Madras Christian College
(Autonomous)

DEPARTMENT OF MICROBIOLOGY
B.Sc. MICROBIOLOGY
COURSE CURRICULUM

From June 2018

Madras Christian College (Autonomous)
DEPARTMENT OF MICROBIOLOGY
B.Sc., Microbiology

Program Specific Outcomes

Students of B.Sc. Microbiology will be able to

PSO 1: Appreciate the diversity of microorganisms and microbial communities for betterment of human life.

PSO 2: Understand the basic and applied concepts of all areas of Microbiology.

PSO 3: Carry out all basic microbiological analysis.

PSO 4: Perform the role of microbiologist in food, dairy, pharmaceutical and clinical sectors.

Madras Christian College (Autonomous)

DEPARTMENT OF MICROBIOLOGY

B. Sc., Course Curriculum – Modified (2020)

Sem	Course Code	Title	Nature of the course	Hours per Cycle	Exam hours	Marks CA	Marks ESE	Credits
I		English	Part II	4	3	50	50	3
		Language	Part I	4	3	50	50	3
		Value Education	Part IV	2	3	50	50	1
	184MB1M01	Introduction to Microbes (Theory)	Core	6	3	50	50	6
	184MB1M02	Introduction to Microbes (Practical)	Core	4	6	50	50	4
	184MB1A02	Biochemistry I (theory)	Allied	4	3	50	50	3
	184MB2A02	Biochemistry I (practical)	Allied	2	3	50	50	2
	184UC1G01	Microbiology in day today life.	General course	4	3	50	50	2
			Total	30				24
Sem	**Course Code**	**Title**	**Nature of the course**	**Hours per Cycle**	**Exam hours**	**Marks CA**	**Marks ESE**	**Credits**
II		English	Part II	4	3	50	50	3
		Language	Part I	4	3	50	50	3
		Value Education	Part IV	2	3	50	50	1
	184MB2M01	Immunology (theory)	Core	6	3	50	50	6
	184MB2M02	Immunology (practical)	Core	4	6	50	50	4
	184MB2A04	Biochemistry II (theory)	Allied	4	3	50	50	3
	184MB2A03	Biochemistry II (practical)	Allied	2	3	50	50	2
		Microbiology in day today life	General course	4	3	50	50	2
			Total	30				24

Sem	Course Code	Title	Nature of the course	Hours per Cycle	Exam hours	Marks CA	Marks ESE	Credits
III		English	Part II	4	3	50	50	3
		Language	Part I	4	3	50	50	3
		Personality Development	Part IV	2	3	50	50	1
	184MB3M01	Microbial Physiology (Theory)	Core	5	3	50	50	5
	184MB3M06	Microbial Physiology (Practical)	Core	2	6	50	50	2
	184MB3M03	Bioinstrumentation (Theory)	Allied	4	3	50	50	3
	184MB3M04	Bioinstrumentation (Practical)	Allied	2	3	50	50	2
	184MB3M05	Microbial Ecology	Core	3	3	50	50	3
	184MB3I03	Introductory Forensic science /	Inter-disciplinary	4	3	50	50	3
		Environmental Studies	Part IV					2
			Total	30				24/25
Semester	**Course Code**	**Title**	**Nature of the course**	**Hours per Cycle**	**Exam hours**	**Marks CA**	**Marks ESE**	**Credits**
IV		English	Part II	4	3	50	50	3
		Language	Part I	4	3	50	50	3
		Personality Development	Part IV	2	3	50	50	1
	184MB4M01	Microbial Genetics and Molecular Biology (Theory)	Core	5	3	50	50	5
	184MB4M02	Microbial Genetics and Molecular Biology (Practical)	Core	2	6	50	50	2
	184MB4A03	Hematology and Histopathology (Theory)	Allied	4	3	50	50	3
	184MB4A04	Hematology and Histopathology (Practical)	Allied	2	3	50	50	2
	184MB4M05	rDNA Technology and Bioethics (Theory)	Core	3	3	50	50	3
		Introductory Forensic science /	Inter-disciplinary	4	3	50	50	3
		Environmental Studies	Part IV					2
			Total	30				24/25

Semester	Course Code	Title	Nature of the course	Hours per Cycle	Exam hours	Marks CA	Marks ESE	Credits
V	184MB5M01	Bacteriology and Virology (Theory)	Core	5	3	50	50	4
	184MB5M02	Bacteriology and Virology (Practical)	Core	3	6	50	50	2
	184MB5M03	Industrial Microbiology (theory)	Core	5	3	50	50	4
	184MB5M04	Industrial and Environmental Microbiology (Practical)	Core	6	6	50	50	6
	184MB5M05	Environmental Microbiology (Theory)	Core	5	3	50	50	4
	184MB5M07	Computer Training	Core	2	3	50	50	3
	184MB5L01	Energy Utilization and Waste recycling	General Elective	4	3	50	50	3
			Total	30				26
Semester	**Course Code**	**Title**	**Nature of the course**	**Hours per Cycle**	**Exam hours**	**Marks CA**	**Marks ESE**	**Credits**
VI	184MB6M01	Pharmaceutical Microbiology (Theory)	Core	6	3	50	50	5
	184MB6M02	Food and Dairy Microbiology (Theory)	Core	6	3	50	50	5
	184MB6M03	Food, Dairy & Pharmaceutical Microbiology (Practical)	Core	6	6	50	50	6
	184MB6M04	Parasitology and Mycology (Theory)	Core	6	3	50	50	5
	184MB6M05	Parasitology and Mycology (Practical)	Core	3	6	50	50	2
	184MB6M06	Bioinformatics (Theory)	Core	3	3	50	50	2
			Total	30				25
		Grand Total (Semester I – Semester VI)		180				150

Semester I – Core Paper
Introduction to Microbes

Sub Code: 184MB1M01 **Number of Hours: 6**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Acquire knowledge on the fundamentals of microbiology
CO 2: Know about the importance of maintaining aseptic conditions in the microbiology laboratory
CO 3: Cultivate microorganisms in the laboratory
CO 4: Independently handle compound microscopes
CO 5: Perform all basic staining techniques for microscopical observation
CO 6: Learn about the types and the action of antibiotics

Unit – I

Introduction & Scope of Microbiology. Milestones in the history of Microbiology. Evolution of microorganisms. Contributions of the pioneers – Leewenhoek, Louis Pasteur, Joseph Lister, Robert Koch, Paul Ehrlich, Edward Jenner. Recent advancements in Microbiology.

Unit – II

Microbial taxonomy - Concepts of taxonomy (characterization, classification and nomenclature) and systematics; classification of microorganisms - Three kingdom, Five kingdom concept and Eight kingdom concept. Outline of Bergey's system of classification.

Unit – III

Prokaryotic cell structure and functions - Cell wall, Cell membrane, Components external to cell wall- Capsule, Slime layer, S layer, Flagella, Pili, Fimbriae. Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles. Bacterial endospores and their formation. Structure of eukaryotic microorganisms and their cell organelles. Difference between prokaryotes and eukaryotes.

Unit – IV

Microscopy – simple, compound, dark field, phase contrast, Fluorescence & Electron microscopy – SEM and TEM. Staining - Dyes and stains: Types. Simple and differential staining. Special staining (Acid Fast, Capsule, Spores & Metachromatic granules)

Unit – V

Isolation of microbes by pure culture techniques – serial dilution, spread, pour and streak plate. Control – sterilization – physical and chemical methods. Antimicrobial chemotherapy – Antibiotics, types and mode of action/resistance.

Text Books:

1. Pelzar Jr. M. J., Chan, E.C.S and Kreig, N.R (1993). Microbiology, Mc Graw Hill Inc. New York.
2. Lansing M. Prescott., John. P. Harley. Donald A. Klein (2013). Microbiology, 9th Edition, Mc Graw Hill Inc. New York.

Reference Books:

1. David, B.D., Delbecco, R., Eisen, H.N and Ginsburg, H.S (1990). Microbiology, 5th Edition. Harper & Row, New York.
2. Robert F. Boyd (1987). General Microbiology, 2nd Edition. Times MIRROR / Moshy College Publishing Virginia.
3. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Derek Weber (2014). Microbiology: An Introduction, 12th Edition.

