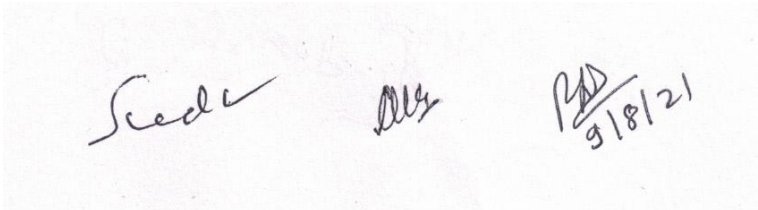
Learning Outcomes based Curriculum Framework (LOCF)
for
M. Sc. Microbiology (For UTD)

Choice Based Credit System (CBCS)
2020-2022

School of Studies in Microbiology
Vikram University, Ujjain (M.P.)



1. Introduction:

Learning Outcome based approach to curriculum planning (LOCF) is a paradigm shift in the higher education and it is based on first identifying the outcomes of the learning required for a particular subject of study, and then planning all components of course so as to achieve the outcomes. The Choice Based Credit System (CBCS) curriculum for M.Sc. Microbiology (For UTD) has now been developed into a new system called Learning Outcome Curriculum Framework (LOCF). It is expected that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology.

The student will have to earn 104 actual credits (valid credits) and 16 virtual credits (total 120 credits) in total four semesters (two year duration). The course will comprise of Lectures (L), Seminars(S), Practicals (P), Library Assignments (LA), Project work (PW) and Comprehensive viva.

The semester will consist of 16-18 weeks of academic work. One credit is equivalent to one hour (60 minutes) of teaching (lecture) or two hours (120 minutes) of S, P, LA, and PW per week in a semester. The credits for the course have been distributed among the courses under Core, Skill development, Generic Elective and Discipline Specific Elective categories. The credits associated with the courses will be valid credits, while credits associated with Comprehensive viva-voce will be virtual credits.

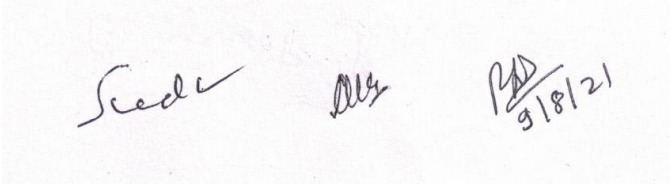
During the semester, a teacher offering the course will do the continuous evaluation of the student at three points of time by conducting three tests of 20 marks each. Of these, two must be written tests and the third may be written test / Quiz/ Seminar/ Assignment for theoretical courses. Marks obtained in two best tests out of three will be awarded to the student. In each course, there shall be End Semester Exam of 60 marks. Each student has to appear in at least two tests and Encl Semester Examination; otherwise, the student will be awarded Ab Grade in that course. Examination and evaluation of the courses will be as per ordinance 14 of the Vikram University.

1. Objectives of the programme:

The aim of the postgraduate degree in Microbiology is to make students familiar about the various basic concepts and skills of Microbiology. The understanding, knowledge and skills of students will be developed through teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills by seminars and group discussions, exposure to industry/ laboratories and interaction with experts in industry, scientists, pathologists, training for writing short reports, review papers and project reports where they will be guided and mentored by the academic and other experts of the subject.

The important qualification descriptors for a PG degree in Microbiology are following:

1. Knowledge of application of microbiology in diverse fields.

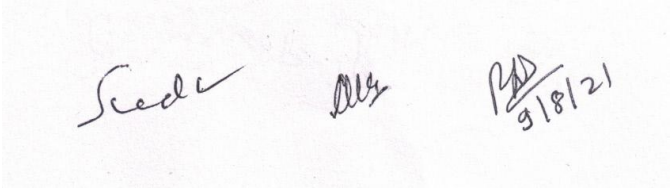


2. Understanding of different types of microbes, their habitats and various Microbiological processes.
3. Developing basic skills of isolating microbes, culturing microbes, maintaining microbes, identifying microbes, determination of microbial contamination in water, food etc., control of microbes, antibiotic susceptibility, safety issues related to handling of microbes, Good Microbiological practices etc.
4. Generation of new knowledge through small research projects
5. Ability to participate in team work through small microbiology projects, field trips, surveys and laboratory visits.
6. Analysis of data collected through study and small projects.
7. Ability to present and articulate their knowledge of Microbiology through seminars, poster presentations, group discussion and review writing.
8. Knowledge of recent developments in the area of Microbiology.
9. Awareness how some microbiology leads may be developed into enterprise.

1. Programme Learning Outcomes:

A candidate who has acquired a PG degree in Microbiology needs to have acquired/developed following competencies during the programme of the study:
1. Student has acquired knowledge and understanding of the microbiology concepts and their application in diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2. Student has acquired basic practical skills/competencies in working with microbes, their isolation, identification, use in the laboratory as well as outside, including the use of good microbiological practices.
3. Student has become competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake higher studies etc.
4. Student has developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career.

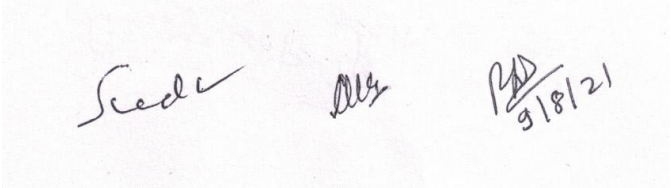
The details of the course are given below:



Semester I

S.No.	Course code	Title of course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	MB 101	General Microbiology and Microbial Diversity	Core	40	60	100	5
2	MB 102	Microbial Genetics	Core	40	60	100	5
3	MB 103	Biochemistry and Microbial Physiology	Core	40	60	100	5
4 5	MB 104 or MB 105	Biological Tools and Techniqes. or Computer in Biology & Biostatistics	Generic elective *	40	60	100	5
6	ED	Enterprenurship Development	Skill development course**	30	50	80	4
7	MB 106	Practical-I (Laboratory Skill Development/ Survey)	Core	15	25	40	2
8	MB 107	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total				600[$]	30

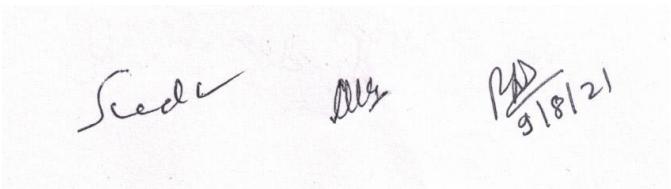
*Any 01out of 02 Generic Elective can be opted by the students.
** Common course offered by the University.
[$] One credit is equal to 20 marks.



Semester II

S.No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	MB 201	Bacteria and Cyanobacteria	Core	40	60	100	5
2	MB 202	Medical Microbiology and Virology	Core	40	60	100	5
3	MB 203	Molecular Biology	Core	40	60	100	5
4 5	MB 204 MB 205	Microbial Technology or Advances in Virology	Discipline specific elective*	40	60	100	5
6	CS	Communication Skills	Skill development course**	30	50	80	4
7	MB 206	Practical-II (Laboratory Skill Development/ Field work)	Core	15	25	40	2
8	MB 207	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total				600[$]	30

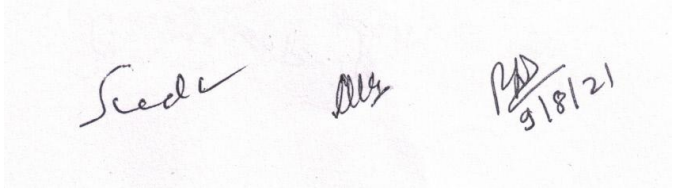
*Any 01out of 02 Discipline specific Elective can be opted by the students.
** Common course offered by the University.
[$] One credit is equal to 20 marks.



Semester III

S.No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks	University Examination Marks	Total Marks	Credits
1	MB 301	Food and Industrial Microbiology	Core	40	60	100	5
2	MB 302	Immunology	Core	40	60	100	5
3	MB 303	Yeast and Fungi	Core	40	60	100	5
4 5	MB 304 MB 305	Environmental Microbiology or Plant Pathology	Discipline specific elective*	40	60	100	5
6	PD	Personality Develpoment	Skill development course**	30	50	80	4
7	MB 306	Practical-III (Laboratory Skill Development/ Minor project)	Core	15	25	40	2
8	MB 307	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total				600[$]	30

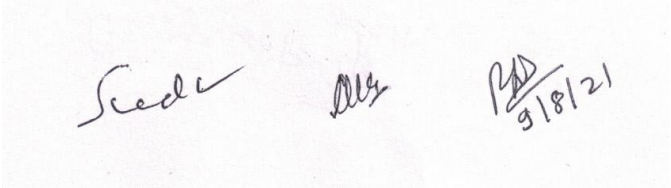
*Any 01out of 02 Discipline specific Elective can be opted by the students. This course can be opted by any student of University.
** Common course offered by the University.
[$] One credit is equal to 20 marks.



Semester IV

S. No.	Course code	Title of Course	Course type	Marks			
				Internal Examination Marks (40%)	**University Examination Marks (60%)**	**Total Marks**	**Credits**
1	MB 401	Project Work/ On site training 1. Project work and presentation 2. Project report assessment and Viva-voce	Core	 100 -	 - 140	240	12
2	MB 402 MOOC	Industrial visit/ Scientific or Pathology Lab visit/ Minor Project/ Case study or An equivalent MOOC	Core	30 (Report)	50 (Viva-voce)	80	4
3	MB 403	Review writing	Core	30 (Report)	50 (Viva-voce)	80	4
4	MB 404	Seminar/ Group discussion	Core	25 (Write up)	35 (Presentation)	60	3
5	MB 405	Poster Presentation	Core	25 (Write up)	35 (Presentation)	60	3
6	MB 406	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total				600[$]	30

[$] One credit is equal to 20 marks.



