B.Sc.
Microbiology and Clinical Lab Technology

Model Syllabus

August 2023

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS UNDER CBCS PATTERN (w.e.f.2023-24)
B. Sc. MICROBIOLOGY AND CLINICAL LAB TECHNOLOGY

Sem.	Part	Course Code	Courses	Title of the Paper	T/P	Credit	Hours/ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2311T	T/OL	**தமிழ் இலக்கிய வரலாறு** –I /Other Languages-I	T	3	6	25	75	100
	II	2312E	E	General English - I	T	3	6	25	75	100
	III	23BMC1C1	CC-I	Cell Biology	T	5	5	25	75	100
		23BMC1P1	CC-II	Lab in Cell Biology	P	3	4	25	75	100
		-	Generic Elective (Allied)	Microbiology/ Biotechnology/ Biochemistry/ Zoology	T	3	3	25	75	100
				Respective Allied Theory Practical	P	2	2	25	75	100
	IV	23BMC1S1	SEC -I	Skills in Microbiology and Clinical Laboratory	T	2	2	25	75	100
		23BMC1FC	FC	Introduction to Clinical Lab Diagnosis	T	2	2	25	75	100
				Total		**23**	**30**	**200**	**600**	**800**
II	I	2321T	T/OL	**தமிழ் இலக்கிய வரலாறு** –II/Other Languages-II	T	3	6	25	75	100
	II	2322E	E	General English - II	T	3	6	25	75	100
	III	23BMC2C1	CC-III	General Microbiology	T	5	5	25	75	100
		23BMC2P1	CC-IV	Lab in General Microbiology	P	3	4	25	75	100
		--	Generic Elective (Allied)	Microbiology/ Biotechnology/ Biochemistry/ Zoology	T	3	3	25	75	100
				Respective Allied Theory Practical	P	2	2	25	75	100
	IV	23BMC2S1	SEC -II	Human anatomy and Haematology	T	2	2	25	75	100
		23BMC2S2	SEC-III	Microbial physiology and Metabolism	T	2	2	25	75	100
		--	NMC		T	2	-	25	75	100
				Total		**23**	**30**	**200**	**600**	**800**
III	I	2331T	T/OL	**தமிழக வரலாறும் பண்பாடும்** /Other Languages-III	T	3	6	25	75	100
	II	2332E	E	General English – III	T	3	6	25	75	100
	III	23BMC3C1	CC-V	Clinical Biochemistry	T	5	5	25	75	100
		23BMC3P1	CC-VI	Practical-III-Lab in Clinical Biochemistry	P	3	4	25	75	100
		--	Generic Elective (Allied)	Microbiology/ Biotechnology/ Biochemistry/ Zoology	T	3	3	25	75	100
				Respective Allied Theory Practical	P	2	2	25	75	100
		23BMC3S1	SEC-IV	Entrepreneurship	T	2	2	25	75	100
	IV	233AT/ 23BMC3S2	SEC-V	Adipadai Tamil/ Medical Microbiology	T	2	2	25	75	100
		--	NMC		T	2	-	25	75	100
				Total		**23**	**30**	**175**	**525**	**700**
IV	I	2341T	T/OL	**தமிழும் அறிவியலும்** /Other Languages -IV	T	3	6	25	75	100
	II	2342E	E	General English – IV	T	3	6	25	75	100
	III	23BMC4C1	CC-VII	Molecular Biology and Microbial	T	4	4	25	75	100

				Genetics						
		23BMC4P1	CC-VIII	Practical-IV- Lab in molecular Biology	P	3	3	25	75	100
		--	Generic Elective (Allied)	Microbiology/ Biotechnology/ Biochemistry/ Zoology	T	3	3	25	75	100
				Respective Allied Theory Practical	P	2	2	25	75	100
	IV	23BMC4S1	SEC -VI	Communicable and Non-communicable Diseases	T	2	2	25	75	100
		234AT/ 23BMC4S2	SEC -VII	Adipadai Tamil/ Environmental Microbiology	T	2	2	25	75	100
		23BES4	E.V.S	Environmental Studies	T	2	2	25	75	100
		--	NMC		T	2	-	25	75	100
				Total		**24**	**30**	**225**	**675**	**900**

V	III	23BMC5C1	CC-IX	Systematic Bacteriology and Virology	T	4	5	25	75	100
		23BMC5C2	CC-X	Clinical Immunology	T	4	5	25	75	100
		23BMC5C3	CC-XI	Recombinant DNA Technology and Molecular Diagnostics	T	4	4	25	75	100
		23BMC5P1	CC-XII	Practical-V-Lab in Bacteriology, Virology and Clinical Immunology	P	4	4	25	75	100
		23BMC5E1	DSE-I	Basics of Bioinformatics	T	3	5	25	75	100
		23BMC5E2	DSE-II	Food and Dairy Microbiology	T	3	5	25	75	100
	IV	23BVE5		Value Education	T	2	2	25	75	100
		23BMC5I		Summer Internship/Industrial Training		2	-	25	75	100
		--	NMC		T	2	-	25	75	100
				Total		**26**	**30**	**200**	**600**	**800**
VI		23BMC6C1	CC-XIII	Clinical Parasitology and Mycology	T	4	6	25	75	100
		23BMC6C2	CC-XIV	Clinical Bioinstrumentation and Diagnostics	T	4	6	25	75	100
		23BMC6P1	CC-XV	Lab in Clinical Parasitology, Mycology and Bioinstrumentation	P	4	6	25	75	100
		23BMC6E1	DSE-III	Agricultural Microbiology	T	3	5	25	75	100
		23BMC6E2	DSE-IV	Environmental Microbiology	T	3	5	25	75	100
		--		Extension Activity		1		-	-	
		23BMC6S1		Essential Reasoning and Quantitative Aptitude	T	2	2	25	75	100
				Total		**21**	**30**	**150**	**450**	**600**
				Grand Total		**140**	**--**	**1075**	**3225**	**4300**

- T/OL-Tamil/Other Languages,
- E – English
- CC-Core course
- Generic Elective (Allied)
- SEC-Skill Enhancement Course
- DSE – Discipline Specific Elective