Semester I – Core Practicals
Introduction to Microbes

Sub Code: 184MB1M02 **Number of Hours: 4**

1. Sterilization Principle & methods – Moist heat and dry heat sterilization.
2. Operation of laboratory equipments – LAF, incubator and colony counter.
3. Microscopy: Handling and operation of microscopes – Bright-field and Dark-field Microscopes.
4. Staining technique – smear preparation, Simple staining, Gram staining, Acid fast Staining, Capsule & Endospore staining.
5. Microscopic observation of fungal morphology - Lactophenol Cotton Blue staining.
6. Micrometry: Measurement of microbial cell size.
7. Demonstration of motility of microorganisms by Hanging drop and Semisolid agar
8. Preparation of nutrient agar slants and culturing of bacteria; Stab culture.
9. Pure culture techniques – streak, pour and spread plate.
10. Quantitative estimation of microorganisms – total and viable counts.

Semester I – Allied Paper
Biochemistry –I

Sub Code: 184MB1A02 **Number of Hours: 4**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand the structure and properties of monosaccharides and polysaccharides.
CO 2: Identify the basic elements of protein structure.
CO 3: Learn the structure and basic functions of nucleotides.
CO 4: Know about different classes of lipids and their roles in biological systems.
CO 5: Become familiar with the structures of amino acids, their chemical properties and their organization into polypeptides and proteins.

Unit – I

Introduction to Biomolecules. Water, pH, Buffers and its types. Carbohydrates – Definition, classification, Importance of carbohydrates. Physical properties- mutarotation, chemical properties, ten reactions of Glucose and four reactions of fructose. Disaccharides - Maltose, Lactose, and Sucrose – Structure, occurrence, physical and chemical properties. Polysaccharides – Homo and Heteropolysaccharides.

Unit – II

Amino acids-Classification, essential and non- essential amino acid, Physical and chemical properties: Reaction due to carboxyl, amino and both the groups. Peptide bond. Proteins – classification – shape, solubility and composition, based on biological function. Physical properties –ampholytes, isotonic point, salting in and salting out, denaturation,

Unit – III

Organization of protein structure – primary, secondary, tertiary and quaternary structure. Bonds present in protein structure. N-terminal (Sangers, Edmans and dansyl chloride method). C- terminal (hydrazinolysis and biochemical method) amino acid analysis.

Unit – IV

Classification and functions of lipids. Fatty acids(saturated and unsaturated). Properties- saponification, rancidity.Functions of phospholipids. Cholesterol – Structure and biological importance.

Unit – V

Nucleic acids - Purines and pyrimidine bases, nucleosides, nucleotides, polynucleotides. DNA- structure and types. RNA- structure and types, genetic code, elementary knowledge about mutation.

Text Books:

1. Jain, J.L., Jain, S. and Jain, N., Fundamentals of Biochemistry, S. Chand and Company Ltd. (2005).
2. Biochemistry by U.Satyanaryan, U.Chakrapani Edition 2017
3. Nelson, DL and Cox MM., Lehninger: Principles of Biochemistry, WH Freeman (2008) 5th ed.

Reference Books:

1. Murray, R.K., et al., "Harper's Illustrated Biochemistry". 27th Edition. McGraw-Hill, 2006.
2. A.V.S.RamaRao, Text book of Biochemistry
3. A.C. Deb. Textbook of Biochemistry.
4. David E Metzler: Biochemistry, The Chemical reactions of Living Cells Vol. 1. 2nd Edition, Elsevier Academic Press (2003),
5. Berg JM, Tymoczko JL and Stryer L: Biochemistry, 5th Edition, WH Freeman and Company, (2005)
6. Voet, D.J and J.G. Voet and C.W. Pratt "Principles of Biochemistry" 3rd Edition, John Wiley & Sons Inc., 2008.
7. Plummer DT An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Limited (1988) E

Semester I – Allied Paper Practicals
Biochemistry –I

Sub Code: 184MB2A02 **Number of Hours: 2**

I) Qualitative analysis of Carbohydrates:

Xylose,
Glucose,
Fructose,
Galactose,
Lactose,
Maltose,
Sucrose,
Starch.

II) Qualitative analysis of amino acids:

Arginine, Cystine, Tryptophan, Tyrosine and Histidine.

Semester II – Core Paper
Immunology

Sub Code: 184MB2M01 **Number of Hours: 6**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Acquire basic knowledge and recent developments in the field of Immunology.
CO 2: Understand the principles of non-specific and specific immunity.
CO 3: Become familiar with the cellular and molecular components of the immune system.
CO 4: Learn about the different types of vaccines and its importance.
CO 5: Know about the hypersensitivity reactions and diseases.
CO 6: Carry out serological procedures for diagnosis.

Unit I

History of immunology. Introduction to immunity. Structure and functions of the cells and organs of the immune system.

Unit II

Antigen – properties and types of antigen. Immunogen, Adjuvant, and Hapten. Immunoglobulins – structure, types, properties and its functions. Monoclonal and Polyclonal antibodies.

Unit III

Types of immunity. Introduction to Major histocompatibility complex (MHC). Humoral and Cell mediated immune response. Complement – the classical and alternate pathways.

Unit IV

Antigen - Antibody reactions: principles and applications, Agglutination, Precipitation, Complement fixation, Immunofluorescence - direct and indirect, Immunoelectrophoresis, ELISA and RIA. Skin test - (Mantoux test).

Unit V

Hypersensitivity – definition, types and characteristics. Autoimmunity – mechanism and the related diseases. Immunoprophylaxis – vaccines and immunization schedule.

Text Books:

1. Kuby, J. Immunology, 7th edition, W.H. Freeman and Company, New York.
2. Ananthanarayanan .R and Jayaram Panikaer, C.K. (2017), 10th edition. Textbook of Microbiology, Orient Longman.

3. Immunology: a short course / by Eli Benjamini, Richard Coico, Geoffrey Sunshine, 4th edition, 2000.
4. Kannan I, (Edition 2013). Immunology. MJP Publishers, Chennai.

Reference Books:

1. Roitt's - 13th edition. Essential Immunology, Blackwell Scientific Publishers.
2. Cellular and Molecular immunology, 8th edition (2014), Abul Abbas Andrew H. Lichtman, Shiv Pillai, Elsevier.
3. Hand book of Human Immunology, 2nd edition, (2008), Maurice R.G. O'Gorman, Albert D. Donnenberg, C.R.C Press.
4. Manual of Clinical Laboratory and Immunology 6th Edition. 2002 by Noel R. Rose, Chief Editor: Robert G. Hamilton and Barbara Detric k (Eds.), ASM Publications.

Semester II – Core Practicals
Immunology

Sub Code: 184MB2M02 **Number of Hours: 4**

1. Blood collection and plasma / serum preparation.
2. Total and differential white blood cell counts.
3. Agglutination reactions
    a. Febrile - Widal test
    b. Latex - ASO, RA and CRP test.
    c. Haemagglutination - Blood grouping & Rh typing.
4. Flocculation - RPR test
5. Precipitation reactions in gel
    a. Ouchterlony double immunodiffusion,
    b. Single radial immunodiffusion,
6. Precipitation in agar with an electric field
    a. Immunoelectrophoresis
    b. Counter immunoelectrophoresis
7. ELISA (Demonstration only)

Semester II – Allied Paper
Biochemistry –II

Sub Code: 184MB2A04 **Number of Hours: 4**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand the different metabolic pathways of carbohydrates, lipids and protein.
CO 2: Acquire knowledge on electron transport systems, energetics and phosphorylation.
CO 3: Learn about enzymes and enzyme kinetics.
CO 4: Know about the types of vitamins and their deficiency disorders.
CO 5: Differentiate macro and micro minerals and their nutritional importance.

Unit I

Basic concepts of metabolism. Carbohydrate Metabolism: Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway. Lipid metabolism – Beta oxidation, Protein metabolism - Deamination, transamination, decarboxylation and urea cycle.

Unit II

Electron transport in mitochondria – components of electron transport chain. Reactions and energetics. Oxidative level phosphorylation –mechanism of chemi-osmotic theory. Substrate level phosphorylation.

Unit III

Enzyme - Definition, Units, Active site; Lock and key hypothesis and Induced fit theory. Michaelis-Menton Equation, Lineweaver-Burk plot, Factors affecting enzyme activity – substrate, pH and temperature. Enzyme inhibition – Competitive, Non competitive and Uncompetitive. Isoenzymes.

Unit IV

Vitamins definition, classification -Fat soluble vitamins (A, D, E, K) and Water soluble vitamins (B1, B2, B3, B6, B12 and C): Sources, Requirements functions and deficiency Disorder

Unit V

Macro Minerals- Calcium and Phosphorous: Sources, Functions, and effects of deficiency. Micro minerals- Iron, Iodine, Zinc, Sodium and Potassium: Sources, Functions, and effects of deficiency/imbalances.