Semester- I
MB 101: General Microbiology and Microbial Diversity (core)
Credits: 5

Course Objectives: The objective of this course is to give the students basic idea about world of microorganisms, historical developments and major mile stones in the field of microbiology. The students will also learn about diversity of microorganisms, their classification and microscopic techniques for study of microorganisms.

Course Learning Outcomes: Upon successful completion of the course, the student –

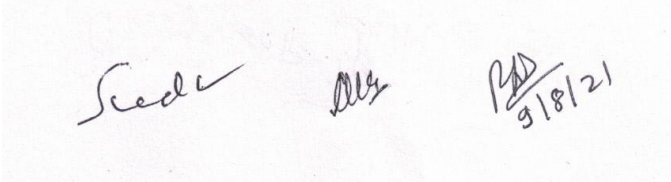
Outcome 1. Has gained knowledge about history, classification and taxonomy of microorganisms.
Outcome 2. Has understood the types of culture media, various methods for isolation and cultivation of Microorganisms.
Outcome 3. Is acquainted with different types of microscopy and staining techniques for study of microorganism.
Outcome 4. Learned various methods for preservation and maintenance of Microorganisms.
Outcome 5. Has developed a very good understanding of the characteristics of different types of microorganisms.

UNIT 1
1.1 History and Scope of Microbiology
1.2 Classification of microorganisms: Concept of three domain of life
1.3 Whittaker Five Kingdom Concept, Bergey's Manual of Systematic Bacteriology.
1.4 Nomenclature and taxonomy: Phenetic, Numerical and Molecular taxonomy.

UNIT 2
2.1 Nutrition of Microorganisms**:** Basic Nutrient Requirements, Nutritional Types of Microorganisms
2.2 Culture Media, Types of Media, Synthetic or Defined Media, Complex Media,
2.3 Cultivation of Microorganisms: Aerobic and anaerobic, Spread Plate, Streak Plate and Pour Plate
2.4 Isolation of Pure Cultures, Colony Morphology and Growth Characteristics.

UNIT 3
3.1 Staining: Simple Staining, Differential Staining ,Capsule, Flagella and Spore staining
3.2 Microscopy: Light Microscope, Bright-Field Microscope, Dark-Field Microscope
3.3 Electron Microscopy, Scanning Electron Microscope
3.4 Motility test, Biochemical test, Pathogenicity test.

UNIT 4
4.1 Preservation and maintenance of Microorganisms.
4.2 Control of Microorganisms by Physical and Chemical Methods
4.3 Microbial diversity of Archaebacteria: Characteristic features and importance.
4.4 Microbial diversity of Eubacteria: Characteristic features and importance .



UNIT 5

5.1 General characteristics and Morphology of Actinomycetes, Spirochetes, Chlamydia, Rickettsia and Mycoplasma

5.2 General characteristics and Morphology of Actinomycetes, Spirochetes, Chlamydia, Rickettsia and Mycoplasma

5.3 Mycology: General characteristics, Classification and Morphology,

5.4 Virology: General characteristics, Classification and structure

Reference Books

1 Text book of Microbiology By Ananthanarayan. R. and C. K .J. Paniker.

2 Microbiology by Prescott, Harley and Klein, The Mc Graw Hill companies Inc. , New York

3 Brock Biology of Microorganisms. By Medigan, M.T., Martinko, J., M . and Parker, J. Pearson Education Inc., New York

4 Bergey's Mannual of Determinative Bacteriology (8 Edition) Buchanan, R.E. and Gibboson , N.E., Williams and Wilkinson company, Baltimore.

5. The Microbial World By Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. ,Printice-Hall of India (Pvt.) Ltd., New Delhi.

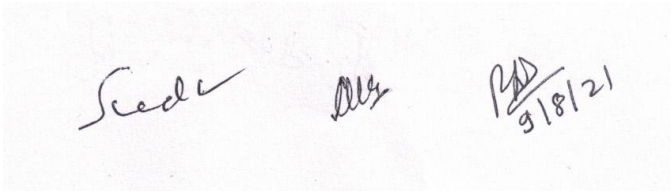
6. Microbiology By Pelczar M., Chan E.C.S. and Krieg, N.R. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.

7. Microbial Diversity. Academic Press byColwd, D.

8. Microbial life in extreme environment By Kushner D.J.

9. An Introduction to Mycology by Mehrotra, R.S. and K.R.Aneja, New Age International Press, New Delhi.

10. Webster, J. 1985. Introduction to fungi . Cambridge University Press. Cambridge, U.K.



Semester- I
MB 102: Microbial Genetics (core)
Credits: 5

Course objectives: The purpose of this course is to introduce the student about history of genetics. Student will gain an understanding of mechanisms of DNA replication, DNA repair, Mutation, Mutagensis, Transposons, and Genetic recombination.

Course learning outcomes: Upon successful completion of the course, the student-

Outcome 1. Has gained knowledge about historical developmets in gentics , the structure of nucliec acid , and plasmids.
Outcome 2. Understood the mechanisms of DNA replication and DNA repair.
Outcome 3. Has gained knowledge about different types of mutations and mutagenesis.
Outcome 4. Has learned about spontaneous mutatuions and random and non adaptive nature of mutatuions, transposable elements and genetic recombination.
Outcome 5. Has acquired knowledge about conjugation, transformation, genetic mapping and phage genetics.

UNIT 1

1.1 Brief history of Genetics.
1.2 Nucleic acids as carriers of genetic information, Experimental evidences.
1.3 Components of nucleic acids, Double helix, Alternate forms, Denaturation and melting curves, Superhelicity in DNA.
1.4 Plasmids : Types, Transfer and replication in bacteria

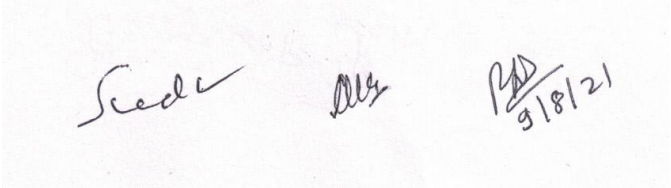
UNIT 2

2.1 DNA Replication : General principles, Various modes of replication (Theta model and rolling circle model).
2.2 Properties of DNA polymerases, Proof reading, Continuous and discontinuous synthesis of DNA.
2.3 DNA repair : Various repair systems of DNA and their mechanisms. ,.

UNIT 3

3.1 Absolute and conditional mutants : Types of Mutation and uses of mutation.
3.2 Mutagenesis : Physical and Chemical mutagens, Base analogue mutagens, Mutagenesis by intercalating substances, Biochemical basis of mutation.
3.3 Isolation of mutants, Replica plating.
3.4 Revertant and reversion.: Second site revertants, Reversion as a means of detection of mutagens and carcinogens (Aims test).

UNIT 4



4.1 Suppression : Supressor mutations.
4.2 Spontaneous mutation: The random and non adaptive nature of mutations (fluctation test), Origin of spontaneous mutants.

4.3 Transposable elements: Insertion sequences, Types of bacterial transposons, Excision of transposons, Genetic phenomenon mediated by transposons in bacteria, Transposons and evolution.
4.4 Genetic recombination, Complementation and complementation analysis..

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UNIT 5

5.1 Bacterial Conjugation: F insertion in *E.coli* chromosomes, Hfr transfer, Recombination mapping.
5.2 Bacterial Transformation: Its discovery, Mechanism and mapping by transformation,.
5.3 Phage Genetics : Phage mutants, Genetic recombination in phages, Fine structure mapping of T4 rII locus. Deletion mapping,

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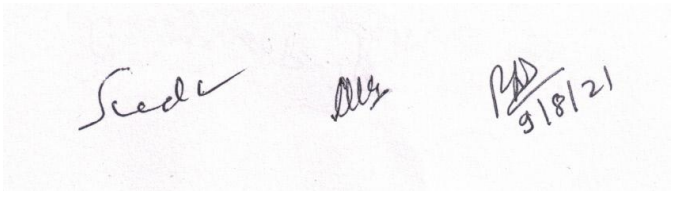
Reference Books

1. Neidhardt et.al. (1996). Cellular and Molecular Biology, II Ed., ASM press.
2. Lodish, Berk, Zippursky.Matsudaira, Baltimore, Darnell, (2000). Molecular Cell Biology IV Ed., W.H. Freeman.
3. Stryer, L. (2001). Biochemistry, V Ed. W.H. Freeman.
4. Nelson, D.L.,Cox, M.M. (2000). Lehringer- Principles of Biochemistry. III Ed. McMillan.
5. Murray, R.K., Granner, D.K., Maps, P.K. and Rodwell,V.C. (1998). Harper's Biochemistry. XXIV Ed., Prentice Hall International Inc.
6. Lewine, B. (2000). Gene VII, Oxford University Press.
7. Watson, J.M., Hopkins, N.H., Robert , J.W., Stietz,J.A.and Weiner, A.M. (1987). Molecular Biology of Gene. IV Ed. Benjamin and Cumming Pub. Inc. Comp.
8. Freifelder, D. (1995). Molecular Biology. Narosa Publishing House, New Delhi.
9. Fairbanks, D.J. and Andersen, W.R. (1999). Genetics- the Continuity of Life. Brooks/Cole Publishing Company, New York.
10. Brown ,T.A. 1999. Genome. IV.ed. John Wiley and Sons (Asia).
11. Brown, T.A., (2001). Gene Cloning and DNA Analysis. IV Ed. Blackwell Science.
12. Klug, W.S. and Cummings, M.K. (2000) Concenpt of genetics. VII Ed., Pearson Education, New Delhi.



