell death and apoptosis.
4. Cancer biology: characteristics of cancer cell, types of cancer, oncogene and tumor markers.

UNIT-III

1. Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars.
2. Structure, properties and function of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins, glycolipids.
3. Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes.
4. Lipids with specific biological functions, micelles and liposomes.

UNIT-IV

1. Amino acids: structure, classification, properties and functions.
2. Proteins: structural and functional proteins, synthesis of peptide bonds. Primary, secondary, tertiary and quaternary structure of proteins. Protein sequencing.
3. Nucleic acids: structure and properties of purines and pyrimidine bases, nucleosides and nucleotides.
4. Basic structure and types of DNA and RNA.

UNIT-V

1. Enzymes: basic concept as a biocatalyst, specificity, active sites, activity unit and iso-enzymes, enzyme classification.
2. Enzyme kinetics- Michaelis-Menton equation for simple enzymes, determination of kinetic parameters.
3. Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes.
4. Vitamins and cofactors: structure, distribution and biological properties.

Reference books

1. Biochemistry by Donald Voet and Judith G. Voet ,third edition, John Wiley and sons, inc. , U.S.A.
2. Biochemistry by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, sixth edition , W. H. Freeman and Company, New York.
3. Molecular Cell Biology , by Harvey Lodish ,Fifth edition , W.H. Freeman and Company, New York
4. Molecular Biology of The Cell by Bruce Alberts, Fourth edition, Garland Science Taylor and Francis Group, U.S.A.
5. Biochemistry by Lubert Stryer, Fourth edition, W. H. Freeman and Company, New York.
6. Biochemistry by Christopher K. Mathews, K.E. van Holde and Kevin G. Ahern, Third edition, Pearson Education (Singapore) Pte. Ltd., Indian branch, New Delhi
7. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.

MB: 104 (Core) BIOINSTRUMENTATION

Outcome of MB 104-

- *This will help the students to know about the history, types and applications of microscopy.*
- *It will benefit the students to know about various separation techniques*
  - *A. Chromatography (Paper, Column, TLC, GC-MS)*
  - *B. Electrophoresis (Agarose, PAGE, SDS-PAGE)*
  - *C. Spectroscopy (IR, ESR, NMR)*
  - *D. Centrifugation (Differential, Density Gradient)*
  - *E. Radiography*

UNIT-I

1. Microscopy: history and principles of microscopy, properties of light, magnification power, resolution limit, resolving power, numerical aperture.
2. Principles and applications of light microscopy, bright field, dark field, phase contrast and fluorescent microscopy. Determination of size of microorganisms by micrometery.
3. Principles and application of electron microscopy- transmission and scanning electron microscopy. Fixation and staining techniques in electron Microscopy.
4. Newer techniques in microscopy- confocal microscopy, scanning probe microscopy (scanning tunneling microscope and atomic force microscope).

UNIT-II

1. Chromatography: Principles, types and applications of partition, paper and thin layer chromatography.
2. Adsorption and Gel filtration chromatography: Principle, matrix, column packing and applications.
3. Affinity, ion exchange, and Gas chromatography: Principle and applications.
4. High performance liquid chromatography (HPLC) and FPLC: Principle, Instrumentation (Reservoirs, pumps, columns) and applications.

UNIT-III

1. Electrophoresis: principle, types and applications of Paper, Starch gel and Agarose gel electrophoresis.
2. Polyacrylamide Gel Electrophoresis: Native PAGE and SDS-PAGE.
3. Isoelectric focusing, Isotachophoresis and gradient gel electrophoresis.
4. Two dimensional gel electrophoresis and pulse field gel electrophoresis.

UNIT-IV

1. Spectroscopy: Laws of absorption, Principles, design and applications of colorimetry, UV-visible spectroscopy.
2. Principles, design and applications Infrared and fluorescence Spectroscopy.
3. Principles, design and applications of NMR and ESR.
4. Principle, design and applications of Mass Spectroscopy (types of ion source, analyzers and detectors), GC-MS, MALDI-TOF.

UNIT-V

1. Centrifugation: Basic principles of centrifugation, differential and density gradient: zonal and isopycnic centrifugation. Sedimentation coefficient, factors affecting sedimentation coefficient.
2. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.
3. Radioisotope techniques: half life, radioactive decay, radioactive assay methods based on ionization and excitation of gases-Geiger Muller counter, liquid scintillation counter and gamma counter.
4. Autoradiography- principle and applications. Quenching and application of radioisotopes in biological systems.

Reference Books

1. A Biologist Guide to Principles and Techniques of Practical Biochemistry, Wilson and Goulding
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Frefelder,
3. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, Mc Graw Hill Higher education.
4. Principles of Instrumental Analysis, Skoog and West.
5. Biological Spectroscopy, Campbell and Dwek.
6. Principles and Techniques of Biochemistry and Molecular Biology, Wilson Keith and Walker John (2005) 6th Edition. Cambridge University Press, New York.

MB – 105: LAB COURSE I

Practical Exercises

Lab course I (Basics in Microbiology and General Bacteriology & Virology and Mycology)

1. Good Microbiology laboratory practices: Laboratory safety (Dos 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.
   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.

9. To check motility of bacteria by hanging drop and semi-solid agar methods.
10. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks).
11. To study effect of salt, pH and temperature on microbial growth.
12. Determination of bacterial growth by turbidity measurements and to plot bacterial growth curve.
13. Inoculation and cultivation of viruses in embryonated eggs.
14. Isolation of bacteriophage (coli phages) from sewage.
15. Enumeration of bacteriophage by plague forming unit method.
16. Determination of one step growth curve of bacteriophage.
17. Isolation cultivation and morphological studies of fungi.
18. Isolation cultivation and morphological studies of Actinomycetes.