Text Books:

1. Jain, J.L., Jain, S. and Jain, N., Fundamentals of Biochemistry, S. Chand and Company Ltd. (2005).
2. Biochemistry by U.Satyanaryan, U.Chakrapani Edition 2017

3. Nelson, DL and Cox MM., Lehninger: Principles of Biochemistry, WH Freeman (2008) 5th ed.

Reference Books:

1. Murray, R.K., et al., "Harper's Illustrated Biochemistry". 27th Edition. McGraw-Hill, 2006.
2. A.V.S.RamaRao, Text book of Biochemistry
3. A.C. Deb. Textbook of Biochemistry.
4. David E Metzler: Biochemistry, The Chemical reactions of Living Cells Vol. 1. 2nd Edition, Elsevier Academic Press (2003),
5. Berg JM, Tymoczko JL and Stryer L: Biochemistry, 5th Edition, WH Freeman and Company, (2005)
6. Voet, D.J and J.G. Voet and C.W. Pratt "Principles of Biochemistry" 3rd Edition, John Wiley & Sons Inc., 2008.
7. Plummer DT An Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Limited (1988) E

Semester II – Allied Paper Practicals
Biochemistry –II

Sub Code: 184MB2A03 **Number of Hours: 2**

Volumetric analysis

1. Estimation of Glucose by Benedict's method
2. Estimation of Glycine by Sorensons formal titration method
3. Estimation of Iron using $KMnO_4$ as link solution and ferrous ammonium sulphate as standard.
4. Estimation of acid number of given oil.
5. Estimation of NaOH using HCl as link and Na_2CO_3 as standard
6. Estimation of oxalate

Biochemical Preparation

1. Preparation of starch from potatoes.
2. Preparation of casein and lactalbumin from milk.

Colorimetric Estimation

1. Estimation of Glucose by Enzymatic method
2. Estimation of Protein by Lowry's method

Semester III – Core Paper
Microbial Physiology

Sub Code: 184MB3M01 **Number of Hours: 5**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand the microbial nutritional requirements.
CO 2: Have an insight on the growth kinetics of microorganisms
CO 3: Appreciate the role of various types of culture media in the growth of microorganisms
CO 4: Learn about microbial metabolism
CO 5: Know about microbial photosynthetic mechanisms

Unit – I

Microbial Nutrition, Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. Classification of microorganisms based on Nutritional requirements, Nutrient uptake mechanisms - passive diffusion, facilitated diffusion, active transport, group translocation.

Unit – II

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture. Preservation of microorganisms, Culture depositories.

Unit – III

Microbial growth - Definition of cell growth; generation time, Bacterial growth curve and Measurement of Growth, Sporulation. Batch, Fed-batch and Continuous cultures: principles, steady state, chemostat and Turbidostat.

Unit – IV

Metabolism - Concept of Metabolism: Anabolism, Catabolism. Central catabolic pathways – glycolysis, glyoxylate pathway, hexose monophosphate pathway, Entner Doudoroff pathway, tricarboxylic acid cycle – electron transport system.

Unit – V

Physiology of Fermentation: Homolactic and heterolactic. Photosynthesis: Oxygenic and anoxygenic photosynthesis in prokaryotes, photophosphorylation; Calvin cycle.

Text Books:

1. Microbial Physiology by S.Ram Reddy and S. M. Reddy. Anmol Publications. 2008
2. Microbial Physiology by Albert G. Moat, John W. Foster, Michael P. Spector. 2002

Reference Books:

1. Advances in Microbial Physiology by Robert K. Poole. Academic Press. 2006
2. Microbial Physiology by Meenakumari. MJP Publishers. 2006
3. Microbial physiology and Metabolism by D.R.Caldwell, Wm.C.Brown Publ. 1995.
4. Mandelstam Joel and McQuillen Kenneth (1976) Biochemistry of Bacterial Growth, Blackwell Scientific Publication London.

Semester III – Core Practicals
Microbial Physiology

Sub Code: 184MB3M06 **Number of Hours: 2**

1. Bacteria growth curve
2. Growth of the bacteria at different pH
3. Effect of different temperatures on microbial growth
4. Estimation of chlorophylls from Cyanobacteria
5. Cultivation of anaerobic bacteria
6. Carbohydrate fermentation test
7. Growth of bacteria in different media
8. Isolation of Pigment producing bacteria
9. Preservation and maintenance of microbial cultures

Semester III – Allied Paper
Bioinstrumentation

Sub Code: 184MB3M03 **Number of Hours: 4**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Operate basic instruments in the Microbiology laboratory
CO 2: Prepare buffers, molar and normal solutions
CO 3: Know the principles, protocols and applications of various instruments and techniques
CO 4: Appreciate the advantages and disadvantages of various techniques
CO 5: Choose the right technique/protocol for a particular process

Unit I

Basic instruments in microbiology - Principle and applications of autoclave, hot air oven, Laminar air flow, Incubators, and pH meter. Biochemical calculation of molar and normal solutions

Unit II

Microscopy– Simple, Compound and phase contrast microscopes. Principle and applications of SEM and TEM. Electrophoresis – Principle, instrumentation and applications of AGE and PAGE.

Unit III

Centrifugation Technique – Principle (concept of g and rpm) and types of Centrifugation (preparative and analytical), svedberg unit. Types of rotors and centrifuges.

Unit IV

Chromatography Techniques: Principle, instrumentation and applications of Chromatography – Column, Paper, Thin layer, Gas liquid chromatography, HPLC.

Unit V

Colorimetry - Principle, instrumentation and applications. Spectroscopy - visible and UV spectrophotometer, Flame photometry. Measurement of Radioisotopes, Autoradiography.

Text Books:

1. Wilson K., Walker J. Principle and Techniques of Biochemistry and Molecular Biology. Cambridge University Press (2006) 6th edition
2. Stryer, A.L., Berg J.A. and Tymoczko, J.L., Biochemistry, W.H.Freeman & Co Ltd (2002).

Reference Books:

1. Pingoud A., Urbanke C., et al. Biochemical Methods – A concise guide for Students and researchers. Wiley (2002)
2. Hawes C., Satiat-Jeunemaitre B. Plant Cell Biology. Oxford University Press (2001) 2nd edition
3. McHale J.L. Molecular Spectroscopy. Pearson (2008) 1st edition
4. Zubey, G.L., Principles of Biochemistry, Pearson-Education (2007).
5. Marimuthu R. Microscopy and Microtechniques. MJP Publishers Chennai (2008)

Semester III – Allied Practicals
Bioinstrumentation

Sub Code: 184MB3M04 **Number of Hours: 2**

1. Usage and calibration of Micropipettes
2. pH metry: Preparation of buffers- Acidic and alkaline range, Calibration of pH meter
3. Preparation of molar, molal and Normal solutions
4. Colorimetry / Spectrophotometry - Protein and Carbohydrate estimation
5. Paper chromatography
6. Thin layer chromatography
7. Electrophoresis of Proteins – Serum electrophoresis
8. Separation and determination of dry weight of bacterial cells by differential centrifugation – conversion of rpm to g
9. Counter current separation using immiscible solvents

Semester III – Core Paper (Without practicals)
Microbial Ecology

Sub Code: 184MB3M05 **Number of Hours: 3**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand microbes and their natural habitats.
CO 2: Learn about the microbial processes that occur in various ecosystems
CO 3: Learn about interactions of microbes with other living beings in an ecosystem.
CO 4: Knowledge about the dynamic activities of microbes in nutrient cycling of the earth.
CO 5: Appreciate the role of microorganisms in biodegradation processes.

Unit I

History, significance and developments in the field of microbial ecology, contributions of Beijerinck, Winogradsky, Selman. A. Waksman. Ecosystem: components and functioning of ecosystem, concept of homeostasis. Concepts of habitat and niche. Concepts of population and community. Development of microbial communities in different ecosystems, microbiome.

Unit II

Microbes and their natural habitats. Terrestrial Environment: Soil characteristics, Soil profile, Soil as a natural habitat of microbes, Soil microflora. Aquatic Environment: Stratification and Microflora of fresh water, marine habitats, brackish waters and mangroves.

Unit III

Extreme habitats: Extremophiles: Microbes thriving at high and low temperatures, pH, high hydrostatic and osmotic pressures, hypersaline and nutrient limiting environments.