Semester – I
MB 103 Biochemistry and Microbial Physiology (core)
Credits: 5

Course Objective: The objective of this course is to give students basic idea about different types of biomolecules and biochemical process.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Has developed a very good understanding of various biomolecules which are required for development and functioning of a bacterial cell. The student has learned the principles of thermodynamics.
Outcome 2. Has learnt the basic concepts of enzyme biochemistry including enzyme kinetics, and has become aware of different variants of enzymes found in living cells.
Outcome 3. Has understood the variety of pathways used by bacteria for energy generation and conservation.
Outcome 4. Become conversant with the structure and properties of amino acids, formation of polypeptides and protein folding.
Outcome 5. Acquired knowledge of physiology of nitrogen fixation and assimilation of inorganic nitrogen by bacteria.

UNIT -1

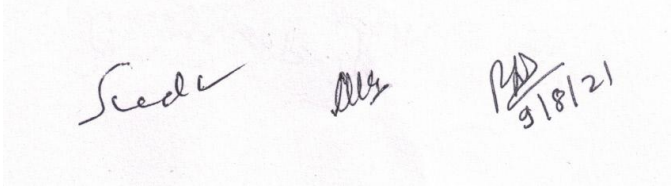
1.1 Biomolecules : Introduction
1.2 Water, pH and buffers: Water structure and interactions, dissociation of water, and its ionic product, Kw. Water as a solvent. Hydrophobic, hydrophilic and amphiphilic substances. Acid –Base reactions, Bronsted acids, pH, the Handerson Hasselbach equation.
1.3 Bioenergetics: Laws of thermodynamics, Gibb's Free energy, Standard free energy and Energy rich compounds.
1.4 Amino acids, peptides, degradation of proteins

UNIT -2

2.1 Proteins: Covalent structure, functions and three dimensional structure of proteins. Protein purification and sequencing techniques
2.2 Enzymes: Classification, Specificity, Active site and activity units, Isozymes, Enzymes kinetics, Michaelis- Menton equilibrium for simple enzymes, Enzyme inhibition, Allosteric enzymes.
2.3 Lipids : Lipids: Classification. Biosynthesis and degradation of Fats and Fatty acids..

UNIT -3

3.1 Structural feature of biomembranes and Transport.
3.2 Carbohydrates: Classification of carbohydrates, Monosaccharides: configuration and conformation, Fischer and Haworth projection formulae. Disaccharides: lactose, maltose, and sucrose. Polysaccharides: structural and storage.



3.3 Respiratory Metabolism: Glycolysis, Pentose phosphate pathway, Entner Doudoroff pathway, Glyoxalate pathway, TCA cycle, Electron transport system, Oxidative and substrate level phosphorylation.

UNIT -4

4.1 Photosynthesis and Pigments: Chlorophyll, Bacteriochlorophyll, Rhodopsin, Carotenoides, Phycobilins; Photoautotrophy, Oxygenic and Anoxigenic photosynthesis, ATP generation,

4.2 CO_2 fixation, C_3 –C_4 pathways and CAM pathways

4.3 Vitamins and their role as coenzymes.

UNIT –5

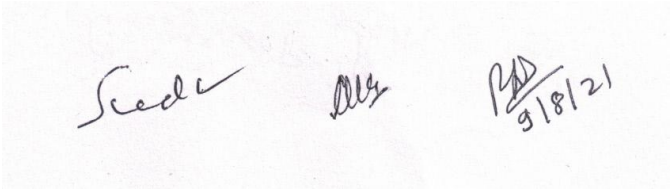
5.1 Types of Fermentation: Homolactic and Heterolactic fermentation, etc. Pasteur Effect

5.2 Nitrogen fixation and assimilation of Nitrogen. Biosynthesis and degradation of Nucleotides.

5.3 Chemoautotrophy: Bacteria oxidizing ammonia, sulphur, iron, hydrogen and CO. Methanogenesis, Luminescent bacteria

Reference Books

1. Burn, Y.V. and Shimket, L.J. (2000) Prokaryote Development, ASM Press.
2. Caldwell, D.R. (1995) Microbial Physiology and Metabolism, Brown Publishers.
3. Gottschalk, G. (1986) Bacterial Mrtabolism, II Ed. Springer Verlog.
4. Madigan, M.T., Martinko, J.M. and Parker, J. (2000) Brock Biology of Microorganisms, 9th Ed. Prentice Hall International Inc.
5. Moat, A.G. and Foster, J.W. (1999) Microbial Physiology, John Wiley and Sons.
6. Stanier, R.Y. Ingrahm, J.L., Wheelis, M.L. and Painter, P.R. (1986) General Microbiology 5th Ed., McMillan Press Ltd.
7. Stryer, L. (2001) Biochemistry. Freeman.
8. Nelson, D.L. and Coax, M.m. (2000). Lehlingers – Priniciples of Biochemistry III Ed. MacMillan Worth Publishers.
9. Honlon, H.R., Moran, L.A., Ochs, Raymoas, Rawn, J.D. and Scimgeour K.G. (1996).Principles of Biochemistry II Ed. Prentice Hall, International Inc.
10. Muiray, P.K., Granne, D.K., Mayes, P.A. and Rodwell, V.W. (1996). Harper's Biochemistry XXIV Ed. Prentice Hall, International Inc..



Semester – I
MB 104: Biological Tools and Techniques. (Generic elective)
Credits: 5

Course Objectives: The objctive of this course is to give the students basic idea about different instruments and techniques used in a biological sccience laboratory for research.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Has developed understanding of principals, and applications of electrophoretic and spectrophotometric methods.
Outcome 2. Has developed understanding of principals, and applications of different separation techniques especially chromatographic, and centrifugation techniques.
Outcome 3. Has learnt about various techniques used for enzyme purification and assay. Has understood the nature and uses of Radioisotope.
Outcome 4. Has developed basic concepts of statistics and their importance.
Outcome 5. Developed skills to use computers for analysis of biological data and is acquainted with Genomics, Proteomics and Nanotechnology.

UNIT 1

1.1 Spectroscopy: Electromagnetic spectrum, Beer Lambert's Law. UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR CD, and NMR spectroscopy, Mass spectroscopy, Fluorescent spectroscopy, Applications of different spectroscopic techniques.

1.2 Electrophoresis: Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis and Electrofocussing.

UNIT 2

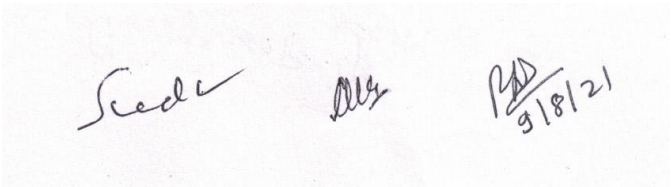
2.1 Centrifugation Techniques: Principles, type of centrifuges, density gradient centrifugation, Ultracentrifugation, Preparative and Analytical centrifugation, Applications of Centrifugation techniques .

2.2 Separation methods: Principles and applications of gel-filtration, ion-exchange and affinity chromatography, Thin layer and gas Chromatography, High pressure liquid (HPLC) chromatography

UNIT 3

3.1 Enzyme purification and assay techniques.

3.2 Radioisotopes: Nature of radioactivity, Types of radioactivity, Radioactive decay, Units of radioactivity, Detection and measurement of radioactivity, Geiger counters, Scintillation counters, autoradiography, Biochemical uses of isotopes (tracers, radio immunoassay).



UNIT 4

4.1 Biostatistics : Introduction to biostatistics, Measures of central tendencies –Mean, Median and Mode, Measures of Dispersion-Range, Standard Deviation, Standard Error and Variance, Test of significance, t-Test, *F*-Test, Chi- Square Test, Probability-Definition, types of probability.

UNIT 5

5.1 Genome Projects, Genomics and Proteomics, Nanotechnology.

5.2 Computer : Introduction, Hardware and Software , Major Components- CPU, Internal Components, Memory, Computer Peripherals, Operating systems: Windows, Application of computer and Internet in Biology.

Reference Books

1. John G. Webster (2004) Bioinstrumentation, Student Edition. John Wiley & Sons Ltd.
2. Keith Wilson & John Walker (2003) Practical Biochemistry Principles and Techniques. 5th Edition, Cambridge University Press.
3. Asokan P (2001) Analytical Biochemistry (Biochemical Techniques). 1st Edition. 2nd Reprint. Published by Chinna Publications. Melvisharam. Vellore, Tamil Nadu.
4. Palanivelu P. (2001). Analytical Biochemistry and Separation Techniques. A Laboratory Manual 2nd Edition. Published by Tulsi Book Centre, Madurai,Tamil Nadu.
5. Wilson K. and Goulding K, A Biologist's Guide to Principles and Techniques of Practical Biochemistry, English Language Book Society.
6. An Introduction to Practical Biochemistry: Plummer D. T.
7. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K.H
8. Microbiology, by Prescott, Hailey and Klein. Wm.C Brown Publishers.
9. Suedecor, GW and Cochram, WG (1968) 'Statistical methods' Oxford & IBH, Delhi.
10. White, R. (2000). How Computer Works. Techmedia.