Semester – I						
Course code:	**Core I**	**L**	**T**	**P**	**C**	**H/W**
23BMC1C1	**Cell Biology**	**-**	T		**5**	**5**

Objectives	➢ Make the students to understand the different aspects to the classification ofProkaryotes and Eukaryotes. ➢ Make the students knowledgeable on the role of cell organelles. ➢ In-depth an on knowledge on the cell cycle and cell signaling.
Unit –I	**Cell as a basic unit of living systems:** History of cell biology, cell as basic unit of life, cell theory, protoplasm theory and organismal theory, broad classification of cell types, Bacteria, Archaea (prokaryotic) and eukaryotic cells and their similarities and Differences.
Unit-II	**Structure and function of cell organelles:** Structure and functions of cell wall: bacterial cell wall – plant cell wall and fungal cell wall, plasma membrane – exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport. Cytoskeletonstructure – microtubules, microfilaments, intermediate filament.
Unit III	**Structure and functions of cell organelles**: Endoplasmic reticulum (rough endoplasmic reticulum and smooth endoplasmic reticulum), golgi apparatus, lysosomes,microbodies (peroxysomes and glyoxysomes), vacuoles, ribosomes, centriole and basal bodies. **Mitochondria** – organization of respiratory chain, chloroplasts – photophosphorylation, nucleus, nucleolus, nuclear membrane and organization of chromosomes.
Unit IV	**Cell cycle:** Eukaryotic cell cycle and its regulation, Cell division- Mitosis and Meiosis **Cell death:** Development of cancer, causes and types, Programmed cell death. **Cellrenewal:** Stem cells Embryonic stem cell, induced pleuripotent stem cells.
Unit V	**Cell signaling: Overview** – types of cell signaling – Signalling molecules and their receptors– signal amplification — Function of cell surface receptors, Quorum sensing. **Pathways of intra-cellular receptors** – Cyclic AMP pathway, cyclic GMP and MAP Kinase pathway.

Reference and Textbooks

Alberts, B. Johnson, A. Lewis, J. Raff, M. Roberts K., (2002). Molecular Biology of the Cell,(4th ed),

De Roberties, E.D.P. and De Roberties, (1995). Cell and Molecular Biology, (8th ed), WaverlyPvt. Ltd., New Delhi.

Garland Publishing (Taylor & Francis Group), New York.

Geoffrey Cooper M, Robert E. Hausman, The Cell: A Molecular Approach, (4th ed), ASM Press,Washington D.C. & Sinauer Associates, Inc, Massachusetts.

Harvey Lodish, (2004). Molecular Cell Biology, 5th edition, W.H.Freeman and Company, NewYork.

Karp, G.Harris, D, (1999). Cell and Molecular Biology – Concepts and Experiments, (2nd ed),John Wiley & Sons, New York.

Lewin, B. (2004). Genes VIII, Pearson Prentice Hall.

Outcomes	➢ The students will get depth knowledge in fundamental principles of cellular biology ➢ Able to understand the principles behind cell movement, cell growth, cell division,cell death, and cell signaling. ➢ Aware of the pathways of intracellular receptors.

Semester –I						
Course code: 23BMC1P1	**Core Practical II**	**L**	**T**	**P**	**C**	**H/W**
	Lab in Cell Biology	-	-	P	3	4

Objectives

- Improve the student's knowledge and impress upon them the important aspects of microorganisms
- Give practical knowledge and skill in the isolation and handling of microorganisms.
- Make acquainted with pure culture techniques and methods of culturing preservation and maintenance of microorganisms

1. Principles of sterile techniques and cell propagation
2. Detection of different stages of Mitosis.
3. Detection of different stages of Meiosis.
4. Identification of given plant, animal and bacterial cells and their components bymicroscopy.
5. Staining for different stages of mitosis in *AlliumCepa* (Onion)
6. Examination of polyploidy in Onion root tip by colchicine treatment.
7. Separation of Peripheral Blood Mononuclear Cells from blood.
8. Identification of cells by Giemsa staining and Leishman staining.
9. Enumeration of cells by Tryphan blue assay.
10. Osmosis and Tonicity

Reference and Textbooks

1. Rajan, S, (2012). Manual for Medical Laboratory Technology, Anjanaa Book House,Chennai.
2. Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers
3. Rajan S and Selvi Christy R (2012).Experimental procedures in Life Sciences,Anjanaa Book house, Chennai.
4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York,
5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology,Churchill Livingstone, London
6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology,(16thed), Churchill, Livingstone, London
7. Hardin J, Bertoni G and Kleinsmith LJ. (2010).Becker's World of the Cell. 8th edition.Pearson.
8. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition.John Wiley & Sons. Inc.
9. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8thedition. LipincottWilliams and Wilkins, Philadelphia.
10. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5thEdition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Outcomes

- The students are be able to identify standard methods for the isolation,identification and culturing of microorganisms.
- The students can able to identify the different groups of microorganisms from different habitats.

Semester – I						
Course code: 23BMC1S1	**SEC I**	**L**	**T**	**P**	**C**	**H/W**
	Skills in Microbiology and Clinical Laboratory		T		2	2
Unit –I	Sterilization, disinfection and aseptic techniques - Definition of sterilization, disinfection, decontamination. Dry heat and moist heat. Principle and working of autoclave, pressure cooker, hot air oven. Maintenance of cultures- Stock cultures and subcultures.					
Unit-II	Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection.					
Unit III	Basic Haematology and Clinical biochemistry – Sample collection - Blood, plasma, serum – definition. ABO blood group system. Haemoglobin determination by haemoglobinometer. Diabetes Mellitus – GTT.					
Unit IV	Anitmicrobial Drugs – types, and applications; Antibiotics – Discovery, types, and functions; Vaccines – types, uses and schedules.					
Unit V	Diagnostic Methods- Outline of Radio imaging- X-Ray, MRI, CT, Ultra sound scan, Mamography, ECG, ECHO, sphygmomanometer, Autoanalyser.					