Unit IV

Biogeochemical cycles – Carbon, Iron, Phosphorous and Sulphur cycles.Nitrogen: nitrogen fixation-symbiotic and nonsymbiotic. Microbial degradation of polysaccharide [cellulose, hemicellulose, lignin, chitin] and Humus formation.

Unit V

Microbial Interactions - interactions with biotic environment: Symbiosis, mutualism, synergism, commensalism, amensalism, competition, parasitism, predation. Interactions within microbial communities: quorum sensing, syntrophy, antibiosis. Interactions of microorganisms with plants, with animals and humans.

Text Books:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York

Reference Books:

1. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
2. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
3. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
4. Lynch JM &Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
5. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England
6. SubbaRao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.

Semester IV – Core Paper
Microbial Genetics and Molecular Biology

Sub Code: 184MB4M01 **Number of Hours: 5**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand the fundamental genetic principles.
CO 2: Learn the concepts of central dogma and gene expression.
CO 3: Gain knowledge about the process of mutation and its significance.
CO 4: Acquire working skills in basic molecular techniques.
CO 5: Address any genetically oriented problems in life.

Unit – I

Historical perspectives – Mendelian genetics. Discovery of DNA as the genetic material and its structure, DNA Topology and topoisomerases, RNA as genetic material, types of non-genetic RNA.

Unit – II

Organization of prokaryotic (nucleoid structure) and eukaryotic (nucleosome structure) genetic material, plasmids – Structure & types, Replication of DNA-different models-sigma, rolling circle, looped rolling circle and linear DNA replication-Events at the replication fork.

Unit – III

Gene transfer mechanism – transformation, conjugation and transduction. Mutation and mutagenesis (spontaneous and induced), Mutagens and their mode of action, carcinogenicity testing (Ames test).

Unit – IV

Gene expression – central dogma and flow of genetic information – transcription – post transcriptional modification, genetic code – translation in prokaryotes and eukaryotes.

Unit – V

Gene regulation – prokaryotes – Operon concept – Lac and tryptophan Operon – Eukaryotes- regulation through transcriptional factors – Britten – Davidson model, RNA editing.

Text Books:

1. Concepts of Genetics, Seventh edition -2007, William S. Klug & Michael R. Cummings.Darling Kindergluy.
2. Molecular Biology of the Gene. 4th Edition. 2004. Pearson Education.

3. Gardner, Simmons and Snustad. 2006. Principles of Genetics. 8th Editon. Wiley Student Edition.
4. David Freifelder, John Cronan and Stanly R. Maloy. 2009. Microbial Genetics. 2nd Edition. Narosa publishing house.

Reference Books:

1. Molecular Cell Biology. 2003, by Lodish et al., Scientific American books, W.H. Freeman and Company.
2. Molecular Genetics of Bacteria. 2nd Edition, 2003. By S. Snyder and W. Champness. ASM press.
3. Molecular Biology. 1995, by David Freifelder, Narosa Publ. House.
4. Text Book of Molecular Biology. 1994, by Sivarama Sastry et al, Macmillan India Ltd.
5. Advanced Molecular Biology: A Concise Reference. 1998, by R.M. Twyman. Viva Books Pvt ltd.

Semester IV – Core Practicals
Microbial Genetics and Molecular Biology

Sub Code: 184MB4M02 **Number of Hours: 2**

1. Qualitative estimation of DNA and RNA by UV spectrophotometric method.
2. Quantitative estimation of DNA by Diphenylamine method.
3. Quantitative estimation of RNA by Orcinol method.
4. Isolation of plasmid-DNA and detection by agarose gel electrophoresis.
5. Genomic DNA Isolation and detection by agarose gel electrophoresis.
6. Preparation of competent cells by calcium chloride method.
7. Isolation of auxotrophic mutants by UV induced mutagenesis (Replica plating technique).
8. Isolation of antibiotic resistant mutants by gradient plating method.

Semester IV – Allied Paper
Allied Hematology and Histopathology

Sub Code: 184MB4A03 **Number of Hours: 4**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Learn the classification and functional properties of blood components.
CO 2: Understand coagulation and anti-coagulation mechanisms of blood.
CO 3: Possess the analytical skills in hematology.
CO 4: Examine blood by staining techniques.
CO 5: Know about blood groups, transfusion process and blood banking.
CO 6: Become familiar with histological procedures.

Unit I

Blood: Definition, Composition - Plasma and Formed Elements (RBC, WBC and Platelets) and functions. Collection of Blood: Capillary and Venous Blood. Anticoagulants: Definition and Types: Wintrobes, EDTA, Heparin, Citrate, Advantages and Disadvantage.

Unit II

Counting of Blood Cells: Neubaeur counting chamber - Total RBC count and Total WBC count: False Low and High Counts, Normal values, Correction for TWBC – Absolute Eosinophil count– Platelet Count– Reticulocyte count. Haemoglobin: Composition and Normal Values - Determinations: Colorimetric – Drabkins, Specific Gravity, Gasometric and Chemical methods.

Unit III

Coagulation Mechanism: Factors, Intrinsic and Extrinsic pathways, PT and APTT. Bleeding Time and Clotting Time. Haematological Indices: - Packed Cell Volume: Wintrobes / Micro HCT method – MCV– MCH – MCHC. Erythrocyte Sedimentation Rate- Principle-Determination: Wintrobes / Westegren Method – advantages / disadvantages – Factors influencing ESR.

Unit IV

Different types of stains: Wright stain, Leishmans stain, Giemsa's stain. Staining Technique – Differential Leucocyte count: Examination of Blood smear – Granulocyte / Agranulocytes, Morphology - Blood parasites: Malarial parasite.
ABO Grouping and Rh Typing: slide / Tube Technique, Coombs Test: Direct / Indirect – Donor screening – Cross Matching: Major / Minor. Preservation and storage of blood.

Unit V

Principles and procedures in preparing tissues for Microtomy – block making – trimming – adjusting the microtome for selecting the blocks -procedure in staining-dehydration and mounting on slides – mounting medium- Types of mounting media-Examination of mounted slides for clarity. Cell culture: Primary cell lines, secondary and continuous cell culture.

Text Books:

1. Essentials of Hematology Paperback – 2013by Shirish M Kawthalkar
2. Wintrobe's Clinical Hematology Hardcover – 2013 by John P. Greer (Editor), Daniel A. Arber (Editor), Bertil E. Glader (Editor), Alan F. List (Editor).
3. Clinical Pathology, Hematology and Blood Banking (For DMLT Students) by Nanda maheshwari

Reference Books:

1. Dacie and Lewis Practical Haematology - 12th Edition - Elsevier
2. Williams Hematology 9thEdition by Kenneth Kaushansky, Marshall Lichtman.
3. Modern Hematology – Biology & Clinical management Edited by Reinhold Munker, Hemana Press (2007)
4. Color Atlas of Hematology practical microscopic and clinical diagnosis by Harald Theml (2005)
5. Clinical Hematology Atlas, Bernadette F. Rodak, Jacqueline H.Carr 4 Edition (2013)

Semester IV – Allied Practicals
Allied Hematology and Histopathology

Sub Code: 184MB4A04 **Number of Hours: 2**

1. Collection of Blood: Capillary blood /venous blood from Adults/ Children.
2. Haemoglobin Estimation: Sahli's acid haematin method, Drabkin's method.
3. Total RBC Count: Macro/ Micro Dilution.
4. Total WBC Count: Macro/ Micro Dilution.
5. Differential Leucocyte Count: Staining technique.
6. Absolute Eosinophil Count
7. Platelet Count: Direct /Indirect Method.
8. Bleeding Time / Clotting Time
9. Peripheral Smear Report
10. Indices: PCV /MCV / MCH/ MCHC.
11. Erythrocyte Sedimentation Rate: Westergren/ Wintrobes.
12. Blood Grouping: Slide /Tube technique.

Semester IV – Core Paper (Without practicals)
Recombinant DNA Technology and Bioethics

Sub Code: 184MB4M05 **Number of Hours: 3**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know about isolation and amplification of DNA samples.
CO 2: Have knowledge on construction of artificial and hybrid vectors.
CO 3: Appreciate the uses of gene cloning methods.
CO 4: Learn tissue culture techniques.
CO 5: Identify ethical issues and appreciate biosafety concepts.

Unit-I

Introduction to rDNA technology, Blotting techniques, Amplification of DNA in vitro-PCR, Analysis of restricted DNA: agarose gel electrophoresis.