MB- 106: LAB COURSE II

Practical Exercises

Lab course II (Cell biology and Biochemistry & Bioinstrumentation)

1. To detect the presence of carbohydrate in the given sample by Molish test
2. To detect the presence of reducing sugar in the given sample by Fehling's test
3. To detect the presence of pentose sugar in the given sample by Bial's test
4. To determine the presence of monosaccharide using Anthrone test
5. To detect presence of reducing sugar using Benedict's test.
6. To determine the presence of monosaccharide using Barfoed's reagent
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test).
8. To determine the presence of ketose sugar by Seliwanoff's reagent in given sample.
9. To determine the presence of protein by Biuret method.
10. To determine the presence of protein by Xanthoprotic test.
11. Quantification of protein contents in given sample by Folin's- Lowry method.
12. To determine Saponification value of given fat sample.
13. Determination of pKa value.
14. To study different stages of mitosis in onion root tip preparations.
15. Verification of Beer-Lambert Law.
16. Determination of absorption maxima of given sample using spectrophotometer.
17. Calibration of an ocular micrometer for different objectives of microscope.
18. Measurement of microorganisms by the use of an ocular micrometer.
19. Separation of given amino acids by paper chromatography.
20. Separation of amino acids by Thin Layer Chromatography.
21. To study microorganisms under dark-field microscope.
22. Separation of sub cellular organelles by differential centrifugation.

MB-107: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 108: Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education:

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 109: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

SEMESTER II (with detailed scheme)

Code	Title of Course	Core / Generic / Centric	T	P	Total Credits	Marks					
						Internal		External		Total	
						Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
MB-201	Microbial genetics and Molecular Biology	Core	3	0	3	40	14	60	21	100	35
MB-202	Immunology	Core	3	0	3	40	14	60	21	100	35
MB-203	Microbial Physiology and metabolism	Core	3	0	3	40	14	60	21	100	35
MB-204	Biostatics, Computer application and Bioinformatics	Core	3	0	3	40	14	60	21	100	35
MB-205	Lab Course III	Core	0	3	3	40	14	60	21	100	35
MB-206	Lab Course IV	Core	0	3	3	40	14	60	21	100	35
MB-207	Seminar	AE & SD	1	0	1	100	35	-	-	100	35
MB-208	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-209	Comprehensive Viva Voce	Core	-	-	4			100	35	100	35

Total Credit Value: # 24 (20 + 4 virtual credits)

***AE & SD- Ability Enhancement and Skill development.**

MB: 201 (Core) MICROBIAL GENETICS AND MOLECULAR BIOLOGY

OUTCOMES of paper-MB201-

- *Explain the students about processes behind mutations and other genetic changes.*
- *Identify and distinguish genetic regulatory mechanisms at different levels.*
- *Solve theoretical and practical problems in genetic analysis particularly concerning genetic mapping and strain construction.*
- *Structural features of nucleic acids and their regulation by transcription, translation and replication can be studied for further research development and help us to know how the genetic material transfers.*
- *Post transcription and translation modification process and splicing are the processes that are important in any modification in damaged DNA and RNA.*

UNIT-I

1. Organization of genetic material in prokaryotes and eukaryotes.
2. Concept of gene, genome, genome size, C-value, and C-value paradox.
3. Nucleic acid as a genetic information carriers; experimental evidence.
4. Gene is a unit of mutation and recombination; molecular basis of mutations, physical and chemical mutagens, spontaneous and induced mutation, selection of mutant.

UNIT-II

1. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
2. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine diamers), repair mechanism; dark reactivation, mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
3. DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polymerases, DNA ligase, primase.

UNIT-III

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

UNIT-IV

1. Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
2. Protein synthesis: steps, details of initiation, elongation and termination.
3. Inhibitors of protein synthesis: signal hypothesis.
4. Post translational modification: covalent modification, phosphorylation, glycosylation, methylation. Protein targeting.

UNIT-V

1. Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter, repressor, induction and repression, positive and negative control.
2. *Lac*-operon, ara-BAD operon, trp operon, attenuation, mechanism of regulation of transcription.
3. Regulation of gene expression in eukaryotes: Britton and Davidson's model of regulation involve HCP and NHCP and hormones.
4. Transposable elements: Jumping genes.

Reference Books

1. 2. Gene IX, Benjamin Lewin Oxford University Press, New York.
3. Principles of Genetics, Snustad and Simmons, Fourth Edition, John Wiley and Sons, Inc.
4. Molecular Cell Biology, Lodish *et.al.,* W. H. Freeman and Company.
5. Genomes by T.A. Brown, John Wiley and sons (Asia)PTE LTD, New York.
6. Principles of Gene Manipulation and Genomics by S.B. Primrose and R. M. Twyman, Seventh edition, Blackwell Publishing, U.K.
7. Cell and Molecular Biology concepts and experiments By Gerald Karp, Third edition, John Wiley and sons, Inc., U.S.A.
8. Chromatin and Gene regulation (2001) Turner Wiley-Blackwell
9. An Introduction to Genetic Analysis, Grifiths *et al.,* W. H. Freeman

MB: 202 (Core) IMMUNOLOGY

OUTCOMES of paper MB-202

- *To provide students a conceptual knowledge of immunological processes.*
- *To understand the mechanism of how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology.*
- *Be able to clearly state the role of the immune system.*
- *Be able to provide an overview of the interaction between the immune system and pathogens.*
- *Immunological aspects provide evolutionary changes in medical microbiology to researchers.*

UNIT-I

1. History of immunology, development of immunology as discipline.
2. Immune response: mechanism of innate and adaptive immune response.
3. Hematopoiesis: development of immune cells, regulation of hematopoiesis.
4. Structure, composition and types of cells involve in immune response: mononuclear cells, granulocytes, antigen presenting cells, lymphoid cells. Mediators and process of Inflammation.