Semester I
MB 105: Computer in Biology & Biostatistic (Generic elective)
Credits: 6

Course Objective: The course will enable the students to understand basic concepts and aspects related to research, data collection, analyses and interpretation. To develop an understanding and knowledge of the basic Computer and Information Technology**.**

Course Learning Outcomes: Upon successful completion of the course, the student-

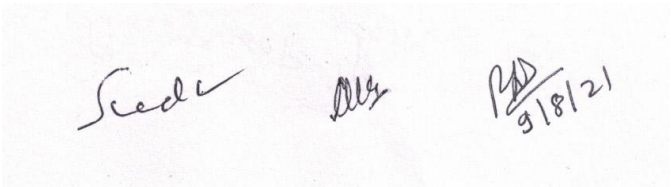
Outcome 1. Has understood the structure of Data Communications System and its components.
Outcome 2. Become familiar with different network terminologies.
Outcome 3. Has acquired knowledge of Statistics and its scope and importance. Knowledge of various types of data, their organisation and evaluation of summary measures such as measures of central tendency and dispersion etc.
Outcome 4. Has gained knowledge about Binomial, Poisson and Normal distributions basic knowledge of sample, and sampling distribution.
Outcome 5. Has gained knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.

UNIT 1
1.1 Computer Basics: Operating Systems, Windows and Unix. Hardware, Software, Disc operating system.
1.2 Multimedia network concept.

UNIT 2
2.1 How the Internet work, Local area network.
2.3 Wide area network HTML & XML concepts.

UNIT 3
3.1 Nature and Scope of Statistical Methods and Their Limitations, Compilation, Classification, Tabulation and Applications in Life sciences- graphical representation,
3.2 Mean, median and mode
4.2 Measures of dispersion**:** Range, mean deviation, standard deviation, variance mean square deviation , coefficient of variation,

UNIT 4
4.1 Introduction to probability theory and distributions (concept without derivations) binomial, Poisson and normal (only definition and problem).
4.2 Concepts of sampling and sampling distribution- tests of significance based on t, chi-square and F for means.

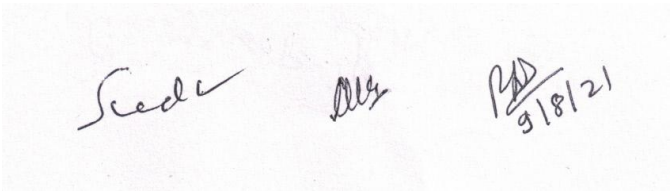


UNIT 5

5.1 Correlation and regression.
5.2 Theory of Attributes and Tests of Independence of Contingency Tables.
5.3 Applications of computers in biostatistical problems

Reference Books

1. Bliss, C.I.K. (1967). Statistics in Biology, Vol.1 Mc Graw Hill, New York.
2. Campbell, R.C. (1974). Statistics for Biologists, Cambridge University Press, Cambridge.
3. Gralla, P. (2000). How Internet Works. Techmedia.
4. Hewitt, W. (1977). Microbiological Assay. Academic Press, New York.
5. White, R. (2000). How Computer Works. Techmedia.



Semester- II
CORE THEORY COURSES

MB 201: Bacteria and Cyanobacteria (core)
Credit: 6

Course Objective: The main objective of this course is to provide in-depth knowledge of bacterial cell structure, bacterial diversityand its significance**.**

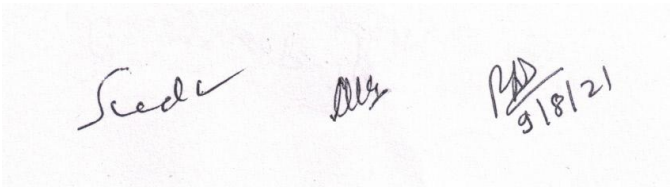
Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Has get acquainted with microbial evolution and basic concept about Bergey's Manual of Systematic Bacteriology.
Outcome 2. Has gained knowledge about characteristics and classification of Cyanobacteria and Prochlorophytes, Mycoplasmaand Photosynthetic Eubacteria.
Outcome 3. Has learnt about Chemolithothrophs and MethophylesAerobic and Enteric Eubacteria.
Outcome 4. Can enlist the salient feature of Gram-negative Anaerobic Eubacteria ,Spirochetes, Rickettsias and Chlamydias.
Outcome 5. Has gained the knowledge of various groups of bacteria with their significance.

UNIT 1
1.1 Microbial Evolution : Evolution of Earth and Early Life Forms, Measure of Evolution, Three Domain of Life Systems.
1.2 Bergey's Manual of Systematic Bacteriology : Basic concept.
1.3 Archaea : General characteristics, Classification and important genera.

UNIT 2
2.1 Cyanobacteria and Prochlorophytes : General characteristics, Classification, Photosynthesis (oxygenic and anoxygenic) , Heterocyst and Nitrogen fixation, General account of Prochlorophytes.
2.2 Mycoplasma and Planctomyces : General characteristics, Classification. Comparative features between Mycoplasma and Bacteria.
2.3 Photosynthetic Eubacteria : General characteristics, Classification, purple bacteria and green bacteria.

UNIT 3
3.1 Chemolithothrophs and Methophyles : General account
3.2 Gram-negative Aerobic Eubacteria : Classification and characteristics of Pseudomonads, Azotobacters, Rhizobia, Prosthecate bacteria, Sheathed bacteria. Spirilla, *Campylobacter*, *Bdellovibrio,* Gliding-Myxobacteria, Cytophaga group.



3.3 Enteric Group and Related Eubacteria : Classification and general account of Vibrios, Photobacteria.

UNIT 4

4.1 Gram-negative Anaerobic Eubacteria : Classification and general account of Bacteroides, Sulphur-reducing bacteria.

4.2 Spirochetes, Rickettsias and Chlamydias : Classification and general account

4.3 Gram-positive Endospore Forming Bacteria : Classification, spores, general account of *Bacilli*, *Clostridia*, *Desulfotomaculum*.

UNIT 5

5.1 Gram-positive Nonsporulating Eubacteria : Classification and general account of Staphylococci, Streptococci, Lactobacilli, Micrococci, Deinococci, Thermus, Corynebacteria, Propionibacteria, Arthrobacters, Mycobacteria.

5.2 Actinomycetes : Classification, Morphology, Reproduction, Biological importance of actinomyces.

5.3 General account of Nocardioform, Dermatophilus group, Streptomyces, Actinoplanales.

Reference Books

1. Pelzar, M.J.Jr., Chen E.C.S. and M.R.Kreig (1986). Microbiology V ed. Mcgraw Tata Hill Book Company, New Delhi.

2. Stanier, R.Y., Ingram, J.L., Wheelis, M.L. and P.R. Painter 1986. General Microbiology V Ed. McMillan Press Ltd., London.

3. Trainor,F.R. (1978). Introductory Phycology, John Wiley and Sons, New York.

4. Fogg, G.E., Stewart, W.D.P., Fay, P. and E.A. Walsly. (1973). The Blue-Green Algae. Audemic Press, London.

5. Madigan, M.T., Martinko, J.M. and Parker, J. (2000). Brock Biology of Microorganisms, IX Ed., Prentice Hall, International Inc.

6. Maniloff, J. (ed.) (1992). Mycoplasmas : Molecular Biology and Pathogenesis. American Soc. Microbiol. Washington D.C.

7. Davis, B.D., Dulbecco, R., Eisen, H.N. and H.S. Ginsberg. (1980). Microbiolgy IV Ed. Harper and Row Publishers, Singapore.

Semester II
MB 202: Medical Microbiology and Virology (core)
Credit:6

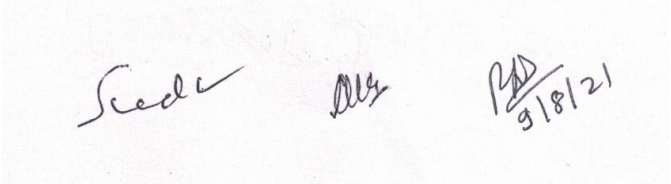
Course Objective: The course will enable the students to understand the basic and general concepts of causation of disease by the pathogenic microorganisms and the various parameters of assessment of their severity including the broad categorization of the methods of diagnosis. The students will also gain knowladge about history, general characters of viruses and how viruses are classified on basis of architecture and genetic material.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1.Gained the knowledge of most common medically important organism and the infections they cause.
Outcome 2. Acquired the knowledge of different approaches, techniques and tools used to identify pathogens and diagnostic approaches for microbial pathogens.
Outcome 3. Is able to describe classification of viruses, replication of viruses.
Outcome 4. Is able to describe steps in virus infection, transmission, patterns of infection, virus virulence, and host defense against virus infection.
Outcome 5. Is able to describe unusual infectious agents, virus mediated cellular transformation and Oncogenesis.

UNIT-1
1.1 Infection: Type of infection, Source of infection , Factors which influence the transmission and spread of infection, Epidemiology , Nosocomial infection.
1.2 Mechanisms of Pathogenesis, Virulence factors, Normal microflora of human body
1.3 Epidemiology, pathogenicity, diagnosis & Control of important bacterial diseases: Tuberculosis, Anthrax, Typhoid, Diptheria, Leprosy.
1.4 Diseases caused by Rickettsia & Chlamydia, Drug resistance in bacteria
UNIT- 2
2.1 Mycoses, Casual organisms, Pathogenesis and diagnosis of the fungal diseases: Aspergillosis, Cryptococcosis, Histoplasmosis, Candidiasis
2.2 Kerationophilic Fungi, Dermatophytes- *Microsprum, Trichophyton* and *Epidermatophyton* , Ring worm disease (Tinea disease).
2.3 Casual organisms, pathogenicity and diagnosis of the protozoan disease- Giardiasis, Amebiasis, Malaria.
2.4 Diagnosis of microbial infection: collection of clinical samples, cultivation of microorganisms, staining, Motility test, Biochemical test, Pathogenecity test.