Unit-II

Tools of genetic engineering –Restriction enzymes, Vectors- plasmid, phage (2 examples), cosmid, phagemid and shuttle vectors(1 example), DNA probe, linkers and adaptors, Cloning organisms - (Bacteria and Yeasts), Cloning strategies, Preparation of genomic libraries and selection of recombinants.

Unit-III

Applications of genetic engineering: Medicine-gene therapy, Pharmaceuticals-vaccines, interferon and insulin production, Agriculture-GM crops, and Environment-pollution detection and control.

Unit-IV

Introduction to cell and tissue culture- Tissue culture as a technique to produce novel plants and hybrids, Tissue culture media (composition and preparation), callus and suspension culture, protoplast culture, concept of transgenic plants and transgenic animals.

Unit-V

Ethical issues against molecular technologies-Legal issues-legal protocols followed by various countries with respect to molecular technologies, Social issues-public opinions, Ethical conflicts in rDNA technology-interference with nature, biosafety concepts.

Text Books:

1. Gene Cloning and DNA Analysis – An Introduction. 5th edition-2006 .T.A Brown. Blackwell Publication.

2. An introduction to genetic engineering. 2nd edition. 2004. D.S.T. Nicholl. Cambridge University Press.
3. Smita Rastogi and Neelam Pathak. 2009. Genetic Engineering. Oxford Higher Education.
4. Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources Institute, TERI

Reference books:

1. Principles of Gene Manipulation and Genomics. 7th edition -2008, S.B. Primrose and R.M. Twyman. Blackwell publication.
2. Recombinant DNA Genes and Genomes: A Short course. 3rd edition -2007 James D. Watson, Amy A. Caudy, Richard M. Mayes & Jan A. Witkow.
3. Recombinant DNA and biotechnology: A guide for Teachers: 2nd ed. H. Kreuzer and A.Massey. ASM Press.
4. Principles of Gene Manipulation: An introduction to genetic engineering. 2001. 6th ed. Old and Primrose. Blackwell Scientific Publication.
5. Monika Jain. 2011. Recombinant DNA techniques. Narosa Publishing House.
6. K. Rajagopal.2012. Recombinant DNA Technology and Genetic Engineering. Tata McGraw Hill Education Private Limited.

Semester V – Core Paper
Bacteriology and Virology

Course Code: 184MB5M01 **Number of Hours: 5**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Acquire basic knowledge on bacteria and viruses of medical importance.
CO 2: Appreciate the role of indigenous microbial flora in human health.
CO 3: Know about the mechanisms of bacterial and viral pathogenesis and disease control measures.
CO 4: Learn about the various laboratory methodologies for bacterial and viral identification.
CO 5: Perform isolation and identification of pathogenic bacteria from clinical samples.
CO 6: Understand the use of laboratory animals in host-parasite interactions.

Unit – I

Collection and transport of clinical specimens for microbiological examination. Normal microflora of human body and its importance. Gnotobiosis and host-parasite interactions. Nosocomial infection and Antimicrobial susceptibility tests.

Unit–II

Classification, morphology, culture identification, pathogenesis, laboratory diagnosis and prophylaxis of gram positive bacterial pathogens - *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Clostridium*, *Bacillus* and *Mycobacterium tuberculosis*.

Unit–III

Classification, morphology, culture identification, pathogenesis, laboratory diagnosis and prophylaxis of gram negative bacterial pathogens - *Salmonella*, *Shigella*, *Escherichia coli*, *Pseudomonas*, *Vibrio*, Introduction to Rickettsia (typhus fever group and Rocky mountain spotted fever), Spirochetes -*Treponema* and *Leptospira*

Unit – IV

General properties of viruses and its common diagnostic methods. Brief account on classification, morphology, cultivation, antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis of the following group of viruses – Variola (Pox virus), Herpes simplex virus, Polio viruses, HIV, Hepatitis A and B virus, Rabies virus, Mumps virus and Dengue virus.

Unit – V

Introduction to emerging and re-emerging viruses - H1N1 Flu (Swine Flu), Ebola and Chikungunya.

Text books:

1. Ananthanarayanan .R and Jayaram Panikaer, C.K. (2017), 10th edition. Textbook of Microbiology, Orient Longman.
2. Review of Medical Microbiology 14th edition, Jawetz.
3. Chakraborty P. A Text book of Microbiology. 2nd Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
4. Satish Gupte. The short textbook of Medical Microbiology. 8th Edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.

Reference books:

1. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2002) Medical Microbiology, 16th Edn. Churchill Livingstone, London.
2. Topley &Wilson's (1995) principles of Bacteriology, Virology and Immunity. 9th Edi. Edward Arnold London (5 Vol.)
3. Principles of Virology: (2015), 4th edition. S. Jane Flint, Vincent R. Racaniello.

E-references:

1. Microbiology and Immunology online, University of South Carolina School of medicine. https://www.microbiologybook.org.
2. https://microbe.net/resources/microbiology-web-resources/
3. http://www.blackwellpublishing.com/wagner/animations.asp

Semester V – Core Practicals
Bacteriology and Virology

Course Code: 184MB5M02 **Number of Hours: 3**

1. Direct microscopy of clinical specimens - Throat swab, Pus, Sputum and Stool.
2. Isolation and identification of bacterial pathogens from clinical specimen (Sputum, Pus, Urine, Feces and blood) by staining, cultural characteristics and bio-chemical identification.
3. Diagnostic analysis of urine for significant bacteriuria – Qualitative and Semi-Quantitative.
4. Antimicrobial susceptibility test by Kirby-Bauer disc diffusion method.
5. Minimum inhibitory concentration (MIC) test- Demonstration.
6. Spotters –Virology

Semester V – Core Paper
Industrial Microbiology

Course Code: 184MB5M03 **Number of Hours: 5**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Appreciate the role of microorganisms in industrial processes
CO 2: Isolate and maintain the commercially-potent microbial strains
CO 3: Know the significance of microbial strain improvement
CO 4: Understand the industrial fermentation processes
CO 5: Perform the role of a microbiologist in the fermentation industry
CO 6: Have a basic knowledge on patenting procedures

Unit - I

Industrial Microbiology: Introduction, history and development – Prospecting and screening of commercially important microorganisms – Concept of strain improvement and strain improvement techniques – Culturing and maintenance of industrially important microbes - Immobilization of enzymes and microbial cells.

Unit – II

Fermenter: principles, components, design and types – Types of fermentation: Submerged and solid state; Batch, fed-batch, Continuous and semi-continuous culture systems – Operation, optimization and automation of fermentation processes.

Unit – III

Upstream processing: Scaling up of the culture - Commercial media used in bacterial and fungal fermentation – Industrial sterilization: fermenters, fermenter components and media – Downstream processing: Cell separation, cell lysis and product recovery methods.

Unit – IV

Microbial production of amylase – Production of L-Glutamic acid – Acetic acid and citric acid production – Vitamin B_{12} production from microorganisms - Manufacture of alcoholic beverages by fermentation: beer, wine – Single cell proteins: bacterial, fungal and algal SCPs.

Unit – V

Microbial production of biosurfactants, bioplastics and other biopolymers (xanthan and cellulose) - Brief account of patenting processes in India. Government initiatives: Technology business incubators, SBIRI.

Text Books:

1. Patel A.H. (2016). Industrial Microbiology (2nd edition). Laxmi Publications.
2. Reed G. (2004). Prescott and Dunn's Industrial Microbiology, Macmillan.
3. Casida L.E. (1968). Industrial Microbiology. Wiley.

Reference Books

1. Waites M.J., Morgan N.L., Rockey J.S. & Higton G. (2013). Industrial Microbiology – An Introduction. Blackwell Science.
2. Stanbury P.F., Whitaker A., Hall S.J. (2016). Principles of Fermentation Technology (3rd edition), Butterworth-Heinemann, Elsevier.
3. Fogarty W.M. & Kelly C.T. (2012). Microbial Enzymes and Biotechnology (2nd edition). Elsevier Applied Science.
4. Goldberg E. (2012). Handbook of Downstream Processing. Blackie Academic & professional, Chapman and Hall.
5. Singh K.K. (2014). Biotechnology and Intellectual Property Rights: Legal and Social Implications. Springer.