UNIT-II

1. Anatomical organization of immune system: primary and secondary lymphoid organs: structure and function.
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, super antigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes, molecular mechanism of antibody diversity and class switching.
4. Cell mediated immunity and its mechanism.

UNIT-III

1. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
2. Complement system: components, activation pathways, regulation of activation pathways and role of complement system in immune response.
3. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors.
4. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.

UNIT-IV

1. Hypersensitivity: type I, II, III and types IV hypersensitivity. Immunodeficiency diseases: primary and secondary immunodeficiency.
2. Autoimmunity: organ specific autoimmune diseases, mechanism of autoimmune diseases and therapeutic approaches.
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.
4. Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy.

UNIT-V

1. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine and applications, subunit vaccines and anti-idiotype vaccine.
2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basis research.
3. Antibody engineering: Chimeric and Humanized monoclonal antibodies.
4. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen- antibody interaction by precipitation, agglutination, RIA, and ELISA.

Reference Books

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.
3. Immunobiology: The immune system in health and disease by Janeway CA, Travers P, Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.
5. Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell Publishing/Oxford Univ. Press; 2006.

MB: 203 (Core) MICROBIAL PHYSIOLOGY AND METABOLISM

OUTCOMES of paper MB-203-

- *Students will be able to understand the laws of thermodynamics, energy kinetics and their applications to biological system and various biochemical studies and reactions.*
- *Knowledge of major biomolecules-carbohydrates, lipids, proteins, amino acids, nucleic acids.*
- *Provides a clear understanding about the biosynthesis and degradation pathways involved.*
- *Addresses the fixation of molecular nitrogen into usable form by microorganism*
- *Conceptual studies of aerobic and anaerobic bacteria help us in agriculture.*

UNIT-I

1. Bioenergetics and metabolism: Basic concepts.
2. First and second law of thermodynamics, concept of free energy, entropy and enthalpy.
3. High energy phosphate compounds, role of ATP, ATP cycle, structural basis of free energy change during hydrolysis of ATP.
4. Biological redox reactions, Biological reducing power and its role in biological system.

UNIT-II

1. Carbohydrate metabolism: glycolysis and its regulation, Feeder pathway of glycolysis and carbohydrate– homo and hetero lactic fermentation, Glycogenesis, Glycogenolysis and regulation, Gluconeogenesis.
2. Pentose phosphate pathway, E-D pathway, Kreb's cycle and glyoxalate pathway.
3. Electron transport system in Mitochondria, Electron careers and multi enzyme complex I to IV.
4. ATP synthesis: substrate level and oxidative phosphorylation and un-couplers, inhibitors of oxidative phosphorylation.

UNIT-III

1. Photosynthesis: Oxygenic and an-oxygenic microorganisms, structure of chloroplast, light reaction, photolysis of water and photophosphorylation, C3 and C4 pathway of carbon fixation.
2. Nutritional classification of microorganisms, Energy generation in cyanobacteria, green bacteria, purple sulphur bacteria and chemolithotrops.
3. Lipid biosynthesis: Biosynthesis of lipids and fatty acids, triglycerol and phospholipids and their regulation
4. Lipid Metabolism: Degradation of Lipids, oxidation of unsaturated, saturated, even and odd chain fatty acids, ketone bodies.

UNIT-IV

1. Amino acid metabolism: Biosynthetic families of amino acids - Outlines
2. Catabolism of amino acids: Breakdown of amino acids into six common intermediates and urea cycle and relationship with TCA cycle. - Outlines
3. Nucleotide metabolism: Biosynthesis of purines and pyrimidine nucleotides by de novo and salvage pathways.
4. Degradation of Purines and Pyrimidine nucleotides.

UNIT-V

1. Nitrification, denitrification, Nitrate and ammonia assimilation pathways, Nitrogen cycle.
2. Diazotrophs and Biochemistry of nitrogen fixation, Structure of nitrogenase complex.
3. Regulation of nitrogenase complex by oxygen and combined nitrogen sources.
4. Nif genes and their regulation.

Reference Books

1. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc.,2008
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008.
3. Microbial lipids edited by C. Ratledge and SG Wilkinson, second edition, Academic Press; 1988.
4. Microbial Physiology by Albert G. Moat and John W. Foster. Third edition, John Wiley and Sons; 2002
5. The Physiology and Biochemistry of Prokaryotes by David White. Second Edition, Oxford University Press; 2000.

MB: 204 (Core) BIOSTATISTICS, COMPUTER APPLICATION & BIOINFORMATICS

OUTCOMES of paper MB-204-

- *Students will know the theory behind fundamental bioinformatics analysis methods.*
- *Be familiar with widely used bioinformatics databases.*
- *Know basic concepts of probability and statistics.*
- *Course will prepare the students for various applications of bioinformatics in life sciences research.*

UNIT–I

1. Definition of statistics and scope of statistics in bio research.
2. Types of sampling methods, survey design, organization and graphical representation of data.
3. Measures of central tendency
4. Measure of dispersion, correlation, calculation of Karl Pearson's coefficient of correlation, theory of multiple correction and property.