UNIT-3
3.1 Structure, morphology, Classification and nomenclature of animal viruses, Measurement of viruses.



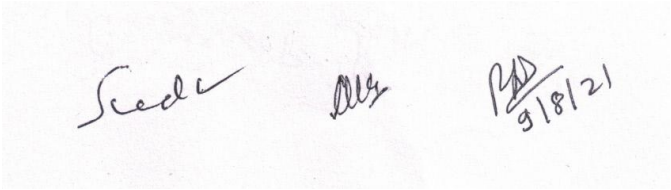
3.2 Replication of Viruses (Lysogenic and Lytic), Morphology, pathogenesis, diagnosis and Prevention of Pox viruses , Herpes Simplex virus, Picorna Viruses
3.3 Morphology, pathogenesis and diagnosis of Paramyxo virus, Hepatitis viruses
3.4 Morphology, pathogenesis and diagnosis of Arboviruses, Rhabdo viruses (Rabies virus), Polio virus

UNIT-4
4.1 Pathogenesis and replication, and diagnosis of Oncogenic viruses, HIV viruses
4.2 General account of Viral related agents- Viroids, Virusides, and Prions.
4.3 Serological methods: Agglutination tests, Precipitation tests, Haemagglutinatin test,
4.4 Compliment Fixation test, Antigen-antibody reactions: ELISA, RIA.

UNIT-5
5.1 Cultivation of viruses in animal Inoculation, cell culture and embryonated eggs,
5.2 Purification of viruses.
5.3 Antibiotics, Antibiotic Sensitivity test, Drug resistance in bacteria
5.4 Types of vaccines and their use in diseases control

Reference Books

1. Text book of Microbiology by Ananthanarayan. R. and. Paniker C.K.J Text Book of Medical Microbiology by Chaapra. H.L.
2. Microbiology Including Immunology and Molecular Genetics. III Ed. By Davis.. Dulbecco. Eisen and Ginsberg.
3. Medical Laboratory Manual for Tropical Countries. Vol. II by Cheesbrough, M. and Mccontney practical Medical Microbiology Edited by Coffee, Dugmiol, Fraser and Marmion
4. Mackis and Mccontney practical Medical Microbiology Edited by Coffee, Dugmiol, Fraser and Marmion.
5. Microbiology Including Immunology and Molecular Genetics. III Ed. By Davis.. Dulbecco, Eisen and Ginsberg.



Semester II
MB 203: Molecular Biology (core)
Credit: 6

Course Objective: The purpose of this course is to introduce the student to the advanced concepts in molecular biology. Student will gain an understanding of molecular mechanisms of transcription, translation, and gene regulation in prokaryotic and eukaryotic organisms**.**

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Has learnt about synthesis, maturation and processing of RNA
Outcome 2. Has gained knowledge about genetic code and structure and function of r RNA,tRNA and mRNA.
Outcome 3. Become familiar with various levels of gene regulation in both prokaryotic and eukaryotic organisms.
Outcome 4. Gained knowledge about cell organelles and apoptosis.
Outcome 5. Has acquainted with cell cycle, cell division and signal transduction.

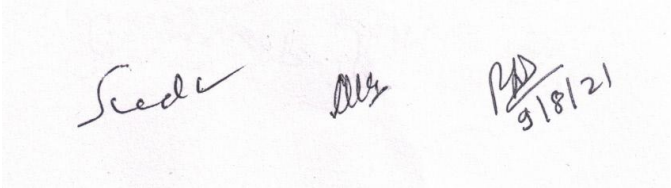
UNIT 1
1.1 Transcription:General principle, Basic apparatus, Types of RNA polymerases. Process of RNA synthesis and Inhibition. Polycistronic and Monocistronic RNAs.
1.2 Maturation and Processing of RNA: Nuclear splicing, Catalytic RNA and RNA editing.

UNIT 2
2.1 Genetic code
2.2 Translation : Stuctural features of RNA (rRNA, tRNA and mRNA) and their relation to function.
2.3 Initiation and elongator classes of tRNA, Ribosome binding site on mRNA and crresponding site on rRNA. Peptidyl transferase activity of 23S rRNA.

UNIT 3
3.1 Protein targeting and degradation.
3.2 Regulation of Gene Expression: Operon concept.
3.3 Lactose operon and tryptophan operon, Regulation by attenuation.

UNIT 4
4.1 Global Regulatory Responses: Heat shock, Stringent response and Regualtion by small molecules such as ppGPP and cAMP.
4.2 Stucture and fuction of cell and cell organelles.
4.3 Apoptosis : Significance and mechanism**.**

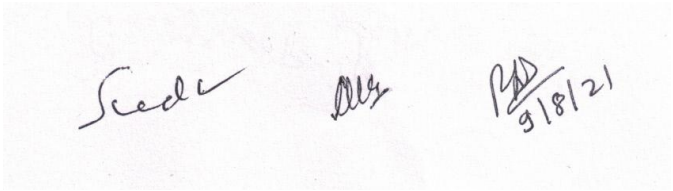
UNIT 5



5.1 Cell Division : Mitosis and Meiosis.
5.2 Cell cycle and its regulation
5.3 Signal transduction**.**

Reference Books

1 Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. (1998). Molecular Biology of the Gene. Benjamin Cummings.
2 Maloy, S.R., Cronan, J.E. and Freifelder, D. (1994). Microbial Genetics IInd ed. Jones & Bartlelt Publication, Bostan, London.
3 Freifelder, D. (1995). Molecular Biology. Narosa Publishing House, New Delhi.
4 Freifelder, D. (1995). Microbial Genetics. Narosa Publishing House, New Delhi.
5 Lewin, B. (1998). Gene VII. Willey Eastern Publication.
6 Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. (1998). Molecular Biology of the Gene. Benjamin Cummings.
7 Fairbanks, D.J. and Andersen, W.R. (1999). Genetics the Continuity of Life Brooks/Cole Publishing Company, New York.
8 Brown ,T.A. 1999. Genome. IV.ed. John Wiley and Sons (Asia).
9 Brown, T.A., (2001). Gene Cloning and DNA Analysis. IV Ed. Blackwell Science.
10 Klug, W.S. and Cummings, M.K. (2000) Concenpt of genetics. VII Ed., Pearson Education, New Delhi.



Semester II
MB 204: Microbial Technology (Discipline specific elective)
Credit: 6

Course Objective: The main objective of this paper is to ensure that the student develops a clear comprehension of the concepts of recombinant DNA technology. The student will get acquainted with the tools and techniques used such as the enzymes, vectors, and cloning methods that can be used, and the applications of cloning such as creation of DNA libraries and recombinant products.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1.Has familiarized with basic cloning tools such as enzymes used to manipulate DNA, and cloning vectors. Will have learnt construction of genomic and cDNA libraries, and whole genome sequencing
Outcome 2. Has gained knowledge about methods of DNA, RNA and protein analyses.
Outcome 3. Become familiar with protein engineering, amplification of any gene by PCR and large production of protein from recombinant microorganism.
Outcome 4. Has familiarized with how manipulated producer microbes and/or procedures may yield products of medical/therapeutic value, hence contributing to human longevity
Outcome 5. Has acquainted with bioinformatics and its relation with molecular biology, genetics and genomics, gained an in-depth knowledge of primary, secondary and composite databases, organization of diverse types of biological databases, concept and significance of sequence alignment and phylogenetic analysis. Have knowledge on patents and property rights.

UNIT 1

1.1 Recombinant DNA Technology: Isolation of chromosomal and plasmid DNA, Restriction Endonucleases, cloning vectors,
1.2 Genetic transformation
1.3 Creating and screening of gene and cDNA library,

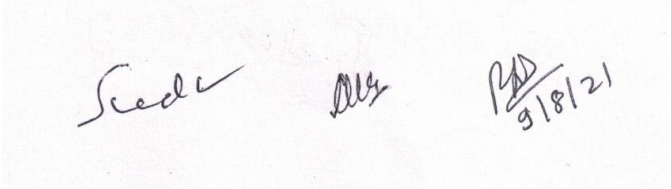
.

UNIT 2

2.1 Manipulation of gene expression in prokaryotes: Role of strong and regulatable promoters, Fusion proteins, Translation expression vectors, Increasing protein stability, Increasing secretion.
2.2 DNA, RNA & Protein blotting
2.3 DNA sequencing techniques**,**

UNIT 3

3.1. Protein engineering
3.2 Chemical synthesis of DNA,



3.3 Polymerase chain reaction : Principle and types
3.4 Large scale production of proteins from recombinant microorganism: Microbial growth kinetics (Batch fermentation, Fed-Batch fermentation, Continuous fermentation), Maximizing the efficiency of the fermentation process.