E-references:

1. Vandamme, E. J. Production of vitamins, coenzymes and related biochemicals by biotechnological processes. Journal of Chemical Technology and Biotechnology. https://onlinelibrary.wiley.com
2. Singhania, Reeta Rani; Patel, Anil Kumar; Pandey, Ashok. Soetaert, Wim; Vandamme, Erick J. (eds.). Industrial Biotechnology. Wiley-VCH Verlag GmbH & Co. KGaA. https://onlinelibrary.wiley.com
3. Jaume Mir. Industrial microbiology - A new challenge. http://scielo.isciii.es/
4. Industrial Microbiology - An Introduction. https://www.wiley.com
5. Industrial Microbiology - Fermenter history, functions and construction. https://www.biologydiscussion.com/

Semester V – Core Practicals
Industrial and Environmental Microbiology

Course Code: 184MB5M04 **Number of Hours: 6**

1. Preparation of wine from grape juice and estimation of alcohol.
2. Preparation of immobilized yeast cells.
3. Production of citric acid using *Aspergillus niger*.
4. Screening of antibiotic-producing organisms from soil.
5. Isolation of organisms producing amylases, cellulases and proteases from soil.
6. Production of cellulase by solid-state fermentation.
7. Cultivation of Spirulina.
8. Enumeration of microorganisms from soil.
9. Enumeration of microorganisms from water.
10. Assessment of microbiological quality of air by settle plate method.
11. Isolation of Rhizobium from root nodules of leguminous plants.
12. Isolation of phosphate-solubilizing microorganisms from soil.
13. Study of plant pathogens – *Erwinia, Pseudomonas, Fusarium, Alternaria.*
14. Microbiological analysis of water sample i) qualitative determination of coliforms by presence-absence test, ii) quantitative estimation of coliforms by MPN method iii) presence of faecal coliforms in water by Ejekman's test.
15. Estimation of 5-day BOD of sewage sample.

Semester V – Core Paper
Environmental Microbiology

Course Code: 184MB5M05 **Number of Hours: 5**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Appreciate the importance of environmental microbiology in understanding and solving global environmental problems
CO 2: Isolate and maintain the potential microbial strains from the environment
CO 3: Carry out microbiological analysis of environmental samples
CO 4: Understand the working of a wastewater treatment plant
CO 5: Have a basic knowledge on production of carbon-neutral biofuels
CO 6: Learn about commercially important crop infectious diseases
CO 7: Understand the significance of biofertilizers in sustainable agriculture

Unit - I

Microbiology of air – Bioaerosols and aeroallergens – Factors influencing the microbial load in air - Air sampling devices and enumeration of air microflora – Air-borne diseases - Air sanitation and microbiological air standards.

Unit – II

Microbiology of water – Water pollution – Eutrophication: sources, consequences and control - Water-borne diseases, their prevention and control – Microbiological examination of water and indicator organisms – Drinking water standards – Treatment of drinking water: Purification and disinfection.

Unit – III

Bioremediation - Sewage microflora - Treatment of domestic and industrial wastewaters: physical, chemical and biological treatments – TNPCB norms and regulations for discharge water - Biodegradation of recalcitrant compounds: lignin and plastics - Biodeterioration: its types, prevention and control.

Unit – IV

Biofuels: Biodiesel, bioethanol, biomethane and biocrude production from microorganisms - Biological sequestration of carbon dioxide with special reference to microorganisms – Concept of Environmental Impact Assessment - Environmental management system.

Unit – V

Brief account of bacterial, fungal and viral plant diseases – Microbial biopesticides: Advantages and drawbacks – Bacterial and cyanobacterial biofertilizers: Mass production and field application methods (Rhizobium and Anabaena) – Integrated pest management system.

Text Books:

1. Atlas R.N. & Bartha R. (1998). Microbial Ecology – Fundamentals and Applications (4th Edition), Benjamin Cummings.
2. Sharma P.D. (2010). Microbiology and Plant pathology (2nd edition). Rastogi Publications.
3. Rangaswami G & Mahadevan A (1998). Diseases of Crop Plants in India (4th Edition), Prentice–Hall of India Pvt. Ltd.

Reference Books:

1. Pepper I.L., Gerba C.P. & Gentry T.J. (2014). Environmental Microbiology (3rd edition). Academic Press, Elsevier.
2. Bitton G. (2011). Wastewater Microbiology (4th edition). Wiley-Blackwell.
3. Bridgewater L. (2012). Standard Methods for the Examination of Water and Wastewater. American Public Health Association.
4. Woolverton C.J., Sherwood L., Willey J. (2016). Prescott's Microbiology (10th edition). McGraw-Hill Education.
5. Ravichandra N.G. (2013). Fundamentals of Plant pathology. PHI Learning Pvt Ltd.
6. Tinsley S., & Pillai I. (2012). Environmental Management Systems – Understanding Organizational Drivers and Barriers. Earthscan.

E-References:

1. Environmental Impact Assessment (EIA) Process and Procedures (2019). https://www.pmfias.com/eia-environmental-impact-assessment/
2. TNPCB discharge standards for treated sewage and trade effluent. https://sites.google.com/a/morfindia.com/projects-morfindia/stp-tnpcb-norms

Semester V – Core Paper
Computer Training

Course Code: 184MB5M07 **Number of Hours: 2**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know about the basics of computers.
CO 2: Have an insight in various computing platforms.
CO 3: Know about HTML function and Web Page designing.
CO 4: Acquire knowledge about networking basics.
CO 5: Understanding internet web browsing, Search engines and Availability of E-resources in life sciences.

Unit I

Knowing Computer – Parts of a Computer - Input and output devices - hardware and software. Application of computers in various fields.

Unit II

Introduction to Computing Platform – Demonstration of Operating systems - Windows, Macintosh, Unix, Linux. Understanding Processing and Presentation of Data – Word Processing (MS-Word), Basics of Spreadsheet (MS-Excel), Basics of presentation
(MS- Power point).

Unit III

Basics of HTML and Web Page Designing - Text styles, Adding pictures, backgrounds and music, tables and frames.

Unit IV

Introduction to internet, WWW and Web Browsers. Basics of Networking – LAN, WAN, Network topology, Protocols. Browsers used in Biology

Unit V

Computer communication: Introduction to internet web browsing, Usage of Electronic mail (E-mail). Introduction to Search engines. Finding scientific articles – PubMed, Medline

Text Books:

1. Dave Taylor. 2nd ed, 2000. HTML 4.0. Tata McGraw –Hill Publishing Company Ltd, New Delhi
2. Paul McFedries. 2016. My Microsoft office 2016 Sams publishing techmedia, New Delhi.

3. Deborah Morley & Charles S Parker 2015. Understanding Computers today and tomorrow comprehensive, 15th ed. Cengage Learning Stamford. CT 06902

Reference Books:

1. Paul McFedries. 2015. Teach yourself VISUALLY Windows 10. Published by John Wiley & Sons, Inc. Indianapolis, IN 46256.
2. Systems Biology: Definitions and perspectives by L.Alberghina H.V.westerhoff, Springer. 2005
3. Synthetic Biology, A New Paradigm for Biological Discovery, a report by Beachhead Consulting, 2006

E-references:

1. Introduction to computers, The Journey inside, Explore the Curriculum. www.intel.in
2. Omkar Phatak, "Role of Computers in Research", http://www.buzzle.com/articles/roleof-computers-in-research.html
3. Rich McCue, Research & Collaboration Tools for Students, Staff & Faculty: Creating a Modern Memex, http://richmccue.com
4. "The role of Computer in Research", http://computersight.com/computers/the-role-of-computer-in-research/
5. "What Is The Role Of Computers In Research?", http://www.blurtit.com/

Semester VI – Core Paper
Pharmaceutical Microbiology

Sub Code: 184MB6M01 **Number of Hours: 6**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Understand and appreciate the importance of pharmaceutical microbiology
CO 2: Learn the commercial production of pharmaceutical products using microorganisms
CO 3: Acquire knowledge about Quality Assurance and Validation protocols in pharmaceutical industries
CO 4: Understand the applications of biosensors in pharmaceutical industries
CO 5: Perform microbiological analysis of pharmaceutical products
CO 6: Know about microbial contamination, spoilage and standards of various pharmaceutical products

Unit – I

Pharmaceutical microbiology: Introduction and scope - Ecology of microorganisms in pharmaceutical industry – Formulation units and active pharmaceutical ingredient manufacture units (API).

Unit – II

Pharmaceutical products from microorganisms – Commercial production of penicillin – Bacterial and viral vaccines: types and commercial manufacture - Microbial production and applications of therapeutic/diagnostic enzymes: streptokinase and streptodornase, β-lactamases.