UNIT-II

1. Regression Analysis, linear regression, regression equation
2. Hypothesis testing: Types of hypothesis testing: t-test, 2 -test, and F- test.
3. Introduction of Design of Experiment (DOC) and factorial design.
4. Application of SPSS software.

UNIT–III

1. History & development of computer organization of a basic compute. computer application in molecular biology.
2. Number system, computer arithmetic & Boolean algebra.
3. Type of operating systems, DOS, WINDOWS & LINUX. Introduction to MS Office.
4. Basic concept of programming; algorithm, flow charts & introduction to computer languages, basic idea of internet. Use of various software in microbiology.

UNIT–IV

1. Bioinformatics: An overview, introduction and scope of bioinformatics.
2. Databases: Characteristics, categories and types. Literature database (PubMed, LITDB), Disease database (OMIM, Gene Cards, Med line Plus). Information retrival system (Entrez, SRS).
3. Sequence Database: EMBL, DDBJ, GenBank, UniGen, PIR, SWISS-PROT and TrEMBL. Structure Database: PDB, CATH, DALI, SCOP.
4. Data mining tools: Modelling tools (Rasmol, SPDV, HyperChem), Data submition tools (Bankit, Sequin, Webin, Sukura, Spin, AutoDep).

UNIT–V

1. Algorithms: Classification of algorithms. Sequence Comparison algorithms (Dot matrix). Submission metrics algorithms (PAM, BLOSUM), Tools for sequence alignment (FASTA, BLAST, ORF finding).
2. Gene Prediction: Methods, Gene mapping: DNA sequencing, Sequence alignment optimal algorithms (Smith-Waterman algorithm, Needleman – Wunsch algorithm). Tools for Genome analysis (COGs, Map Viewer, GEO).
3. Phylogenetic analysis: Phylogenetic trees. Methods of phylogenetic evaluation. Prediction tools (Phylip, GenScan, Pfam, Modeler)
4. Proteomics: Proteome analysis, Tools for Protein sequence analysis and proteomics (PSI- BLAST, CD search, CDART), structure analysis (Cn3D, CD search).

References Books

1. Sampling Techniques, Cochran W.G., Wiley eastern Ltd, New Delhi.
2. Fundamentals of statistics, Goon, Gupta and Dasgupta, World Press, Kolkata.
3. Statistical methods, Gupta S.P., Sultanchand & Sons.
4. Fundamentals of Biostatistics; Irfan Ali Khan and Atiya Khanum, 2nd Edition. Ukaaz Publications, Hyderabad.
5. Bioinformatics: Databases, Tools and Algorithms, by Orpita Bosu, Simminder Kaur Thukral, OXFORD University Press.
6. Bioinformatics: Sequence and Genome Analysis by D.W. Mount , second edition, Cold Spring Harbor Laboratory Press
7. Bioinformatics : Methods and Application by S.C. Rastogi, N. Mendira, P. Rastogi, Third edition , PHI Learning Private Limited
8. Introduction to Bioinformatics by Teresa. K. Attwood and David J. Parry- Smith, Low Price edition, Pearson Education

MB – 205: LAB COURSE III

Practical Exercises

LAB COURSE-III (MICROBIAL GENETICS AND MOLECULAR BIOLOGY & IMMUNOLOGY)

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. Demonstration of genetic recombination in bacteria by conjugation.
4. To perform Ames test for detecting carcinogen or mutagen.
5. Quantification of DNA by DPA method.
6. Quantification of RNA by Orsinol method
7. To check purity and quantity of DNA by Spectrophometeric method.
8. To isolate genomic DNA from Gram positive and Gram Negative bacteria.
9. To isolate total RNA and mRNA from bacteria
10. To perform SDS-PAGE for separation of proteins in given sample.
11. To prepare soluble antigen by different methods.
12. To demonstrate various routes of immunization in mice.
13. To prepare serum and plasma from blood.
14. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
15. To determine Blood group and Rh factor by slide agglutination test
16. To determine Total Leukocyte Count (TLC) for given blood sample
17. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain.
18. To perform Widal agglutionation test (slide and tube) for diagnosis of typhoid.
19. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
20. To perform Redial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
21. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction
22. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction
23. To perform ELISA for assay of antibodies in serum sample against given antigen.

MB- 206: LAB COURSE IV

Practical Exercises

Lab course - IV (Microbial Physiology and Metabolism & Biostatistics, Computer Application and Bioinformatics)

1. To study catalase activity of given microbial culture.
2. To study oxidase activity of given microbial culture.
3. To study ability of microorganisms to hydrolyse casein
4. To demonstrate phenylalanine deaminase activity of given bacterial culture.
5. To demonstrate L-lysine decarboxylase activity of bacterial culture.
6. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms
7. To demonstrate Fat hydrolysis (lipase activity) by bacteria
8. To study ability of microorganisms to hydrolyze gelatin
9. To demonstrate degradation of sulphur containing amino acids by bacteria
10. Representation of statistical data by
    1. Histogram 2. O give curves 3. Pie diagrams
11. Collection of data using different sampling methods
12. Determination of Averages or Central tendencies (Mean, Mode, Median)
13. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation)
14. Application of Tests of significance (Chi-Square test, student t-test, Standard error)
15. Applications of computers in biology using MS-office (MS-Word, Excel, Power point)
16. To access scientific data from Literature data bases (PUBMED, LITDB, Medline)
17. To access nucleic acid databases for retrieval of gene sequence.
18. To access protein databases for retrieval of amino acid sequence of target protein.
19. To perform pair wise sequence alignment using Dot matrix.
20. To perform multiple sequence alignment using BLAST.
21. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
22. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W
23. 3D protein structure prediction and structure refinement using Swiss-PDB viewer

MB-207: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 208: Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education:

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 209: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of each semester of the programme by a board of four examiners, at least ONE of whom shall be external. The grades awarded in the viva-voce shall be shown separately in the grade-sheet.