UNIT 4

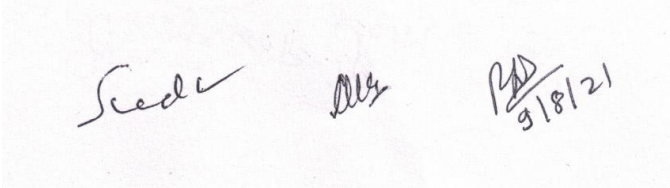
4.1 Bioreactors, Typical large-scale fermentation systems, Harvesting microbial cells, Disrupting microbial cells, Downstream processing.
4.2 Microbial Synthesis of Commercial Products: Human interferons, Human growth harmones, Restriction endonucleases, Microbial synthesis of indigo, Cloning antibiotic biosynthetic genes, Synthesis of novel antibiotics and improving production of antibiotics. Inexpensive xanthan gum production, Microbial synthesis of plant biopolymer.
4.3 Microbial insecticides

UNIT 5

5.1 **,** Patenting biotechnology inventions and IPR. Human gene therapy
5.2 Introduction to bioinformatics: Definition, History and Scope of Bioinformatics. Biological databases: Primary, Secondary and composite databases, Nucleotide Sequence Databases-Genebank, EMBL, DDBJ, Protein sequence databases-SWISSPROT, TrEMBL, PIR, Uni Prot, PROSITE, Structural databases-PDB, MMDB, NDB, SCOP, CATH.
5.3 Sequence Analysis: Sequence alignment, quantitative measures of sequence similarity, methods of sequence alignment. Phylogenetic analysis, Microarray technology, Bioinformatics in drug discovery.

Reference Books :

1. Old & Primrose, 1994. Principles of Gene Manipulation. Blackwell Scientific Publications.
2. Freifelder, D. 1995. Molecular Biology. Narosa Publishing House, New Delhi.
3. Glick BR, Pasternak JJ (1998) Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington DC.
4. Brown, T.A. 2001. Gene Cloning and DNA Analysis, IV Ed. Blackwell Science.
5. Glick BR, Pasternak JJ. (1994) Molecular Biotechnology, ASM Press, Washingon DC.
6. Cynthia Gibas & Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai.
7. H.H. Rashidi & L.K Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.



Semester II
MB 205: Advances in Virology (Discipline specific elective)
Credit: 6

Course Objective: The major objective of this course is to acquaint students with the structure of viruses of plants, animals, and bacteria, their genome organization, and replication strategies within the host cell.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Understood history of viruses, the chemical nature of viruses and technique for isolation of different types ofviruses infecting animals, plants and bacteria (bacteriophages).
Outcome 2. Gained knowledge about the biology of bacteriophages
Outcome 3. Become familiar with diversity and multiplication of lytic and lysogenic bacteriophages.
Outcome 4. Gained knowledge of a variety of plant viruses and animal viruses.
Outcome 5. Has able to describe role of viruses in the causation of the cancer'

UNIT 1

1.1 Brief History of Animal, Plant and Bacterial Viruses. Techniques, Extraction, Chemical methods of Purification including Centrifugation. Electron microscopy.
1.2 Assay of Viruses : Physical and Chemical methods for Animal viruses, Assay of Plant viruses, Plaque method for bacteriophages. Titration : One step growth curve.

UNIT 2

2.1 Host cells for viral cultivation.
2.2 General Properties of Bacteriophages : Architecture and Biochemical nature of various bacteriophages, Outline of multiplication, Basics of lytic cycle and lysogeny.
2.3 Lytic Cycle : Infection, Mechanism and regulation of protein and nucleic acid synthesis, Assembly, Release of particles with respect to DNA phages and RNA phages

UNIT 3

3.1 Lysogeny : Establishment and regulation of lysogeny in lambda phage, Bacterio- phages as transducing agent.
3.2 Animal and Plant Viruses : Architecture, Biochemical nature, Outline of infection, Multiplication and release, Classification of viruses.

UNIT 4

4.1 Animal DNA Viruses : Sturcture, Mechanism of replication of viral nucleic acid, protein synthesis and regulation of viruses with respect to : Papovaviruses (SV40), Adenoviruses, Herpesviruses, Poxviruses, Parvoviruses.
4.2 Hepatitis Viruses : Types, Structure and replication of Hepatitis B virus

UNIT 5

5.1 Tumor virology.

5.2 Animal RNA Viruses : Structure, Biochemical mechanism of replication of viral nucleic acid and protein regulation of viruses with respect to : Polioviruses, Togaviruses, Rhaddoviruses, Reoviruses, Influenza virus, Retroviruses (HIV), TMV, Viroides, Prions.

Reference Books

1.Luria, E.E., Darnell, J.E.Jr., Baltimore, D. and Campbell, A. (1978). General Virology III ed. John Wiley and Sons. New York.

2.Davis, B.D., Dulbecco, R., Eisen, H.N. and H.S. Ginsberg (1980). Microbiology IV Ed. Harper and Row Publisher Singapore.

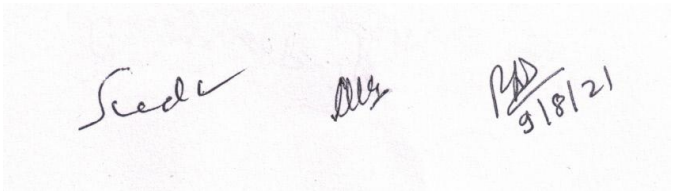
3.King, C.A. (1974). Molecular Virology. Mcgraw Tata Hill Book Company, New Delhi.

4.Gibbs, A. and Harrison, B., (1976). Plant Virology. The Principles. Edward Arnold, Great Britain.

5. Watson, J.D., Hopkin, H.N., Robert, J.W., Sietz, J.A. and A.M. Weiner.(1998). Molecular Biology of Gene. V ed . Benjamin/Cumming Publishing Company Inc, California.

6. Cann, A.J. (2001). Principles of Molecular Viroloogy III Ed. Acedemic Press.

7. Dimmock, N.J., Easton, A.J. and Leppard, K.N. (2001). Introduction to Modern Virology. Blackwell Science.



Semester- III
MB 301: Food and Industrial Microbiology (core)
Credit: 6

Course Objective: The course aims to provide instruction in the general principles of food microbiology, understand food spoilage microorganisms, the microbiology of food preservation and fermented foods.The course will enable students to apply the learning of microbiology concepts toward the exploitation of microbial population for industrial and human benefits.

Course Learning Outcomes: Upon successful completion of the course, the student-

Outcome 1. Understood the principles of microorganisms during various food-processing and preservation steps.
Outcome 2. Gained knowledge about the role of microorganisms in the production of food, its spoilage, including their role in homemade fermented foods.
Outcome 3. Has abled to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens**.**
Outcome 4. Has developed an understanding of different types of reactors or fermenters which are used for laboratory, pilot and industrial scale fermentations and their processes parameters.
Outcome 5. Has acquired knowledge about various industrially relevant microbial products and their production process.

UNIT 1
1.1 Food as substrate for Microorganisms, Factors Influencing Microbial Growth in Food ,
1.2 Principles and mechanism of food spoilage,
1.3 Ffood preservation: Asepsis, Physical methods, Chemical preservation, Radiation Method,
1.4 food additives, Food adulteration, Canning

UNIT 2
2.1 Microbial enzymes used in dairy and food industry, Application of Starter culture and its types
2.3 Fermented Food, Microorganisms Used in Food Fermentation
2.3 Fermented food: Bakery product, Idly, Dosa, Khaman, , Fermented vegetables
2.4 Food borne Infections,Staphylococcal Intoxication, Botulism, Mycotoxicosis, Food poisoning

UNIT 3
3.1 Composition of milk, Microbiology of milk and milk products, Source of microorganisms in milk.
3.2 Preservation of milk and milk products, Pasteurization: Types and methods,
3.3 Microbiological examination of milk: Standard plate count, microscopic count, Reductase test (Methelene blue reduction and Resazurin reduction test)
3.4 Fermented dairy products: Curd, Cheese, Yoghurt, Skimmed milk

UNIT 4

4.1 Isolation of suitable Industrial importance microorganisms from the environment

4.2 Industrial strains and strain improvement, Strain stability,

4.3 Fermentation media, fermenter design, Control and monitoring

4.4 Downstream processing: Cell harvesting, Cell disruption, Product recovery

UNIT 5

5.1 Production of enzymes: Amylase, Protease, Lipases, Production of Vitamins. Production of Antibiotics

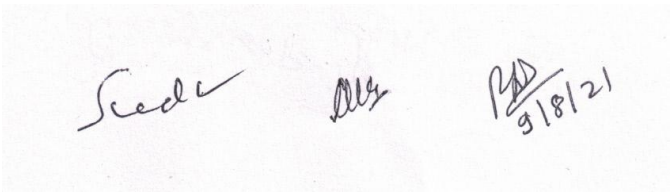
5.2 Production of Alcoholic beverages: beer, wine and whiskey, Production of Vinegar and Cider. Production of organic acids: Acetic acid, citric acid, Lactic acid

5.3 Production of Vaccine, Production of Insulin

5.4 Production of Single Cell Proteins, Mass production of baker's yeast

Reference Books

1. Food microbiology by Frazier and Westhoff.
2. Fundamentals of food microbiology by Fields, M.L.
3. Food Microbiology By Adams M.R. and Moss, M.O. Royal Society of Chemistry Publication, Cambridge.
4. Principles of Fermentation Technology. Stanbury, PF., Whittaker, A and Hall, S.J (1995) 2nd Edition. Pergamon Press.
5. Basic Food Microbiology ByBanwart, GJ (1989) CBS Publishers and Distributors, Delhi.
6. Food poisoning and Food Hygiene By Hobbs BC and Roberts D. Edward Arnold (A division of Hodder and Stoughton) London.
7. Dairy Microbiology ByRobinson R.K. Elsevier Applied Sciences. London.
8. Industrial Microbiology by Casida, L.E.
9. Industrial Microbiology by Patel, A.H.
10. Industrial Microbiology by Prescot and Dunn.
11. Industrial Microbiology by Onions, Allsopp and Eggins.
12. Microbial Enzyme and Biotechnology by Fogarty and Kelly.
13. Comprehensive Biotechnology by Murrag (Ed.). Vol. I
14. Process development of Antibiotics fermentation by Calam, C.T.
15. Biotechnology: A Text Book of Industrial Microbiology ByCrueger and Anneliese Cruger. Panima Publishing Corporation, New Delhi.