Reference and Textbooks

1. GradWohl, Clinical Laboratory-methods and diagnosis, Vol-IKanai L. Mukherjee, Medical Laboratory Technology Vol. I.Tata McGraw Hill 1996, NewDelhi.
2. Sood Ramnik,(2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications
3. Ananthnarayanan, R and Jeyaram Panicker, C. K. Textbooks of Microbiology. Orient Longman. 17th edition. (2010).
4. Michael, J. Pelczar, Jr. E.C.S., Chan, Noel R. Krieg Microbiology Tata McGrawHill Publisher. (1998).
5. Willey, J.M., Sherwood L.M and Woolverton C.J., Prescott, Harley and Klein's. Microbiology. McGraw Hill Higher education. 9th Edition. (2013).
6. Cappuccino, J.G. and Sherman, N. Microbiology: A Laboratory Manual. Pearson Education Limited, London. (2013)
7. Modi H.A, A Handbook of Elementary Microbiology Vol I, Fundamentals of Microbiology, AKTA Prakashan, India, (1995)

Semester - I						
Course code: 23BMC1FC	**Foundation Course**	**L**	**T**	**P**	**C**	**H/W**
	Introduction to Clinical Lab Diagnosis		T		2	2

Objectives	➢ To know the basic Equipments and apparatus in laboratory. ➢ To provide knowledge about the basic laboratory techniques.
Unit –I	Role of Medical Laboratory technologists – ethics of laboratory practice. Laboratory safety – Common lab accidents their prevention and their first aid.
Unit-II	Collection and Transportation of Specimen: Containers - Samples- Urine, Feces, Sputum, Pus, Swab, Blood. Various anticoagulants - E.D.T.A, Dipotassium salts of EDTA, Double oxalate, single oxalate, sodium citrate, Sodium Fluoride, heparin.
Unit III	Introduction to Laboratory Apparatus Pipettes- different types (Graduated, volumetric, Pasteur, Automatic etc.), Calibration of glass pipettes, Burettes, Beakers, Petri dishes, depression plates. Flasks – different types- Volumetric, round bottomed, Erlenmeyer conical etc. Desiccators, Cuvettes - types, significance of cuvettes in colorimeter, cuvettes for visible and UV range, Cuvette holders.
Unit IV	Instruments : Water bath - Use, care and maintenance, Oven & Incubators - Use, care and maintenance, Water Distillation plant and water deionizers - Use, care and maintenance, Colorimeter - Parts, diagram, Use, care and maintenance, pH meter and electrodes - Use, care and maintenance, Guidelines to be followed and precautions to be taken while using pH meter.
Unit V	Solutions and Dilutions - Preparation of solution: Normal solution, Buffer solution, Percent solution, Molar solution. Diluting solutions: e.g. Preparation of 0.1N NaCl from 1N NaCl from 2N HCl. Preparing working standard from stock standard.

Reference and Textbooks

- Godkar, P.B., & Godkar, D.P. (1996). Textbook of Medical Laboratory Technology (2nd edition). Bhalani publication House.
- Mukherjee, K. L. (1996). Medical Laboratory Technology (Volume-I, II, III). New Delhi: Tata Mc GrawHill.
- Satyanarayanan, U. (2002). Essentials of Biochemistry. Books and allied (P) Ltd.
- Deb, A.C. (2002). Fundamentals of Biochemistry. Books and allied (P) Ltd.
- Zubay, G.L. (1998). Biochemistry. New York: W.M.C.Brown Publishers.

Outcomes	➢ The students will gain knowledge on standard methods and techniques in the laboratory. ➢ Understand and acquire knowledge on basic laboratory glasswares and instruments.

Semester – II						
Course code: 23BMC2C1	**Core III**	**L**	**T**	**P**	**C**	**H/W**
	General Microbiology		T		5	5

Objectives	➢ Become familiar with the basic concepts of history of Microbiology ➢ Impart knowledge on structural organization and morphology of microbes ➢ Gain the knowledge of microscopy, sterilization and staining concepts
Unit –I	**History and Scope of Microbiology:** Definition and scope of microbiology. History- Spontaneous generation, Contribution of Leeuwanhoek, Louis Pasteur, Robert Koch, Edward Jenner, Lazaro Spallanzani, John Tyndall, Joseph Lister, Alexander Fleming and Kary B Mullis. Microbial Kingdoms- Haeckel's Three Kingdom and Whittaker's Five Kingdom concept. Bacterial classification (outline) according to Bergey's manual of systemic Bacteriology.
Unit-II	**General characteristics and Ultra structure of bacteria:** Size, shape and arrangement of bacterial cells, Cell wall of Gram negative, Gram positive bacteria, Capsule composition and function, Cell membrane structure and functions, Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials– polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions, Bacterial endospores. Bacterial Reproduction.
Unit III	**Staining techniques, Bacterial Growth and Nutrition:** Types of staining – Principle and procedure –Simple, Differential – Gram, Acid fast, Structural – capsule, endospore. Bacterial Growth curve – Lag Phase, Exponential Phase and decline Phase. Factors influencing and affecting microbial growth – pH, temperature and light. Nutritional groups of bacteria.
Unit IV	**Principles and methods of Sterilization and Types of media:** Physical methods (Heat, Filtration and radiation) and Chemical methods. Chemotherapy – antibiotics – source –classification – mode of action – antimicrobial resistance. Types of growth media (natural, synthetic, complex, enriched and selective media).
Unit V	**Microscope Principles and applications:** Principles of microscopy, Simple, compound light microscopy– construction and function of parts, principle, construction, and applications of Dark field, Phase contrast and Fluorescence microscopes. Electron microscopy – TEM and SEM – principle, construction, and uses.