The conversion of CGPA in to percentage will be as follow to facilitate its application in other academic matters: Equivalent Percentage = CGPA x10

SEMESTER III (with detailed scheme)

Code	Title of Course	Core / Generic / Centric	T	P	Total Credits	Marks					
						Internal		External		Total	
						Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
MB-301	Medical and Pharmaceutical Microbiology	Core	3	0	3	40	14	60	21	100	35
MB-302	Fermentation and Microbial Technology	Core	3	0	3	40	14	60	21	100	35
MB-303	Recombinant DNA Technology	Elective-I	3	0	3	40	14	60	21	100	35
MB-304	Environmental Microbiology	Elective-II	3	0	3	40	14	60	21	100	35
MB-305	Lab Course V	Core	0	3	3	40	14	60	21	100	35
MB-306	Lab Course VI	Elective	0	3	3	40	14	60	21	100	35
MB-307	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-308	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-309	Comprehensive Viva Voce	Core	-	-	4			100	35	100	35

Total Credit Value: # 24 (20 + 4 virtual credits)

***AE & SD- Ability Enhancement and Skill development.**

MB: 301 (Core) MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

Outcome of paper-MB-301-

- *The students will be aware of conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body and predisposing factors.*
- *This course will provide knowledge of normal microflora of human body, different types of infections with mode of spread and most importantly host parasite relationship*
- *Students will understand the different disease causative agents viz- Gram positive, Gram negative bacteria, viruses, protozoans and fungi. Students will develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases, complete knowledge about of source, pathogenicity and treatment,.*
- *Students will be benefitted by knowledge of different antimicrobial agents their spectrum, would know about procedure of trials and safety profile of various drugs. Practically will know about disease and their prevention. So this will aid a social awareness towards healthy living*

UNIT-I

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.
2. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.
3. Normal microflora of human body: normal flora of skin, respiratory, gastrointestinal, genital tract, role of resident and opportunistic flora, concept of probiotics and uses.
4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

UNIT-II

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

Morphology, pathogenesis, immune response, diagnosis and prevention of

1. Pox viruses (Variola, Vaccinia, Small pox) Herpes Simplex type I and type II, Picorna viruses (Entero viruses and Polio viruses).
2. Paramyxo viruses (Rubella virus and Para influenza viruses), Orthomyxo viruses (Measles & Mumps viruses).
3. Hepatitis viruses (Type A, B, C, D, E), Arbo viruses (Alpha virus and Flavi viruses), Rhabdo viruses (Rabies virus).
4. Oncogenic viruses, HIV virus.

UNIT-IV

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),
2. Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania, Trypanosoma* and *Toxoplasma.*
3. Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)
4. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

UNIT-V

1. Antimicrobial agents: Histroy, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action)
2. Methodologies for testing of antibacterial, antifungal, and antiviral drugs (*in vivo* and *in vitro* infectivity models), mechanism drug resistance.
3. Preclinical development: Safety profile of drugs (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and neurotoxicity), Toxicological evaluation of drug (LD50, Acute, subacute and chronic toxicity), Mutagenecity (Ames test, micronucleus test) and Carcinogenicity.

4. Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials –Objectives, Conduct of trials, Outcome of trials.

Reference Books

1. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press.
2. Brock Biology of Microorganisms, M.T, Madigan, J.M. Martinko and J. Parker, Ninth edition, Prentice Hall, Upper Saddle River, NJ.
3. Microbiology; An introduction, G.J. Tortora, B.R. Funke and C.L. Funke.
4. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
5. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
6. Medical Microbiology; Jawetz, Melnick, & Adelberg's, Fifth edition, MacGrow Hills
7. Medical Bacteriology, Medical Mycology and AIDS; N.C.Dey, T.K. Dey and D. Sinha, New Central Book Ajency (P) Ltd.
8. Principles of Therapeutics, Burn J. H., Blackwell Scientific Pub. O. Ltd. Oxford.
9. Principles of Drug Action, The Basis of Pharmacology, Goldstein A., Aronow L., and Kalman S. M., Harper international edition New York.
10. Mannfred A. Holliger, (2008), *Introduction to pharmacology*, 3rd Ed., CRC Press

MB: 302 (Core) FERMENTATION AND MICROBIAL TECHNOLGOY

Outcome of paper-MB-302

- *The course will develop interest of students for industrial approach, knowledge of different industrially important microorganisms and a practical idea about their applications and future perspective.*
- *Students will have opportunities to interact about different industrial processes- fermentation, production of important products- alcohol, glycerol and many more, develop monitoring and operating skills.*
- *Students will develop conceptual and technical idea of advanced techniques like immobilization, biochips, biosensors with their industrial applications.*
- *Students will get a vision of latest microbial applications in production of vaccines and other therapeutic agents- interferons, insulin etc.*
- *Students will identify the strain improvement techniques and understand their principles.*

UNIT-I

1. Industrially important strains of bacteria, fungi, and actinomycetes. Novel microbes for future industry.
2. Isolation and screening of the industrially important strain from diverse ecosystem.
3. Method of strain improvement, mutagenesis, strain breeding by protoplast fusion, sexual and para sexual recombination.
4. Fermentation technology: principles of fermentation. Fermenter (batch and continuous) and bioreactors: monitoring and control of parameters, designing, operation and application.

