

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

Syllabus  
M. Sc. Microbiology (For UTD)

*Revised Course Structure*  
*Choice Based Credit System (CBCS)*  
*2018-2020*

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The School of Studies in Microbiology will have choice based credit system (CBCS) in M.Sc. Microbiology (For UTD). 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.

The details of the course are given below:

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## Semester I

S.No.	Course code	Title of course	Course type	Marks			Credits
				Internal Examination Marks	University Examination Marks	Total Marks	
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	MB 104	Biological Tools and Techniques.	Generic elective *	40	60	100	5
5	MB 105	or Computer in Biology & Biostatistic					
6	ED	Enterprenurship Development	Skill development course**	30	50	80	4
7	MB 106	Practical-I (Laboratory Skill Development/ Survery)	Core	15	25	40	2
8	MB 107	Comprehensive Viva (Virtual Credits)	Core	-	80	80	4
		Total				600 <sup>5</sup>	30

\*Any 01 out of 02 Generic Elective can be opted by the students.

\*\* Common course offered by the University.

<sup>5</sup>One credit is equal to 20 marks.

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## Semester II

S.No.	Course code	Title of Course	Course type	Marks			Credits
				Internal Examination Marks	University Examination Marks	Total Marks	
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	MB 204	Microbial Technology or	Discipline specific elective*	40	60	100	5
5	MB 205	Advances in Virology					
		Skills	development course**	30	50		
7	MB 206	Practical-II (Laboratory Skill Development/ Field work)	Core	15	25	40	2
8	MB 108	Comprehensive Viva (Virtual Credits)	Core		80	80	4
		Total				600 <sup>§</sup>	30

\*Any 01 out of 02 Discipline specific Elective can be opted by the students.

\*\* Common course offered by the University.

§ One credit is equal to 20 marks.

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## Semester III

S.No.	Course code	Title of Course	Course type	Marks			Credits
				Internal Examination Marks	University Examination Marks	Total Marks	
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	MB 304	Environmental Microbiology or Plant Pathology	Discipline specific elective*	40	60	100	5
5	MB 305						
6	PD	Personality Development	Skill development course**	30	50	80	4
7	MB 306	Practical-III (Laboratory Skill Development/ Minor project)	Core	15	25	40	2
8	MB 108	Comprehensive Viva (Virtual Credits)	Core		80	80	4
		Total				600 <sup>§</sup>	30

\*Any 01 out of 02 Discipline specific Elective can be opted by the students.

\*\* Common course offered by the University.

§ One credit is equal to 20 marks.

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## Semester IV

S. No.	Course code	Title of Course	Course type	Marks			Credits
				Internal Examination Marks (40%)	University Examination Marks (60%)	Total Marks	
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	Industrial visit/ Scientific or Pathology Lab visit/ Minor study	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 <sup>s</sup>	30

<sup>s</sup> One credit is equal to 20 marks.

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## **M. Sc. Microbiology (For UTD)**

### **Semester- I**

#### **CORE THEORY COURSES**

#### **MB 101: General Microbiology and Microbial Diversity (core)**

**Credits: 6**

##### **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 Archaeobacteria: 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

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- 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 by Colwd, 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.

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**Semester – I**

**MB 102: Microbial Genetics (core)**

**Credits: 6**

**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 : Suppressor mutations.
- 4.2 Spontaneous mutation: The random and non adaptive nature of mutations (fluctation test), Origin of spontaneous mutants.

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- 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..

## 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,

## 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). Lehninger- 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) Concept of genetics. VII Ed., Pearson Education, New Delhi.

## 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 Metabolism, II Ed. Springer Verlag.
4. Madigan, M.T., Martinko, J.M. and Parker, J. (2000) Brock Biology of Microorganisms, 9<sup>th</sup> Ed. Prentice Hall International Inc.
5. Neill, 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 5<sup>th</sup> Ed., McMillan Press Ltd.
7. Stryer, L. (2001) Biochemistry. Freeman.
8. Nelson, D.L. and Coax, M.m. (2000). Lehlingers - Principles 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..

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**Semester – I**

**MB 103 Biochemistry and Microbial Physiology (core)**

**Credits: 6**

**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, their biosynthesis, 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<sub>2</sub> fixation, C<sub>3</sub> –C<sub>4</sub> pathways and CAM pathways
- 4.3 Vitamins and their role as coenzymes.

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**Semester – I**  
**GENERIC ELECTIVE THEORY COURSES**

**MB 104: Biological Tools and Techniques. (Generic elective)**

**Credits: 6**

**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. 5<sup>th</sup> Edition, Cambridge University Press.
3. Asokan P (2001) Analytical Biochemistry (Biochemical Techniques). 1<sup>st</sup> Edition. 2<sup>nd</sup> Reprint. Published by Chinna Publications. Melvisharam. Vellore, Tamil Nadu.
4. Palanivelu P. (2001). Analytical Biochemistry and Separation Techniques. A Laboratory Manual 2<sup>nd</sup> 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**

**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

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**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.

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**Semester- II**  
**CORE THEORY COURSES**

**MB 201: Bacteria and Cyanobacteria (core)**

**Credit: 6**

**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 Chemolithotrophs and Methophytes : 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

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- 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.F. Stewart W.D.P. Fay P. and F.A. Walsby (1973) The Blue-Green Algae. Academic 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). Microbiology IV Ed. Harper and Row Publishers, Singapore.