Unit – III

Microbial contamination, spoilage and standards of various pharmaceutical products - sterile preparations: injectables, ophthalmic suspensions, implants and other parenteral preparations; their sterilization processes – Non-sterile pharmaceutical products - Solid dosage forms; liquid orals; creams, lotions and ointments; other parenteral formulations.

Unit – IV

Microbial limit test of pharmaceutical products - Sterility testing and pyrogen testing (LAL) of pharmaceutical products - Antibiotic bioassays: diffusion assays, transferase assays - Applications of biosensors in pharmaceutical industries – Concept of clean rooms, their certification and monitoring of viable and non-viable particles.

Unit – V

Quality Assurance and Validation – Aspects of QC and QA in pharmaceutical manufacturing - GMP and GLP in pharmaceutical industries – Regulatory agencies and ICH: their role in drug standards, quality and safety – certification systems - Drug

discovery and clinical trials - Drug licensing process in India. Central Drugs Standard Control Organization. (CDSCO)

Text Books:

1. Hugo, W.B., Russell, A.D, pharmaceutical Microbiology. 7th edition. Blackwell scientific publications. 2004
2. Russell & Ayliffe, G.A.J (1982) Principles and practice of Disinfection, preservation and sterilization Oxford: Blackwell scientific publications.

Reference Books:

1. Gregory P.H. Microbiology of the Atmosphere.2nd edition. Leonard Hill. 1973
2. Geoffrey Hanlon and Norman Hodges. Essential Microbiology for pharmacy and pharmaceutical science. (2013).Wiley Blackwell.
3. S. P. Vyas & V. K. Dixit. Pharmaceutical Biotechnology. (2003) CBS Publishers & Distributors, New Delhi.
4. Bhatia R and Ichhpujani RL. Quality Assurance in Microbiology. (1995). CBS Publishers, New Delhi.

Semester VI – Core Paper
Food and Dairy Microbiology

Sub Code: 184MB6M02 **Number of Hours: 6**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know the role of microbes in fermentation processes
CO 2: Understand about contamination, food spoilage and preservation techniques
CO 3: Perform the role of Microbiologist in food industries.
CO 4: Know about microbial standards of various types of foods
CO 5: Appreciate the significance of food safety and food certification systems

Unit I

Microorganisms important in food microbiology – General characteristics, classification and importance. Food as a substrate for microorganisms. Principles of food preservation –Asepsis/Removal of microorganisms: Irradiation, anaerobic conditions, temperature, drying, food preservatives.

Unit II

Microbial growth and food spoilage –factors affecting microbial growth and survival in food – contamination and spoilage of meat, fish, poultry, fruits and vegetables - canned foods.

Unit III

Sources of microorganisms in milk –contamination and spoilage of milk and milk products - Microbiological analysis of milk – Lactic acid bacteria: Probiotics, prebiotics and synbiotics - Manufacture of yoghurt, kefir, koumiss, butter and cheese.

Unit IV

Methods for microbiological examination of foods -Good manufacturing practices (GMP), quality control and HACCP - food control agencies, types of food standards, certification systems and regulation.

Unit V

Biotechnology of dairy foods - GM foods – Production of sauerkraut, oriental fermented foods – idli, tempeh, soy sauce, kombucha, natto. Food-borne diseases – food-borne infection and intoxication, risk factors associated with food-borne illness, detection of food-borne pathogens.

Text Books:

1. Adams M.R., Moss M.O. and McClure P. (2016). Food microbiology. 4th edition. The Royal Society of Chemistry, Cambridge, UK.

2. Frazier W.C. and Westhoff D.C. (1988). Food Microbiology. 4th edition, McGraw Hill, New York.
3. Robinson R.K. (2005). Dairy Microbiology Handbook 3rd edition. Wiley Interscience.

Reference Books:

1. Food Safety Management. (2014). Edited by Motarjami Y and Lelieveld H. Academic Press, Elsevier.
2. Denyer S.P., Hodges N., Gorman S.P. and Gilmore B. (2011). Hugo and Russell's Pharmaceutical Microbiology. 8th edition, Wiley-Blackwell.
3. Sandle T. (2016). Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control. Woodhead Publishing, Elsevier.
4. Microbiology in Pharmaceutical manufacturing. (2008). 2nd Edition. Vol I & II edited by Richard Prince. Published by PDA.
5. Mehra P.S. (2011). A textbook of Pharmaceutical Microbiology. I.K. International Publishing House Pvt. Ltd.

Semester VI – Core Practicals
Food, Dairy and Pharmaceutical Microbiology

Sub Code: 184MB6M03 **Number of Hours: 6**

1. Microbial limit test of raw materials/excipients.
2. Sterility testing of injectables, saline and ophthalmic preparations.
3. Sterility testing of surgical cotton, gauze, surgical gloves, and soluble powders.
4. Determination of microbial load in non-sterile pharmaceuticals (syrups/tablets/creams/ophthalmic preparations).
5. Evaluation of chemical disinfection by Rideal-Walker test.
6. Evaluation of chemical disinfection by Chick martin test.
7. Determination of surface microbiological quality of autoclaves/vessels/incubators by contact plate method.
8. Swab testing of irregular surfaces/operators' hands.
9. Determination of microbiological quality of packing materials.
10. Microbiological quality of air in sterile areas/filtration chambers.
11. Detection and estimation of bacteria in milk by Standard Plate Count Method.
12. Enumeration of bacteria in milk by Breed's count method.
13. Determination of milk quality by Methylene blue reduction.
14. Determination of milk quality by Resazurin test.
15. Litmus milk test.
16. Preparation of yoghurt.
17. Enumeration of microorganisms in curd/yoghurt.
18. Isolation and enumeration of microorganisms from bread/other bakery products.
19. Isolation & enumeration of microorganisms from mayonnaise, spreads and sauces.
20. Isolation &enumeration of microorganisms from fruits and vegetables.

Semester VI – Core Paper
Parasitology and Mycology

Sub Code: 184MB6M04 **Number of Hours: 6**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Learn about the pathogenic parasites and fungi causing human diseases.
CO 2: Learn the techniques to collect clinical samples
CO 3: Have knowledge on handling the specimen.
CO 4: Isolate and identify the pathogens
CO 5: Acquire knowledge on the diagnosis, prevention and control measures

Unit – I

Introduction to protozoa and Helminthes. Morphology, life cycle, Pathogenicity and laboratory diagnosis of common intestinal protozoans – *Entamoeba histolytica*, *Giardia lamblia*, Urogenital Protozoans– *Trichomonas vaginalis*, Blood and tissue protozoans – *Trypanosoma cruzi*, *Plasmodium* sp., *Leishmania donovani*, *Toxoplasma gondii*.

Unit – II

Morphology, life cycle, Pathogenicity and laboratory diagnosis of common Nematodes – *Ascaris lumbricoides*, *Wucheriria bancrofti*, Trematodes – *Fasciola hepatica*, Cestodes – *Taenia saginata* and *Taenia solium*.

Unit – III

Introduction to medically important fungi. Collection of clinical specimen for the diagnosis of fungal infection. Anti-fungal therapy.

Unit – IV

Dermatophytes and agents of superficial mycoses. Oppurtunistic mycotic infections - *Aspergillus*, *Mucor*, *Rhizopus* and *Candida*.

Unit – V

Yeasts and yeast like fungi of medical importance causing systemic mycoses - Coccidiomycosis, Blastomycosis, Histoplasmosis.

Text Books:

1. JegadishChander, 2016. A Text Book of Medical Mycology. Interprint, New Delhi.
2. Chakraborty, P., 2003. A Text Book of Microbiology. 2nd edition, Published by New Central Agency (P) Ltd., Kolkatta.

ReferenceBooks:

1. Monica Cheesbrough, 2003. District Laboratory Practice in Tropical Countries. Part 1 and 2. Cambridge University Press.
2. Subhash Chandra Parija, 2004. Text book of Medical Parasitology – Protozoology and Helminthology. 2nd edition, published by All India Publishers and Distributors, Medical book publisher, New Delhi.
3. JeyaramPaniker, 2004. Text book of Medical Parasitology. 5th edition, JAYPEE brothers, Medical Publishers (P) Ltd, New Delhi.

Semester VI – Core Practicals
Parasitology and Mycology

Sub Code: 184MB6M05 **Number of Hours: 3**

1. Normal saline/Lugol's iodine preparation for the examination of parasites in stool.
2. Examination of faeces by concentration methods.
3. Demonstration of common parasites.
4. Demonstration of dermotophytic fungi.
5. Wet mount examination of fungi by KOH.
6. Lactophenol cotton blue staining of fungi- Aspergillus, Mucor, Penicillium and Rhizopus.
7. Slide culture technique.
8. Germ tube, assimilation, fermentation tests for yeasts.