UNIT-II

1. Downstream processing: filtration of fermentation broths recovery of biological products by distillation, superficial fluid extraction.
2. Detection, analysis and quality control of fermentation products and row materials.
3. Industrial production of alcohols: vinegar, wine and alcohol.
4. Industrial production of solvents-glycerol, acetone, and butanol.

UNIT-III

1. Industrial production of citric acid and glutamic acid.
2. Microbial production of enzyme of industrial important: amylase and proteases.
3. Methods of whole cell immobilization, enzyme immobilization and application.
4. Industrial production of antibiotics, penicillin and streptomycin.

UNIT-IV

1. Hygiene and safety in fermentation industries.
2. Microbial production of Vitamin B2 and B12.
3. Microbial production of Interferon, Insulin, flavours and fragrances.
4. Bioelectronics: Biochips and biosensors.

UNIT-V

1. Microbial production of vaccines.
2. Microbial production of polymers: Dextran and xanthan.
3. Microbial transformations: Steroid biotransformation
4. Intellectual property rights (IPR) and protection (IPP)

Reference Books:

1. Principles of Fermentation Technology by Stanbury, P.F., Whitaker A. and Hall. 1995. Butterworth Heinemann
2. Biotechnology - A Text Book of Industrial Microbiology by Cruger.
3. Fermentation Biotechnology: Industrial Perspectives by Chand.
4. Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.
5. Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. Verlag Chemie. 198

MB: 303 (Elective I) RECOMBINANT DNA TECHNOLOGY

Outcome of paper –MB303

- *Will enhance the vocabulary of the terminologies related to molecular biology and recombinant DNA technology*
- *Understand the properties, structure and function of genes in living organisms at the molecular level, working of enzymes used in RDT.*
- *Knowledge of different cloning vectors and cloning techniques including – isolation, transformation and transfection methods.*
- *Have a conceptual knowledge about Genomic and cDNA libraries and significance in gene expression and also about mechanism of mutagenesis*
- *Discuss the different molecular techniques of sequencing, principles of hybridization, oligonucleotide synthesis, PCR and molecular typing, all are highly significant.*
- *Will develop the knowledge of transgenic animals, whole genome sequencing and construction of knockout mutants.*
- *Students will find a deep sense towards practical aspect of all molecular techniques and their application in different scientific research areas, in social (medicine, GMOs) and industrial utilization.*

UNIT-I

1. Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, polymerases, ligase, kinases and phosphatases. Linkers and adapters.
2. Cloning vectors: Plasmids, Phages (Lamda and M13) Phagmids, Cosmids and Expression vectors.
3. Cloning vectors for Yeast (shuttle vector and YAC) and cloning vector for animal cells: SV 40, vaccinia and Retroviruses.
4. Cloning techniques: DNA isolation (Bacteria, Fungi, Plant and animal), Insert preparation, Ligation, Transformation methods (chemical methods, Electroporation and microinjection), Transfection.

UNIT-II

1. Genomic and cDNA library.
2. Screening of clones from libraries: Expression based screening, Interaction based screening.
3. Gene Expression: Expression vectors, factors affecting expression of cloned gene in *E. coli*.
4. Mutagenesis: Site directed mutagenesis, Transposon mutagenesis.

UNIT-III

1. DNA Sequencing: Sangers method, Maxmam Gilbert method, Thermocycle sequencing and Pyrosequencing
2. Principles of hybridization and hybridization based techniques: Colony, plaque, *in-situ* Hybridization, Southern, Northern, Western blotting.
3. Oligonucleotide synthesis, Restriction mapping, S1 nuclease and RNase mapping.
4. Polymerase Chain Reaction (PCR): Principle, Types and variants of PCR (Touch-Down PCR, Hot start PCR, Inverse PCR, RT-PCR, multiplex PCR, nested PCR).

UNIT IV

1. Molecular typing: RFLP (Ribotyping, IS based), RAPD, AFLP, VNTR, SNP, Whole genome sequence: GIS
2. Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility, shift assay, DNA foot-printing & DNA fingerprinting.
3. Transgenic animals: Strategies and methods.
4. Construction of knockout mutants.

UNIT-V

1. Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics, recombinant and DNA vaccines.
2. Gene therapy: somatic and germ line gene therapy.
3. Applications of Recombinant DNA Technology in Agriculture and Industry.
4. Biosafety & ethical considerations for GMOs.