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**Semester II**

**MB 202: Medical Microbiology and Virology (core)**

**Credit:6**

**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, Diphtheria, 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- *Microsporum*, *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, Pathogenicity 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, Haemagglutinin 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 M... 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.

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## Semester II

### MB 203: Molecular Biology (core)

Credit: 6

#### 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 : Structural 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 corresponding 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 Regulation by small molecules such as ppGPP and cAMP.
- 4.2 Structure and function 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.



**Semester II**  
**DISCIPLINE SPECIFIC ELECTIVE THEORY COURSES**

**MB 204: Microbial Technology (Discipline specific elective)**

**Credit: 6**

**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 hormones, 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

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**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, Washington 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****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 : Structure, 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 :

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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.
4. 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.
5. Cann, A.J. (2001). Principles of Molecular Virology III Ed. Acedemic Press.
6. Dimmock, N.J., Easton, A.J. and Leppard, K.N. (2001). Introduction to Modern Virology. Blackwell Science.

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**Semester- III**

**CORE THEORY COURSES**

**MB 301: Food and Industrial Microbiology (core)**

**Credit: 6**

**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 Food 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
- 2.2 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,

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- 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) 2<sup>nd</sup> Edition. Pergamon Press.
5. Basic Food Microbiology By Banwart, 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 By Robinson R.K. Elsevier Applied Sciences. London.
8. Industrial Microbiology by Casida, L.E.
9. Industrial Microbiology by Patel, A.H.
10. Industrial Microbiology by Prescott and Dunn.
11. Industrial Microbiology by Onions, Allsopp and Eggins.
12. Microbial Enzyme and Biotechnology by Fogarty and Kelly.

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13. Comprehensive Biotechnology by Murrug (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.

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### Semester III

#### MB: 302 Immunology (Core)

Credit: 6

#### 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 Hypersensitivity

#### UNIT 5

- 5.1 Tumour Immunology.
- 5.2 Transplantation Immunology.
- 5.3 Immunological Techniques : Precipitation reactions, Haemagglutination, Complement fixation, Immunofluorescence (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. Stobo J.D. Falerberg, H.A. and J.V. Wells. 1994. Basic and Clinical Immunology.
3. Elgert K.D. 1996. Immunology. Wiley-Liss. A John Wiley & Sons Inc. Publication. pp 468.
4. Roitt I. and Delves P.I. 1995. Essential Immunology Review. Black Well Science.
5. Janis, K. 1991. Immunology II ed. W.H. Freeman and Company, New York.
6. Tizard, J.R. 1984. Immunology - An Introduction. Saunders's College Publishing New York.
7. Mele, D., Champion, B., Cook, A. and Owen M., 1991. Advanced Immunology II Ed. Mosby St. Louis.

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**Semester III**

**MB 303: Yeast and Fungi (core)**

**Credit: 6**

**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, Blastocladales, Monoblepharidales.
- 2.2 Zygomycota : Classification, structure and reproduction in typical members of Mucorales, Endogonales, Entomophthorales, 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 Cleistothecia, Perithecia and Apothecia : General Account, Classification, Life cycle and Types of ascocarps in Eurotiales, Hypocreales, Melanosporales, Phylochorales, Sordariales, Pezizales, 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, Compatibility

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- 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 Saprologniales 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.

#### UNIT 5

##### 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 Genetics. 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, Inc., 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.

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**Semester III**

**DISCIPLINE SPECIFIC ELECTIVE THEORY COURSES**

**MB 304: Environmental Microbiology (Discipline specific elective)**

**Credit: 6**

**UNIT 1**

- 1.1 Microbial ecology: basic concept, types, Extreme Environments
- 1.2 Air as an environment of microorganisms: indoor and outdoor, Adaptation of microorganisms to the air environment: types of microorganisms occur in air
- 1.3 Airborne diseases in Human and plant , Control of airborne microorganisms
- 1.4 Cultivation and detection of microbes in air (microscopic and culture), Sedimentation method, Filtration methods.

**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
- 2.4 Sewage: Composition, Characterization and its disposal,

**UNIT 3**

- 3.1 Waste water treatment – Primary, secondary and tertiary treatments. Home treatment system.
- 3.2 Water purification and sanitary analysis.
- 3.3 Measurement of water quality, BOD, COD.
- 3.4 Water borne bacterial infections.

**UNIT 4**

- 4.1 Biogeochemical cycles - Carbon, Nitrogen, Phosphorus and Sulphur cycle.
- 4.2 Interaction of microorganisms: Symbiosis, Parasitism, Antagonism, Commensalism.
- 4.3 Plant microbe interactions – Rhizosphere, Phyllosphere and mycorrhiza.

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4.4 Symbiotic nitrogen fixation. Agrobacterium and its importance and biofilms.

#### UNIT 5

5.1 Bioremediation, Bioremediation of oil spills, Composting.

5.2 Biodegradation, Xenobiotics and their degradation.

5.3 Coal desulphurization, Biomining.

5.4 Biocorrosion, 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 by Alexander, 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

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**Semeter III**

**MB 305: Plant Pathology (Discipline specific elective)**

**Credit: 6**

**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, ...
- 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.

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**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

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