Reference and Textbooks

1. Prescott, Joanne Willey, Linda Sherwood, & Christopher,J.W., (2017). *Microbiology* (10th ed). NewYork: McGraw Hill.
2. Tortora G.J., Funke, B.R.and Case, C.L. (2009). *Microbiology* (9th ed). Noida: Dorling Kindersely(India) Pvt. Ltd.
3. Pelczar, M.J., Schan, E.C. and Kreig, N.R. (2010). *Microbiology: An Application Based Approach*.Tata McGraw Hill Education Private Limited.
4. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). *Biology Microorganisms* (12th ed).New Jerry: Prentice Hall.
5. Atlas, R.A., & Bartha, R., (2000). *Microbial Ecology, Fundamentals and Application*. New York:Benjamin Cummings.
6. Stanier R.Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.

Outcomes	➢ Can clearly understand the history and classification of bacteria ➢ The students are getting depth knowledge of various types of microscopes and their application. ➢ Able to understand various (physical and chemical) methods of control of microorganisms ➢ The students are aware of the structure of bacterial cells and also the staining methods used to identify the bacteria.

Semester –II						
Course code: 23BMC2P1	**Core Practical II**	**L**	**T**	**P**	**C**	**H/W**
	Lab in General Microbiology			P	3	4

Objectives

- Improve the student's knowledge and impress upon them the important aspects ofmicroorganisms
- Practical knowledge and skill in the isolation and handling of microorganisms.
- Make acquainted with pure culture techniques and methods of culturing preservation and maintenance of microorganisms

1. Safety measures and rules of conduct to be followed in a microbiological laboratory.
2. Cleaning of Glass wares and media Preparation; Bacterial Culture Characteristics &identification
3. Handling and Care of Microbiological Instruments. Preparation & dispensing of Culture media
4. Enumeration of microbes by serial dilution method
5. Pure culture techniques- Spread plate, streak plate and pour plate technique.
6. Staining Techniques – Gram's staining, Acid-fast staining, Endospore Staining and Capsule staining
7. Test for Motility of bacteria - Hanging drop technique
8. Identification of bacteria by biochemical reactions.
9. Identification of bacteria using selective media.
10. Micrometry- Microscopic measurements of Bacterial cell

Reference and Textbooks

1. Rajan S, Manual for Medical Laboratory Technology (2012), Anjanaa Book House,Chennai.
2. Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers.
3. Rajan S and Selvi Christy R (2012). Experimental procedures in Life Sciences, Anjanaa Book house, Chennai.
4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York,
5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, ChurchillLivingstone, London.
6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, (16^{th}ed), Churchill, Livingstone, London.
7. Hardin J, Bertoni G and Kleinsmith LJ. (2010).Becker's World of the Cell. 8th edition.Pearson.
8. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. JohnWiley & Sons. Inc.
9. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition.LipincottWilliams and Wilkins, Philadelphia.
10. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Outcomes

- The students are be able to identify standard methods for the isolation, identification and culturing of microorganisms.
- The students can able to identify the different groups of microorganisms fromdifferent habitats.

Semester - II						
Course code: 23BMC2S1	**SEC-II**	**L**	**T**	**P**	**C**	**H/W**
	Human Anatomy and Haematology		T		2	2

Objectives	➢ Understand the cellular and tissue level organization in the human body ➢ Provide an-in depth knowledge about the structure and functions of the internalorgans. ➢ Understand the human blood and its disorders based on an up-to-date knowledge. ➢ Provide in depth knowledge about the pathology and Pathophysiology of hematological disorders.
Unit –I	**Cellular level of organization:** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, **Forms of intracellular signaling:** a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine.
Unit-II	**Tissue level of organization:** Classification of tissues, structure, location and functions of epithelial, muscular, nervous and connective tissues. Structure, organization and functions of **Integumentary system (**skin), **Respiratory System, Digestive System, Circulatory System and Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction.
Unit III	**Endocrine system:** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders. **Nervous system:** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, receptors, synapse,neurotransmitters. **Central nervous system**: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity. **Peripheral nervous system**: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.
Unit IV	**Composition of Blood and its functions:** Definition**,** Plasma, Red blood cells (erythrocytes), white blood cells (Leucocytes) and platelets. **Plasma proteins** – Albumin, globulin and fibrinogen**. Common anticoagulants -** composition, amount and mechanism of action. **Haemotopoietic system of the body-** Leukopoiesis, erythropoiesis and thrombopoiesis**. Physiology and anatomy of bone marrow. Haematopoiesis-** Definition, hematopoietic stem cell lineages and growth factors, regulation of hematopoiesis and programmed cell death. Components for control of hematopoiesis- cytokines and growth factors. **Haemostasis:** Definition, mechanism of preventing blood loss- Vasoconstrictive phase, platelet phase and Coagulation phase.
Unit V	**Blood clotting factors:** Plasma coagulating factors and platelet coagulating factors**-** Extrinsic and intrinsic pathways – **Blood clotting inhibitors:** anticoagulant, heparin and antithrombin, fibrinolysis by plasmin. **Blood Disorder:** blood disorders that cause a decrease in blood components - anemia, leucopenia and thrombocytopenia. Blood disorders that cause an increase in blood components- erythrocytosis, leukocytosis and thrombocythemia or thrombocytosis. **Types of white blood cell disorders:** lymphoma, leukemia and myeloma**.**

Reference and Textbooks

1. Pal, G. K., & Pravati, P., (2010). Text Book of Practical Physiology, (3rd edn.).Universities Press (India) Private Limited.
2. Pal, G. K., Pal, P., Nanda. N. & Amudharaj. D. (2015). Atlas of Human Anatomy,(1st edn.). Jordi Vigue. Chambarlen Press.
3. Amitrano, R., & Tortora, G. (2012). Update: anatomy & physiology laboratory manual. Cengage Learning
4. Tortora, G. J., & Derrickson, B. (2014). Anatomy and Physiology-WorkBook. CBSpublication
5. Kanai L. Mukherjee, (1996). Medical Laboratory Technology, Volume-I. Tata McGraw Hill, New Delhi. Sabitri sanyal, (2000). Clinical pathology, B. I. Churchill Livingstone (P) Ltd, New Delhi.
6. Judith Ann Lewis, (1994). Illustrated guide to diagnostic tests – students version,Springhouse Corporation. Praful. B. Godkar, et al., (1996). Textbook of Medical Laboratory Technology, 2nd edition, Bhalani publication House.
7. Fischbach F.T., Dunning, M.B, (2002). A Manual of Laboratory and Diagnostic