Reference Books

1. Molecular Biotechnology. Glick BR, Pasternak JJ. ASM Press Washington D.C.
2. Principles of Gene Manipulation. Old and Primrose. Blackwell Scientific Publication.
3. Gene Cloning. T. A. Brown, Blackwell Publishing.
4. Molecular cloning- A laboratory manual, Sambrook, Fritsch and Miniatis, Cold Spring Harber Laboratory Press.
5. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford.
6. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.
7. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.), Stockton Press.
8. Genes and Genomes: A Changing Perspective; Maxine Singer and Paul Berg. University Science Books, Mill Valley, CA, 1991

MB: 304 (Elective II) ENVIRONMENTAL MICROBIOLOGY

Outcomes of paper MB: 304-

- *Students will acquire the knowledge of concepts of microbial habitats, interactions, microbial diversity and conservation techniques.*
- *Will be helpful in providing knowledge of microbiology of different environments-air, soil and water and their significance.*
- *Role of microorganisms in different beneficial process for environment- decomposition of organic matters, bioleaching, bioremediation of different pollutants (xenobiotics, petroleum products, oil spills).*
- *Would provide the knowledge of water quality test (BOD, COD, DO), indicator microbes, biological approaches for waste water treatments (trickling filters, oxidation ponds etc.).*
- *Significant role of microbes in different ecological aspects- extremophiles, microbial films.*

UNIT-I

1. Microbial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2. Microbial interactions: competition, commensalism, parasitism, mutualism, commensalisms, synergism.
3. Population ecology: characteristics of population, population growth curves(r and k selection) population regulation.
4. Conservation and management of microbial diversity: biodeterioration and biodegradation.

UNIT-II

1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi, pollens and viruses.
4. Air borne diseases and their prevention.

UNIT-III

1. Soil microbiology: microflora of soil: soil microorganisms associated with plants: rhizosphere, mycorrhizae.
2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
3. Bioleaching; introduction, application of bacterial leaching techniques, properties of bioleaching.
4. Microbial degradation of xenobiotics, petroleum and oil spills in environmental decay behaviours and degradative plasmid.

UNIT-IV

1. Water microbiology: aquatic microorganisms; fresh water and sea water microflora. Microorganisms and water quality, water pollution.
2. Water purity test and indicator organisms, method used in environmental studies –BOD, COD, DO.
3. Common water born disease and their control measure.
4. Water purification: flocculation, chlorination and purification.

UNIT-V

1. Microbiology of waste water and effluent treatments, aerobic process: primary, secondary and tertiary treatment: trickle filter, oxidation ponds and stabilization ponds, principle of aerobic digestion.
2. Bioremediation methods for controlling environmental waste.
3. Extremophiles –acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms: physiology, morphology, biochemistry of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books

1. Microbial Ecology: Fundamentals and applications, Ronals M, Atlas, fourth edition, Animprint of Addison Wesley Longman. Inc, California
2. Environmental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi
3. Environmental Science, Physical Principles and applications; Egbert Boeker *et. al.*
4. Comprehensive Biotechnology, vol.4, M.moo-young (Ed-in-chief), Pergmon Press, Oxford.
5. Wastewater Treatment for Pollution Control By Soli J Arceivala, Second Edition, Tata McGraw- Hill Publishing Company Limited.
6. Environmental Biotechnology Theory and Application by Gareth M. Evans and Judith C. Furlong, John Wiley and Sons, LTD, U.S.A.
7. Ecology and Environment by P.D. Sharma, Rastogi Publications, New Delhi, India
8. Environmental Sciences earth as a living planet by Daniel K. Botkin and Edward A. Keller, Third edition, John Wiley and Sons, LTD, U.S.A.

MB: 305 Lab course V (Core) (MEDICAL AND PHARMACEUTICAL MICROBIOLOGY & FERMENTATION AND MICROBIAL TECHNOLGOY)

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.
2. To perform various biochemical tests (IMVIC, oxidase, catalase, urea utilization test, sugar utilization and H_2S production on TSI agar slant) used for identification of medically important bacteria.
3. To perform sugar fermentation tests used for identification of medically important bacteria.
4. Preparation of transport media for different clinical samples.
5. Demonstration normal microbial flora of skin, mouth and throat
6. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
7. Isolation and identification of *Staphylococcal* species using suitable media, staining techniques and biochemical tests.
8. Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (*E. coli, Proteus, Pseudomonas, , Klebsiella*)
9. Isolation and identification of enteric fever causing bacteria (*Salmonella typhi*) using suitable media and biochemical tests.
10. Isolation and identification of *Bacillus* species using suitable media, staining techniques and biochemical tests.
11. Microbiological analysis of urine specimens.
12. Microbiological analysis of sputum specimens
13. Isolation of dermatophytes and their identification based on colony morphology and microscopic characteristics.
14. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
15. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
16. To study antibiotic resistance in bacteria
17. Determination of thermal death point (TDP) of an Organism
18. Determination of thermal death time (TDT) of an Organism
19. Isolation of amylase producing microorganisms from Soil
20. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
21. Isolation of lipase producing microorganisms from butter.
22. To isolate antibiotic producing microorganisms form soil
23. To isolate *Penicillium* species producing penicillin.
24. Production of penicillin and to evaluate it activity.
25. To demonstrate handling and sterilization of Fermenter.
26. Production of wine from grapes.
27. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.

MB: 306 Lab course VI (Elective) (RECOMBINANT DNA TECHNOLOGY & ENVIRONMENTAL MICROBIOLOGY

1. Preparation of LB broth, LB Agar with antibiotic for culture and maintenance of Host *E. coli* and *E. coli* with plasmid vector.
2. Isolation of plasmid DNA (or plasmid vector DNA).
3. Restriction digestion of given DNA with suitable restriction enzymes.
4. Ligation of insert (gene) and vector DNA.
5. Preparation of competent cells.
6. Transformation of host *E. coli* with recombinant DNA and selection of recombinants.
7. To perform PCR for amplification of target DNA segment (or gene).
8. Determination of Total Dissolve Solids (TDS) of given water sample.
9. Determination of chemical oxygen demand (COD) of given water sample.
10. Determination of Dissolved oxygen (DO) of given water sample.
11. Determination of BOD of given water sample.
12. Determination of total bacterial population by standard plate count technique.
13. Determination of the most probable number (MPN) of coliform bacteria in water
14. Microbiological analysis of water by membrane filter method.
15. Microbiological analysis of air for presence of pathogenic microorganisms in air.
16. Microbiological analysis of water for presence of pathogenic microorganisms.