Semester III
MB: 302 Immunology (Core)
Credit: 6

Course Objective : The objective of this course is to understand the various components of the host immune system, their structure and organization, and functions to serve as the defense system of the body. It would also make the students understand the operational mechanisms which underlie the host defense system, allergy and organ transplantation**.**

Course Learning Outcomes: Upon successful completion of the course, the student –

Outcome 1. Has gathered information about the structure and organization of various components of the immune system.
Outcome 2. Developed understanding about Immunoglobulins, antigen antibody interactions.
Outcome 3. Has gained knowledge of immune system, cells involved along with complement system and autoimmunity.
Outcome 4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
Outcome 5. Has able to apply the knowledge gained to understand the phenomena like host defense, hypersensitivity (allergy), organ transplantation and certain immunological diseases.

UNIT 1
1.1 Introduction to Immunology : Adaptive and Innate immunity.
1.2 Cells and tissues and organs of immune system, Lymphocyte traffic.
1.3 Antigens, Antigen processing and presentation.

UNIT 2
2.1 Inflammation : Components of inflammation, Complement activation and its role in inflammation
2.2 Immunoglobulins : Structure, Function, Antigen-antibody interaction.
2.3 Major Histocompatibility Complex
2.4 Cytokines and Cytokine receptor

UNIT 3
3.1 T-cell : Ontogeny, T-cell : Receptors.
3.2 B-cell : Ontogeny, Activation, Differentiation.
3.3 Immunity to infection : Viral, Bacterial, Fungal, Protozoa and Worm infections, Vaccination
3.4 Autoimmunity and Autoimmune diseases.

UNIT 4
4.1 Mononuclear Phagocyte and Cell Mediated Cytotoxicity

4.2 Immunodeficiency : Primary and secondary.
4.3 Immunological Tolerance
4.4 Hypersentivity

UNIT 5
5.1 Tumour Immunology.
5.2 Transplantation Immunology.
5.3 Immunological Techniques : Precipitation reactions, Haemagglutination, Complement fixation,Immunoflourescence (FACS), Direct –indirect, Immunoassay (ELISA), Immunoblotting and immunoprecipitation, Monoclonal antibody production.

Reference Books

1.Roitt, I. 1997. Essential Immunology IX ed. Blackwell Science Ltd. Australia.
2.Stites, D.P. Stopo J.D. Falenberg, H.A. and J.V.Wells. 1994. Basic and Clinical Immunology.
3.Elgert K.D.1996. Immunology. Wiley-Liss. A John Wiley & Sons Ine . Publication. pp 468.
4.Roitt I. and Delves P.I.1995. Essential Immunnology Review. Black Well Science.
5.Janis, K. 1991. Immunology II ed. W.H. Freemans and Company, New York.
6.Tizard, J.R. 1984. Immunology - An Introduction. Saunder's College Publishing New York.
7.Mele, D., Champion, B., Cook, A. and Owen M., 1991. Advanced Immunology II Ed. Mosby St. Louis.

Semester III
MB 303: Yeast and Fungi (core)
Credit: 6

Course Objective: The major objective of this course is to make the students familiar with fungal structure, reproduction, physiology, taxonomy, etc. to gain an overview of the research field.
Course Learning Outcomes: By the completion of this course the student –

Outcome 1. Is able to describe useful and harmful activities of fungi.
Outcome 2. Identify commonly available fungi and their characteristics.

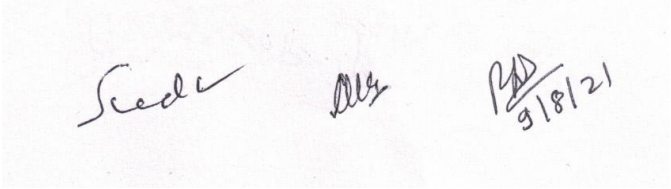
UNIT 1
1.1 Introduction: Significance of Fungi to Human Welfare, Somatic structure, Vegetative growth, Reproduction.
1.2 Systematics of Fungi.
1.3 Fungal nuclei, Nuclear division and Parasexual cycle.
1.4 Fungi as model for genetic studies.

UNIT 2
2.1 Chytridiomycota : Classification, General structure, Life cycle of typical members of Chytridiales, Blastocladiales, Monoblepheridales.

2.2 Zygomycota : Classification,structure and reproduction in typical members of Mucorales, Endogonales, Enomophthorales, Zoopagales. Sporangial organization and Heterothallism.
2.3 Ascomycota : Classification, Structure, Development and Type of ascocarps; Classification.

UNIT 3
3.1 Archeascomycota and Ascomycetous Yeasts : General Account .
3.2 Filamentous Ascomycetes with Cliestothecia, Perethecia and Apothecia : General Account, Classification, Life cycle and Types of ascocarps in Eurotiales, Hypocreales, Melanosporales, Phylochorales, Sordariales, Pezzizales, Helotiales and Rhytismatales.
3.3 Other Ascomycetes : Loculoascomycetous forms and Erysiphales.

UNIT 4
4.1 Deuteromycota : Classification, Conidial types and Ontogeny, Asexual reproduction in typical members of Sphaeropsidales, Melaconiales, Moniliales.
4.2 Basidiomycota : General introduction,Classification, Clamp connection, Dolipore septium, Types and Development of Basidiocarps, Heterothallism, Compatability



4.3 Basidiomycetous Forms :General Account, Classification and Life cycle of Agaricales, Aphyllophorales, Lycoperdales, Nidulariales, Ustilaginales and Uridinales.

UNIT 5

5.1 Oomycota : Classification, General Structure and Reproduction of typical members Saproligniales and Perenosporales.

5.2 Hypochytridiomycota : General Account

5.3 Slime Moulds : Classification, General Structure and Life cycle of typical representative of Acrasiomycota, Dictyosteleomycota, Myxomycota and Plasmodiophoromycota.

Reference Books

1.Alexopoulos, C.J., C.W. Mims and Blackwell, M. (1996). Introductory Mycology IV ed. Wiley Eastern Ltd., New Delhi.

2.Webster, J. (1980). Introduction to Fungi II ed. Cambridge University Press, Cambridge.

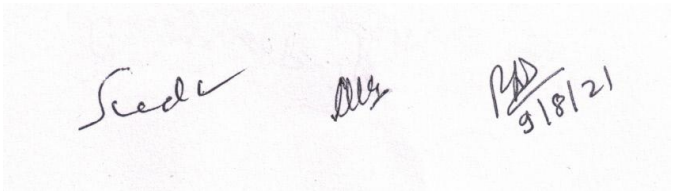
3.Gull, K.S. and Tiker, S.G. (eds) (1981). The Fungal Nucleus Cambridge University Press, Cambridge.

4.Fincham, J.R.S., Day P.R. and Radford, A. (1979). Fungal Geneties. Blackwell Scientific Publications, Oxford.

5.Watson, J.D., Hopkins, H.N. Robert J.W., Sietz, J.A. and Weiner, A.M. (1998). Molecular Biology of Gene Ved. Benjamin/Cummings Publishing Company, Inch., California.

6.London, J. (Ed.) (1971). The Yeasts. North-Holland Publishing Company, Amsterdam.

7. Mehrotra, R.S. and Aneja, K.R. (1990). An Introduction to Mycology. Wiley Eastern Ltd., New Delhi.



Semester III
MB 304: Environmental Microbiology (Discipline specific elective)
Credit: 6

Course Objective: The major objective of this paper is to impart knowledge about structure, composition and functioning of microbial communities of diverse environment. The use of microbial population in agriculture, mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value added products will be discussed.

Course Learning Outcomes: Upon successful completion of the course, the student -

Outcome 1. Has an overview of microbes in extreme environment and air.
Outcome 2. Become acquainted with microbial diversity in water and sewage.
Outcome 3. Is able to describe the role of microbes in liquid waste management, gaining knowledge of various methods employed in sewage treatment.
Outcome 4. Is able to describe the role of soil microbes in nutrient transformation, plant-microbe interactions and nitrogen fixation.Also understand the significance of microorganisms in biogeochemical cycling of nutrients'
Outcome 5. Understood the role of microbes in management of waste plant biomass and can apply knowledge in designing microbe-based processes for pulp, textile, biofuel and animal feed production industries.