8. Tests. Lippinocott Williams and Wilkins, Baltimore.	
Outcomes	After completion of the course, students are expected to be able to: ➢ Identify the structure and functions of internal organs. ➢ Acquire knowledge on cellular level and tissue level organizations. ➢ Identify the structure and functions of the blood cell. ➢ Correlate hematological findings with those generated in other areasof the clinical laboratory

Semester – II						
Course code: 23BMC2S2	**SEC-III**	**L**	**T**	**P**	**C**	**H/W**
	Microbial Physiology andMetabolism		**T**	**-**	**2**	**2**

Objectives	➢ Build up a sufficient background to students about the growth of Microbes ➢ Study the microbial metabolism and nutrition ➢ Attain knowledge on mechanism of photosynthesis
Unit –I	**Microbial Growth:** Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, synchronous growth, diauxic growth curve. **Microbial growth in response to environment** - Temperature, pH. **Microbial growth in response to nutrition and energy** – Autotroph, heterotrophy, Mixotrophs, Methylotrophs. **Survival at extreme environments** – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic.
Unit-II	**Microbial Nutrition:** Microbial Nutrition – Nutritional Requirement, Uptake of nutrientsby cell, Transport of nutrients: Passive and facilitated diffusion, Primary and secondary active transport (uniport, symport and antiport) Group translocation, Iron uptake.
Unit III	**Structure of photosynthetic pigments:** chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. **Mechanism of photosynthesis -** non-cyclic and cyclic electron transport. Photophosphorylation. Photosynthetic Apparatus in Prokaryotes. Outline of oxygenic and Anoxygenic photosynthesis in bacteria
Unit IV	**Aerobic Respiration:** Sugar degradation pathways (EMP, ED, Pentose phosphate pathway TCA cycle). Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, Gluconeogenesis.
Unit V	**Nitrogen Metabolism**: Introduction to biological nitrogen fixation, Ammonia assimilation (glutamate dehydrogenase pathway), Assimilatory nitrate reduction,Dissimilatory nitrate reduction, Denitrification.

Reference and Textbooks:-(APA Format)

1. Gottschalk, G. (1986). Bacterial Metabolism, Springer-Verlag, New-York.
2. Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications, Iowa, USA.
3. Moat, A.G. and Foster, J.W. (1995). Microbial Physiology, John-Wiley, New York.
4. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York. Reddy, S.R. and Reddy, S.M. (2004). Microbial Physiology, Scientific Publishers, Jodhpur, India.
5. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, (2nded.)., CBS Publishers and Distributors, New Delhi.
6. Elliot, W.H. and Elliot, D.C. (2001). Biochemistry and Molecular Biology, (2nded.)., Oxford University Press, U.S.A.
7. Nelson, D.L. and Cox, M.M. (2012). Lehingers's Principles of Biochemistry (6th ed.)., Mac Millan worth Publishers, New Delhi.
8. Srivastava, M.L. (2008). Microbial Biochemistry. Narosa Publishing House, New Delhi.
9. Satyanarayana, U. and Chakrapani, U. (2013). Biochemistry (4th ed.)., Book and Allied Pvt. Ltd., Kolkata

Outcomes	After completion of the course, students are expected to be able to: ➢ Know the various phases involved in the microbial growth ➢ Understand the general concepts of pathways in microbial metabolism ➢ Acquire a clear idea of the role of photosynthetic pigments and the mechanismof photosynthesis.

Semester – III						
Course code: 23BMC3C1	**Core V**	**L**	**T**	**P**	**C**	**H/W**
	Clinical Biochemistry		T		5	5

Objectives	➢ Learn the structure and classification of Biomolecules. ➢ Gain knowledge on clinically important enzymes and diagnostic tests.
Unit –I	**Clinical sample Collection and preservation -** Blood, Plasma, Serum, CSF, Urine and feces. Acid base balance. Buffer systems and Electrolytes. Clinically important enzymes.
Unit-II	**Carbohydrates:** Definition and applications- Monosaccharides, Disaccharides, Oligosaccharides and polysaccharides. Disorders of carbohydrate metabolism-Hypo and hyperglycimea, Diabetes Mellitus- Types, Clinical features and metabolic changes. Glucose tolerance test (GTT) importance and principle and techniques of GTT.
Unit III	**Lipids:** Definition, Classification and properties of lipids. Disorders of lipid metabolism Lipidosis and Xanthomatosis. Atherosclerosis- aetiology, clinical features and complication.
Unit IV	**Aminoacids and Proteins:** Amino acids – classifications, structure and Properties. Protein- Classification and structures (primary, secondary, tertiary & quaternary). Disorders in protein metabolism- Introduction, aetiology and clinical features of phenylketonuria and cystinuria. Clinical Significance of non-protein, nitrogen- urea, uric acid & creatinine.
Unit V	**Vitamins and Function Tests:** Deficiency disorders of vitamins. Function Test: Liver function test (Serum - Bilirubin SGPT, SGOT & Alakaline phosphatase and urine analysis – Bile salts, bile pigments and urobilinogen). Kidney function test (Urea, Uric acid, Creatinine). Pediatric Clinical chemistry: Diseases of new born and their complications.

Reference and Textbooks

1. Zubay G.L. (1998). Biochemistry, W.M.C.Brown Publishers, New York.
2. Deb A.C, (2002). Fundamentals of biochemistry, Books and allied (P) Ltd.
3. Satyanarayanan U, (2002). Essentials of biochemistry, Books and allied (P) Ltd.
4. Campbell, P.N and A.D .Smith, (2010). Biochemistry Illustrated, 4th ed, Churchill Livingstone.
5. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper's
6. Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill
7. Lehninger Principles of Biochemistry 4th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company.

Outcomes	➢ The students are be able to understand the basic fundamentals of Bio molecules ➢ The students can able to identify the different groups of enzymes from different habitats and their clinical importance.