SEMESTER IV (with detailed scheme)

Code	Title of Course	Core / Generic / Centric	T	P	Total Credits	Marks					
						Internal		External		Total	
						Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
MB-401A MB-401B	Agriculture Microbiology Food Microbiology	Generic Elective	3	0	3	40	14	60	21	100	35
MB-402	Lab course VII A Lab Course VII B	Centric/Elective	0	3	3	40	14	60	21	100	35
MB-403	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-404	Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.	AE & SD	1	0	1	100	35	-	-	100	35
MB-405	Project Work	Core	0	12	12			100	40	100	40
MB-406	Comprehensive Viva Voce	Core	-	-	4			100	35	100	35

Total Credit Value: # 24 (20 + 4 virtual credits)

***AE & SD- Ability Enhancement and Skill development.**

MB: 401 A (Generic Elective) AGRICULTURE MICROBIOLOGY

Outcomes of paper MB 401 A

- *Provides knowledge to identify and characterize microorganisms, their interactions (antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism) that affect the sustainable agricultural practices.*
- *Students will be aware of various plant diseases (Bacterial, viral and fungal) and knowledge about more advanced bio-pesticides for the controlling of plant diseases to prevent harmful impact of chemical pesticides.*
- *Agriculture microbiology provides learning opportunities to critically evaluate research methodology and findings.*
- *Study of various biogeochemical cycles to understand the balance of different component of soil like carbon, nitrogen and sulphur.*
- *Provides the knowledge regarding biofertizers and utilization of microbes in reclamation of wetlands.*

UNIT I

1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.
4. Nutrient cycle: Carbon cycle, nitrogen cycle, phosphorous cycle and sulphur cycle.

UNIT II

1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.
3. Bacterial diseases of plants : Citrus canker, blight of rice
4. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady's finger

UNIT III

1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests: *Bacillus thuringiensis* as bacterial insecticide
3. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)
4. Fungal control of insect pests: Entomopathogenic fungi : *Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni*

UNIT IV

1. Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects.
2. Mycotoxins and their effect on human being.
3. General idea about quarantine.
4. Production of biogas and alcohol from agricultural wastes.

UNIT V

1. Bio fertilizer: Types, production and application.
2. Mycorrhizae: Types and their application in agriculture and forestry.
3. Vermicomposting.
4. Reclamation of waste agricultural land by microorganisms.

Reference Books

1. Soil Microbiology by Prof. N.S. Subba Rao, Fourth edition, Oxford and IBH Publishing CO. PVT., LTD., New Delhi
2. Introduction to soil microbiology. Alexander M. (1977) John Wiley & Sons, Inc., New York.
3. Modern Soil Microbiology, Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Marcel Dekker INC, New York.

MB: 401 B (Generic Elective) FOOD MICROBIOLOGY

Outcomes of paper MB -401 B

- *Conceptual study of different microorganisms in food industry for the food preservation by using different techniques.*
- *To provide the knowledge about food born disease and their causal infections like food poisoning and spoilage of food.*
- *Food industry now brought a revolutionary change in quality of commercial food products.*
- *Spoilage of food products like egg, fish, meat and milk is an another problem that can be resolve by concerning knowledge of food microbiology*

UNIT I

1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and dessication.
3. Chemical preservatives and additives.
4. Preservation by radiation.

UNIT II

1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

UNIT III

1. Classification of food borne diseases.
2. Food borne infections: *Brucella, Bacilllus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella* spp.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (*Clostridium Botulinum*).
4. Food adulteration and prevailing food standards in India.

UNIT IV

1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms: Butter, yoghurt and cheese.

UNIT V

1. Microorganisms as source of food: Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions: Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food: Sample collection, preparation and analysis techniques

Reference Books:

1. Food science By Norman N. Potler, Joseph H. Hotchkiss. Fourth edition, CBS Publishers and Distributors, New Delhi
2. Food Microbiology , by William C. Frazier and Dennis C. Westhoff, Fourth edition, Tata McGraw-Hill Publishing Company Limited, New Delhi
3. Modern Food Microbiology by James M. Jay, Fourth Edition, CBS Publishers and Distributors, New Delhi.

MB: 402- Lab course VII A (Generic Elective)
AGRICULTURE 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.

MB: 402 Lab course VII B (Generic Elective)
FOOD MICROBIOLOGY

1. Detection of adulterants in spices, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products.
3. Detection of arsenic by microbiological methods.
4. Detection of nicotinic acid by bioassay.
5. Detection of number of bacteria in milk by SPC.
6. Determination of quality of milk sample by methylene blue reductase test.
7. To demonstrate role of yeast in bread-making.
8. Isolation of microorganisms from spoiled food.
9. Isolation of pathogenic microorganisms from food.

MB-403: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 404: Assignment/personality development/ Yoga/ Language/ Environment/ Physical Education.

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 405 (Core) Project work: It consists of 3-4 months project work/ Industrial training followed by presentation and Viva-voce of 100 marks. The project work shall be evaluated by both the internal and external examiner at the time of oral presentation

MB 406: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.