UNIT 1
1.1 Microbial ecology: basic concept, types and microbial habitats, Extreme Environments and Biodeterioration and biodegration
1.2 Air as an environment of microorganisms: indoor and outdoor, Adaptation of microorganisms to the air environment: types of microorganisms occur in air, Survival and spread of the bioaerosols,
1.3 Biological aerosols as a human hazard source: Infectious airborne diseases, Allergic diseases, Basic sources of bioaerosol emission (natural and related to human activities), Control of airborne microorganisms
1.4 Cultivation and detection of microbes in air (microscopic and culture), Sedimentation method, Filtration methods, Impact methods, Detecting toxins and allergens in air

UNIT 2
2.1 Water Microbiology: Characteristics, sources and types of water, Distribution and Characterization of microorganisms in water,
2.2 Factors limiting growth of microorganisms in water, Abiotic factors and biotic factors
2.3 Sources and types of pollutants, Waste water Microbiology, Sewage: Composition, Characterization and its disposal,

2.4 major groups of microorganisms in sewage, Self purification, Conventional, domestic and municipal sewage treatment Types of sewage, sewage treatment- primary, secondary, tertiary, purification (water renovation),

UNIT 3

3.1 wastewater treatment: Biological methods of wastewater treatment, wastewater treatment (Trickling filters, Activated sludge), Methods of chemical wastewater treatment

3.2 Water borne bacterial infections, indicator microorganisms, Coli forms group

3.3 Most Probable Number (MPN), Standard Plate Count (SCP), microarray, rapid assay procedures of water testing and analysis, , BOD,COD, TOC.

UNIT 4

4.1 Characteristics, composition, formation of soil, Soil as environment for microbial growth: Edaphic factors- Water, Osmotic pressure, The Redox potential, Soil's pH, temperature, Oxidation, The content of nutrients, Toxic compounds, Light

4.2 Activity of microorganisms in soil, the role of microorganisms in organic metabolism: Carbon cycle, Cellulose decomposition, Lignin decomposition, Decomposition of humus, Phosphorus cycle, Iron cycle and Sulphur cycle

4.3 Role of microorganisms in nitrogen processes in soil - the nitrogen cycle: Atmospheric nitrogen fixation, Free living N2 assimilators (non-symbiotic nitrogen fixation), Ammonification, Nitrification, denitrification,

4.4 Iinteraction between microorganisms: Symbiosis, Parasitism, Predation, Antagonism, Commensalism, Rhizosphere , Screening of microorganisms for bioactive molecules: enzymes and antibiotics, Soil born microorganisms and disease

UNIT 5

5.1 Concept, scope and Principles of Bioremediation, Role of microorganisms in Bioremediation, Xenobiotics: Pollutants and their microbial degradation-methane, benzene, pesticides, Compositing

5.2 Microbial degradation of petroleum products, Oil Spills, Role of bio-surfactants

5.3 Coal desulphurization, Nature of industrial effluents of leather, food and pharmaceutical industries, Biodegradation of paper, textiles and wool,

5.4 Biocorosion, GMO and their impact.

Reference Books

1. Brock Biology of Microorganisms by Medigan, M.T., Martinko, J. M .and Parker, J. Pearson Education Inc. , New York
2. Introduction to soil microbiology byAlexander, Martin. John. Wiley & Sons Inc., New York.
3. Sewage treatment in hot climates by Mara, D.
4. Biotechnology and waste water treatment by fields, M.L.
5. Aerobiology by Tilak
6. Bioremediation by Barker, KH, &Herson, D.S. Mc Craw Hill Inc., New York.
7. Microbiology by Prescott , Harley and Klein , The Mc Graw Hill companies Inc. , New York

8. Brock Biology of Microorganisms. By Medigan, M.T., Martinko, J., M . and Parker, J. Pearson Education Inc., New York

Semeter III
MB 305: Plant Pathology (Discipline specific elective)
Credit: 6

Course Objective : The course will facilitate in understanding of how pathogens interact with various plants and effect plant physiology, photosynthesis, respiration, transpiration and translocation. The involvement of various enzymes and toxins and understanding the molecular interaction will help in designing biocontrol strategies and development of transgenic plants.

Course Learning Outcomes: Upon successful completion of the course, the student -
Outcome 1. Has basic concepts of diseases in plants, dispersal of plant pathogen and diseases forecasting.
Outcome 2. Has learnt about role toxins in plant disease, mechanism of defence in plants and plant disease control by physical, chemical and biological methods.
Outcome 3. Understood about causation of diseases in plants by the different types of microorganisms namely bacterial, fungal and viral,
Outcome 4. Understood about, symptoms of diseases and their control, diseases of some important cereals, vegetables.
Outcome 5. Developed skills to analyze the diseased plant samples in the laboratory and are able to identify the salient features of the disease-causing microbe and the lesions produced on the plant parts.

UNIT-1

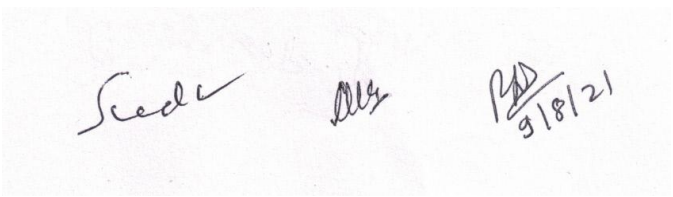
1.1 Introduction: Concept of plant disease, history of plant pathology, symptoms and identification of plant diseases.
1.2 Dispersal of plant pathogens: Autonomous and Passive dispersal.
1.3 Phenomenon of Infection ; Pre-penetration, penetration and post penetration
1.4 Effect of environment on pathogenesis. Disease forecasting.

UNIT-2

2.1 Effect of infection on physiology of the host. Role of toxins in plant pathogenesis.
2.2 Mechanism of Defense in Plants : Structural and biochemical (pre and post infection)
2.3 Control of Plant diseases: cultural, chemical and by breeding disease resistant varieties.
2.4 Assessment of disease incidence and loss.

UNIT-3

3.1 Diseases caused by viruses: mosaic, necrosis and leaf curl of potato, bean mosaic, yellow vein mosaic of bhindi, bunchy top of banana, leaf curl of papaya.
3.2 Disease caused by bacteria : citrus canker, angular leaf spot of cotton, black rot of crucifers, tundu disease of wheat, soft rot of potato, blight of rice, crown gall of stone fruits.



UNIT 4

4.1 Diseases caused by mycoplasma : little leaf of brinjal, greening disease of citrus, grassy shoot of sugarcane, sandal spike, rice yellow dwarf.

4.2 Disease caused by fungi : club root diseases of crucifer, wart of potato, damping of seedling, white rust of crucifers, downy mildew of peas and grapes, late blight of potato.

UNIT 5

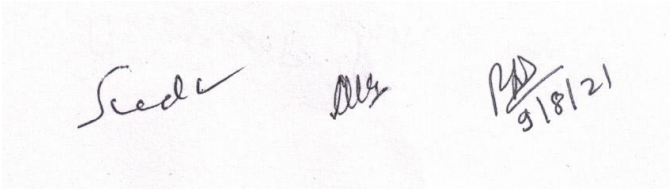
5.1 Stem gall of coriander, peach leaf curl, powdery mildew of wheat and pea, ergot of bajra, false smut of rice

5.2 Loose smut of wheat, covered smut of barley, smut of sugarcane, bunt of wheat, smut of bajra, rust of wheat, linseed , pea and coffee.

5.3 Wilt of cotton, dry rot and stem canker of potato, white rot of onion, tikka disease of ground nut, red rot of sugarcane, leaf spot and blast disease of rice.

Reference Books

1. Agrios, G.N. Plant pathology. 4th edition Academic press, San Diego.
2. Lucas, J.A. Plant pathology and plant pathogens.3rd edition. Blackw Science, Oxford.
3. Rangaswami, G .Diseases of crop plants in India. 3rd edition. Prentice Hall of India,New Delhi.
4. Singh, R.S. Plant diseases management. Oxford & IBH, New Delhi.
5. Waller, J.M., Lenne, J.M. and Waller, S.J, Plant Pathologists pocketbook. 3rd edition. CABI publishers, Wallingford, Oxford.
6. Mehrotra R.S. Plant Pathology Tata McGraw-Hill Limited.
7. Webster, J. Introduction to fungi, Second edition. Cambridge University Press.
8. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. Introductory Mycology, Fourth edition. John Wiley and Sons



Semester IV: Learning Objectives and Outcomes

MB 401: Project Work/ On site training (Core)
Course objective : The objective of this course is to impart work experience and training to students in actual working environment. Student can pursue project work or training in his/ her area of interest.
Learning Outcomes :
Outcome 1. Student will get experience of working in industry/ laboratory etc.
Outcome 2. Student will be able to work independently.
Outcome 3. Student will be able to choose the career as per their interest.

MB 402 : Industrial visit/ Scientific or Pathology Lab visit/ Minor Project/ Case study
Or An equivalent MOOC
Course objective : The objective of this course is give exposure to students about different avenues of jobs.
Learning Outcomes :
Outcome 1. Student will get idea about different areas in which a microbiologist can get job.
Outcome 2. Student will be able to choose the career as per their interest.

MB 403 : Review writing
Course Objective : The objective of this course to teach students basic aspects of searching and compiling literature and writing a review.
Learning Outcomes :
Outcome 1. Student will learn the art of writing and develop ability to express the view in written language.

MB 404 : Seminar / Group Discussion
Course Objective : The objective of this course is to teach students basics of public speaking ad expression of views in front of peer group.
Learning Outcomes :
Outcome 1. Students will get confidence in public speaking.
Outcome 2. Students will be able to make presentation and express their views.
Outcome 3. The personality of students will improve.

MB 405 : Poster Presentation
Course Objective : The objective of this course is to teach students basics of expression of views in the form of poster.
Learning Outcomes :
Outcome 1. Students will learn the importance of posters.
Outcome 2. Students will be able to express their view in form of posters.

_____End