Semester-III						
Course code: 23BMC3P1	**Core Practical III**	**L**	**T**	**P**	**C**	**H/W**
	Lab in Clinical Biochemistry			P	3	4

Objectives	➢ Equip students with a basic understanding of the underlying principles ofquantitative and qualitative research methods. ➢ Provide hands-on training for the collection of blood sample and staining methods.

1. Collection and preparation of blood for separation of plasma & serum
2. Estimation of erythrocyte sedimentation rate
3. Testing blood by anti-globulin test
4. Estimation of haemoglobin and blood glucose
5. Test for urine sugar (Benedict's method)
6. Estimation of blood glucose, cholesterol and iron.
7. Kidney function tests: Quantitative Determination of Urine Creatinine
8. Liver function tests: blood SGOT, SGPT & bilirubin

Reference and Textbooks

1. Rajan, S (2012). Manual for Medical Laboratory Technology, Anjanaa Book House, Chennai.
2. Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers
3. Rajan S and Selvi Christy R, (2012). Experimental procedures in Life Sciences, AnjanaaBook house, Chennai.
4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York,
5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, ChurchillLivingstone, London
6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16th edition, Churchill, Livingstone, London
7. Lisa Anne Shimeld, Delmar, (1999). Essential of Diagnostic Microbiology, New York.
8. Judith Ann Lewis, (1994). Illustrated guide to diagnostic tests – students version, Springhouse Corporation. Praful. B. Godkar, et al., (1996). Extbook of Medical LaboratoryTechnology, 2nd edition, Bhalani publication House.
9. Fischbach F.T., Dunning, M.B, (2002). A Manuel of Laboratory and Diagnostic Tests. Lippinocott Williams and Wilkins, Baltimore.

Outcomes	After completion of the course, students are expected to be able to: ➢ Collect the blood sample from patients ➢ Identify the sugar level in the urine, blood glucose, cholesterol, and iron ➢ Perform staining techniques and calculate the levels of uric acid and Creatinine. ➢ Isolate and identify the peripheral cells.

Semester –III							
CC/DSE/NME		**SEC-IV**	**L**	**T**	**P**	**C**	**H/W**
Course code: 23BMC3S2		**Medical Microbiology**		**T**	**-**	**2**	**2**

Objectives	➢ Identify common infectious agents and the diseases that they cause. ➢ Evaluate methods used to identify infectious agents in the clinical microbiology lab. ➢ Recognize and diagnose common infectious diseases from the clinical presentation andassociated microbiology.
Unit –I	**Introduction to Medical Microbiology: Normal microflora of the human body:** Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. **Antibacterial substance**: Lysozyme, Complement, Properdin, Antiviral substances, Phagocytosis. **Host pathogen interaction:** Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections.
Unit-II	**Diagnostic and Therapeutical Microbiology:** Collections, transport & processing of clinical samples. **General methods of lab diagnosis**-cultural, biochemical, serological & molecular methods. Test for antimicrobial susceptibility. **Elements of chemotherapy-**Therapeutic drugs, Mode of action of Pencillin & sulphur drugs & their clinical use. Drug resistance. **Antiviral agents**- Interferon, Base analogues. **Preventive control of diseases-** active & passive immunization.
Unit III	**Antibacterial agents:** Mechanism of action of Penicillins, Tetracyclines, Cephalosporins, Macrolides. **Antifungal agents:** Mechanism of action of Amphotericin B, Griseofulvin, Nystatin. **Antiviral agents:** Mechanism of action of Amantadine, Acyclovir, Azidothymidine.
Unit IV	**Medical Bacteriology:** Causative agent, symptoms, pathogenesis, treatment and prevention of the following diseases: **Air borne diseases**-Tuberculosis**. Food & water borne diseases**- Cholera, Typhoid. **Contact diseases**- Syphilis, Gonorrhoea. **Zoonotic diseases** - Anthrax. General account of Nosocomial infections
Unit V	**Medical Virology and Parasitology:** Causative agent, symptoms, pathogenesis, treatment andprevention of the following diseases: **Air borne diseases**- Influenza**. Food &water borne diseases**- Hepatitis-A, Poliomyelitis, Amoebiosis. **Insect borne diseases**-Malaria, Filariasis, Dengue fever. **Zoonotic diseases** -Rabies. **Blood borne diseases**- Serum hepatitis, AIDS.

Reference and Textbooks

1. Ananthanarayan R. and Paniker C.K.J. (2009) *Textbook of Microbiology* (8th ed.). UniversityPress Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) *Jawetz, Melnick andAdelberg's Medical Microbiology* (26th ed.). McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) *Mims' MedicalMicrobiology* (4th ed.). Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ(2013) *Prescott, Harley and Klein'sMicrobiology* (9th ed.). McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). *Brock Biology of Microorganisms* (14th ed.). Pearson International Edition
6. Pelczar M.J., Chan E.C.S. and Krieg N.R.(2002), *Microbiology*(5th ed.). McGraw Hill BookCompany, New York
7. Samuel Baron (1996).*Medical Microbiology* (4th ed.), University of Texas medical branch atGalveston, Texas.

Outcomes	➢ The student will be able to explain general and specific mechanisms by which an infectious agent causes disease. ➢ The student will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.