Semester VI – Core Paper (Without Practicals)
Bioinformatics

Sub Code: 184MB6M06 **Number of Hours: 3**

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Learn basic concept in Bioinformatics
CO 2: Learn about retrieval of stored biological data
CO 3: Acquire knowledge about bioinformatics software and tools
CO 4: Analyze the human genome data and identify drug targets
CO 5: Understand algorithms of sequence alignment and scoring matrices

Unit – I

Introduction to Bioinformatics, History and Applications of Bioinformatics, Research areas and Challenges in Bioinformatics. Database and its types, Bioinformatics tools, Sequence assembly, Finding and retrieving sequences. Programming languages – PERL and PYTHON

Unit – II

Introduction to Bioinformatics tools – sequence analysis tools (Genscan, ORF), similarity searching tools (BLAST, FASTA), visualization tools (Rasmol), structure analysis tools (GOR, NN Predict) and Phylogenetics tools (Phylip, Genetree).

Unit – III

Sequence Alignment - Pair-wise sequence alignment, homology algorithms (Smith-Watermann and Needleman-Wunsch algorithm), Substitution matrices – PAM and BLOSUM, Multiple sequence alignment - Clustal Omega.

Unit – IV

Phylogenetic analysis: Introduction and importance, Construction of phylogenetic tree, methods of phylogenetic analysis.

Unit – V

Genome mapping, Gene ontology and Functional genomics. Introduction to Human Genome Project, Human Genetic variations and Disease – GWAS and SNP. DNA Microarray.

Text Books:

1. Arthur M. Lesk, 2013. Introduction to Bioinformatics. 4th Editon. Oxford University press.
2. David W. Mount. 2004. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.

Reference Books:

1. Andreas D. Baxevanis, B. F. Francis Ouellette. 2004. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition. John Wiley & Sons, Inc. Publication.
2. Westhead, Parish and Twyman. 2002 Instant notes in Bioinformatics. Taylor & Francis Publications.
3. Bibekanand Mallick. 2008. Bioinformatics: Principles And Applications. Oxford University press.
4. Özlem Taştan Bishop. 2014. Bioinformatics and Data Analysis in Microbiology. Caister Academic Press.
5. Brian D. Robertson and Brendan W. Wren. 2012. Systems Microbiology: Current Topics and Applications. Caister Academic Press.

Semester I & II – General Course
Microbiology in Day Today Life
(For Non-Microbiology Students)

Number of Hours: 4

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know the groups of microbes, their distribution and the relevance of microbiology to society.
CO 2: Know the concept disease control and prevention.
CO 3: Appreciate the role of microbes in food production.
CO 4: Understand the role of microbes in Agriculture and environment.
CO 5: Learn the role of microbes in causing disease.

Unit-I

Groups of microorganisms –Algae, viruses, bacteria, protozoa and fungi. Distribution of microorganisms in nature. Microbiology and society.

Unit-II

Disease control and prevention - Sterilization, disinfectants, antiseptics, Antibiotics and vaccines.

Unit-III

Role of microbes in food production- fermented dairy products -curd, butter, cheese, yoghurt, fermented foods-idli, bread, pickle, Alcoholic beverages-wine.

Unit-IV

Role of microbes in Agriculture and Environment- as biofertilisers, biopesticides. Composting and sewage treatment.

Unit-V

Role of microbes in disease: Water and food borne diseases- tyhoid, cholera, polio, amoebiasis, Air borne diseases-tuberculosis, common cold, Insect borne- Malaria, Sexually transmitted –AIDS, hepatitis B.

Text Books:

1. R. C. Dubey & D. K. Maheshwari: A Text Book of Microbiology.

Reference books:

2. Robert F.Boyd , " General Microbiology " 2nd Edition times mirror / Moshy college Publishing Virginia.
3. Lansing M. Prescott. John P. Harley., Donald A.Kben, "Microbiology: 5TH Edition McGraw HILL Inc. New York.

Semester III & IV – Interdisciplinary paper
Introductory Forensic Science

Number of Hours: 4

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know the fundamentals of different laws in criminal justice system
CO 2: Learn about the forensic laboratory setup
CO 3: Understand how to collect scientific information through physical evidence
CO 4: Understand the sample collection methods, analyzing and interpreting the findings of a crime scene.
CO 5: Know about the techniques in finding a crime incident.

Unit I

Introduction, Definition, Principles, Need of Forensic Science in present scenario, Scope and development of forensic science, set up of a forensic laboratory.

Unit II

Crime: Definition, types of crime, causes of crime, prevention of crime, Difference in blue and white collar crime, Introduction of Cyber crime, Criminal Justice System, Criminal behavior

Unit III

Crime Scene: Introduction, Significance, Role of Investigator, Evaluation of crime scene, protection of crime scene, Photography of Crime scene, Tools and techniques, Significance of Photography and Videography, Introduction of Sketching, Purpose of Sketching, Making, Types and Methods of Sketching, Searching Methods. Chain of Custody - types, Significance and their evaluation.

Unit IV

Forensic investigation-Extraction of DNA from blood samples- Identification and examination of Blood stains, seminal stains, Menstrual stains and others (Saliva, Urine)-DNA fingerprinting-RFLP-STR-PCR-Legal issues. Case studies.

Unit V

Introduction and concept of Forensic Toxicology-Medico legal post mortem and their examination. Poisons: Types of poisons and their mode of action.

Text Books:

1. Handbook of Forensic Psychology by Dr. Veeraraghavan.
2. Fundamentals of forensic science by Houck, M.M and Seigel J.A., Academic press, London.2006.

3. Forensic Science in Criminal investigation and trials by Sharma B.R.,Universal Publishing Co, New Delhi,2003.

Reference Books:

1. Forensic science – A vision for 21st century by Nanda B.B and Tewari R.K., Select publisher, New Delhi, 2001.
2. Forensic Science - An Introduction to scientific and investigative techniques by James S.H., Nord by J.J, CRC Press, USA, 2003.
3. Criminal Investigation, Practical Fingerprinting, Thumb impression, Handwriting expert testimony, Opinion evidence by Bridges B.C, Univ. Book Agency, Allahbad, 2000.
4. Forensic Science and Crime Investigation by P. K. Janjua, Surinder Nath Ramesh Chandra. Abhijeet publications, 2005
5. A Hands-On Introduction to Forensic Science by Frank H Stephenson, Mark Okuda Stephenson. Routledge publishers, 2014

Semester V – General Elective
Energy Utilization and Waste Recycling

Number of Hours: 4

Course Outcomes:

Upon completion of this course, students will be able to

CO 1: Know about renewable and non-renewable energy resources and its conservation.
CO 2: Learn about segregation of biodegradable and non-biodegradable wastes
CO 3: Learn the concept of waste disposal and recycling.
CO 4: Understand the sewage treatment processes and sludge disposal.
CO 5: Understand the concept of waste management.

Unit-I

Renewable and non- renewable resources, Solar energy, wind energy, tidal energy, Geothermal energy, biomass and biogas and its utilization and conservation.

Unit-II

Biodegradable and non –biodegradable wastes, Solid wastes, liquid wastes, gaseous wastes. Sources and types of solid waste.

Unit-III

Biodegradable waste from kitchen, abattoirs and agricultural fields and their disposal by pyrolysis, sanitary landfill, aerobic composting, biomethanation and incineration. Non-biodegradable waste like plastics, glass, metal scrap and building materials and their recycling.

Unit-IV

Sewage treatment - Primary, secondary and tertiary treatment methods. Disposal of treated sludge.

Unit-V

Hazardous waste from industries and their management through Common Effluent Treatment Plants. Biomedical and electronic waste management.

Text Books:

1. Environmental management. R.K. Jain and others
2. Modern trends in ecology and environment. R. S. Ambasht

Reference books:

1. Resource ecology. S. K. Agarwal
2. Environmental management. H. V. Jadhav, Vipul Prakashan , 2002

3. James G.V.1965, water treatment – A guide to the treatment of water & effluent purification. Asia publishing house. Madras.
4. Boltan, R.L and Klein. (1971) sewage treatment, Basic principle and trends: Butterworths, London.
5. Harley, D.S. 1967. The coming age of solar energy, Sterling publisher's pvt Ltd., Delhi.