Semester – IV						
Course code: 23BMC4C1	**Core VII**	**L**	**T**	**P**	**C**	**H/W**
	Molecular Biology and MicrobialGenetics	**-**	**T**	**-**	**4**	**4**

Objectives	➢ Expand the knowledge on structure and functions of genetic material ➢ Obtain depth knowledge of genome organization, transcription, and translation process in Prokaryotes. ➢ Understand the principles of gene regulation and oncogenes
Unit -I	**Gene**: Structure and function. DNA as a genetic material (Griffth, Avery and Mcleoid, Hershey and Chase experiments). **Genetic code:** Definition, deciphering of codons. **DNA**: Structure (Watson and Crick model) and forms of DNA. **RNA:** Structure, types and Function.
Unit-II	**Mutation:** Definition and Types of mutations: Spontaneous and induced, Base pair changes, Frameshift, Deletion, Inversion, Tandem duplication, Insertion. **Mutagens:** Mode of action of Physical and chemical mutagens. **DNA damage and repair** (Direct, Excision and recombination repair). **Gene transfer among bacteria** – Transformation , Transduction and Conjugation
Unit III	**DNA replication**: Types of replication (Semi conservative replication, experimental evidence for semi conservative replication), Enzymes and proteins involved in DNA replication. Mechanism of DNA replication. Inhibitors of DNA replication. Various models of DNA replication: Rolling circle, D- loop (mitochondrial), Θ (theta)
Unit IV	**Transcription:** Initiation, Elongation, Termination; Differences between prokaryotic and eukaryotic transcription process. Inhibitors of transcription, Reverse transcription, RNA Polymerase. **Translation:** ribosomal cycle including phenomena of initiation,elongation, termination; Post translational modifications.
Unit V	**Regulation of gene in prokaryotes** - Operon concept- lac, trp, arabinose operons, **Functional units in gene**- promoters, repressors, operator, enhancer, introns and exons. **Oncogenes**: Activation of oncogenes. Oncogenic proteins - protein kinases, growth factors, ras protein.

Reference and Textbooks:-

1. Freifelder, D. (1997). *Essentials of Molecular Biology*. Narosa Publishing House, New Delhi.
2. Glick, B.P. and Pasternack, J. (1998). *Molecular Biotechnology*, ASM Press, WashingtonD.C., USA.
3. Freifelder, D. (1990). *Microbial Genetics.* Narosa Publishing House, New Delhi.
4. Glazer, A.N. and Nikaido, H. (1995). *Microbial Biotechnology – Fundamentals of AppliedMicrobiology*, W.H. Freeman and company, New York.
5. Old, R.W. and Primrose, S.B. (1994) *Principles of Gene Manipulation*, Blackwell SciencePublication, New York.
6. Verma, P.S. and Agarwal, V.K. (2004). *Cell Biology, Genetics, Molecular Biology, Evolutionand Ecology*. S. Chand & Co. Ltd., New Delhi.
7. Jeyanthi, G.P. (2009). *Molecular Biology*, MJP Publishers, Chennai.

Outcomes	After completion of the course, students are expected to be able to: ➢ Able to understand the function of genes and their regulation ➢ Understand the level of gene expressions ➢ Acquire depth knowledge on the activation of oncogenes.

Semester – IV						
Course code: 23BMC4P1	**Core Practical IV**	**L**	**T**	**P**	**C**	**H/W**
	Lab in Molecular Biology		**-**	**P**	**3**	**3**

Objectives	➢ Know to isolate genomic and plasmid DNA from bacteria ➢ Determine the ability of microorganisms to produce mutants. ➢ Become familiar with gradient plate method for isolating antibiotic resistant mutants.
	1. Isolation of Genomic DNA from bacteria 2. Isolation of plasmid DNA from bacteria 3. Characterization of plasmid DNA by agarose gel electrophoresis 4. Restriction digestion of DNA 5. Isolation of UV induced mutants of *E. coli* 6. Isolation of mutants by spontaneous mutation – Gradient plate technique

Reference and Textbooks:-

1. De Robertis EDP and De Robertis EMF (2006) *Cell and Molecular Biology* (8thed.)., Lippincott Williams and Wilkins, Philadelphia
2. Karp G (2010) *Cell and Molecular Biology: Concepts and Experiments* (6thed.)., JohnWiley & Sons.Inc.
3. Sambrook J and Russell DW. (2001). *Molecular Cloning: A Laboratory Manual* (4thed.)., Cold Spring Harbour Laboratory press.
4. Krebs J, Goldstein E, Kilpatrick S (2013). *Lewin's Essential Genes* (3rded.)., Jones and Bartlett Learning
5. Gardner EJ, Simmons MJ, Snustad DP (2008). *Principles of Genetics*. (8thed.)., Wiley-India
6. A.Ballows et al., (1998). Laboratory diagnosis of infectious diseases, Volume 1,Springer-Vertlag, New York.

Outcomes	➢ Able to perform isolation of nucleic acids and its confirmation by gel electrophoresis. ➢ Understand the principles of inducing mutation.

Semester –IV							
Course code: 23BMC4S1	**SEC-VI**	**L**	**T**	**P**	**C**	**H/W**
	Communicable and Non-Communicable Diseases		T		2	2

Objectives	➢ Enable students to identify issues specifically related to infectious disease epidemiology. ➢ Evaluate the contributions of various environmental factors to non-communicable diseases. ➢ Impart knowledge on diseases transmitted through air, water, food, vectors and pollution sources as well as major components of health services. ➢ Help the students to apply these understandings to infectious disease prevention and control
Unit -I	**Diseases:** Definition, causes of diseases, acute and chronic diseases. **Environmental factors that contribute to non-communicable diseases:** Outdoor air pollution,household air pollution, impure water, toxic chemicals, radiation, mold and other natural toxins. Differences between communicable and non-communicable diseases.
Unit-II	**Communicable Diseases** Causative agent, symptoms, preventive measures and treatment of Tuberculosis, Measels, COVID,Post COVID fungal infections, H1N1, Typoid,Rabies, Chikungunia and Respiratory tract Infections. Reservoirs of infection agents, Chain of transmission in communicable disease.
Unit III	**Non- Communicable Diseases-** Cardiovascular Diseases, Cancer, diabetes, hypertension, obesity and stroke.
Unit IV	**Chronic diseases transmitted through blood transfusions**- Viral disease- Denguefever, Hepatitis and AIDS; Parasitic disease- Chagas disease, Malaria, Amoebiasis and Leishmaniasis.
Unit V	**Vaccine Preventable Diseases**: - Role of vaccine in global health maintenance. Specific vaccines of use in the developing world. Types of Vaccine. Hospital acquired infection (Nosocomial)

Reference and Textbooks:

1. Garrett, Laurie. (1994) *The Coming Plague: Newly Emerging Diseases in a World Out of Balance.* Penguin Books.
2. Park J. E. and Park K., (1989), "Text Book of Preventive and Social Medicine", (10th ed).
3. Praful B Godkar and Darshan P Godkar, (2014). Textbook of Medical Laboratory Technology (3rd ed), Bhalani publishers.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt (2017). *Roitt's Essential Immunology*, (13th ed). John Wiley & Sons, Ltd.
5. Abul, K. Abbas Andrew H. H. Lichtman& Shiv Pillai. (2015). Basic Immunology, Functionsand Disorders of the Immune System (5th ed). Elsevier

Outcomes	➢ The students are able to know the risk factors for the communicable and non- communicable diseases. ➢ The students can take preventive measures to avoid severe diseases. ➢ Understand the role of vaccines in the global health maintenance.

Semester-IV							
CC/DSE/NME		**SEC-VII**	**L**	**T**	**P**	**C**	**H/W**
Course code: 23BMC4S2		**Environmental Microbiology**		T		2	2

Objectives	➢ Provide the student with an understanding of the current views of microbial association invarious environments. ➢ Evaluate the continuing roles played by microbes in the environment. ➢ Recognize microorganisms as indicators of alteration of an ecosystem. ➢ Understand microbial processes aimed to solve environmental problems.
Unit –I	**Soil characteristics**: Composition of Lithosphere, Soil Microbes, Factors influencing soil microbial population Aeromicrobiology: Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.
Unit-II	**Biogeochemical cycling**: Carbon cycling, nitrogen cycling, Phosphorus cycling and Sulphur cycling. Interaction between Microorganisms – symbiosis neutralism, mutualism, commensalism, competition Amensalism synergism, parasitism and predation
Unit III	**Microbial analysis of drinking water**: Tests for coliforms (presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. Sewage Treatment: primary, secondary and tertiary treatments (Trickling filters, activated sludge process and Oxidation lagoons).
Unit IV	**Bioremediation:** Types and uses - Genetically Engineered microbes for Bioremediation. **Microbial leaching:** In situ & Ex situ methods –copper and uranium mining.
Unit V	**Biosafety & Environmental monitoring**: Environmental regulations - Biohazards - Types ofhazardous emission – Biosafety measures - Monitoring of Genetically Engineered Microbes in the Environment.

Reference and Textbooks:-

1. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications. (III Ed) Benjamin Cummings, Redwood City.CA.
2. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd. NewDelhi.
3. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press. New York.
4. Clescri, L.S., Greenberk, A.E. and Eaton, A.D.1998. Standard Methods for Examination of and Waste Water, 20th Edition, American Public Health Association.
5. Mara. D and Horan. N 2003. The Handbook of Water and Waste Water Microbiology. Academic.Press, California.
6. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. (4th ed) PrenticeHall Int. Inc., London.

Outcomes	After completion of the course, students are expected to be able to: ➢ Understand on soil characteristics and biogeochemical cycling ➢ Be familiar with the microbial analysis of drinking water and Aeromicrobiology ➢ Know the different aspects of waste management and sewage Treatment systems ➢ Acquire knowledge on bioremediation and microbial leaching

Semester V						
Course code: 23BMC5C1	**Core IX**	**L**	**T**	**P**	**C**	**H/W**
	Systematic Bacteriology and virology		T		4	5

Objectives	➢ Study about the basic principles and application relevance of clinical disease. ➢ Learn the biology of bacteria and viruses related with infectious diseases
Unit –I	**General characteristics, epidemiology, pathogenicity, Laboratory diagnosis and treatment of diseases caused by Gram positive bacteria**- *Staphylococcus aureus, Streptococcus pyogenes, Corynebacterium diphtheria.* **Gram negative bacteria***: - E.coli, Shigella dysenteriae,, Neisseria gonorrhoea* and *Pseudomonas aeruginosa,.*
Unit-II	**General characteristics, Epidemiology, Pathogenicity, Laboratory diagnosis and Treatment of diseases caused by** *Clostridium sp, Klebsiella, Proteus, Salmonella, Haemophilus influenzae,* and. Acid fast bacteria- *Mycobacterium leprae and M. tuberculae*
Unit III	**General characteristics, Epidemiology, Pathogenicity, Laboratory diagnosis andtreatment of diseases caused by Spirochetes** – *Borrelia burgdorferi and Leptospira mayottensis, Rickettsiae prowazekii* and *Chlamydiae trachomatis.*
Unit IV	**Virology:** Viral architecture- Capsid, viral genome and envelope. Baltimore Virus classification. **Life cycle of virus**: Lytic and lysogenic cycle of lambda phage; structure and Life cycle of TMV; Structure and life cycle of T4 phage. **Viral diseases** :- Causativeagent, symptoms, pathogenesis, treatment and prevention of Polio, rabbies, yellow fever,mumps, influenza, measles, encephalitis, hepatitis and AIDS.
Unit V	**Cultivation and Diagnosis of viruses:** Tissue culture techniques, embryonated egg, chick embryo fibroblast, animal inoculation, CPE, inclusion bodies. Visualization and enumeration of virus particles:- **Measurement of infectious units**: Plaque assay, Fluorescent focus assay, Infectious center assay, Transformation assay, Endpoint dilution assay. Measurement of virus particles and their components by haemagglutination.

Reference and Textbooks

1. Jawetz and Melnick, (2004). Review of Medical Microbiology, Lange, New York
2. Morag C Timbury (2002). Notes on Medical Microbiology and Immunology, 3rd edition,Churchill Livingstone, London.
3. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16th edition,
4. Churchill Livingstone, London
5. Benjamin A. Pierce (2008), "Genetics a conceptual approach", 3rd ed., W.H.Freeman andcompany.
6. Edward Arnold (2000) Principles of Virology.

Outcomes	After completion of the course students are expected to be able to: ➢ Acquire information about the concepts of systematic bacteriology and gain knowledge on medically important micro-organisms. ➢ Attain knowledge of morphology, cultural characteristics, biochemical tests, epidemiology, laboratory diagnosis etc of pathogenic organisms. ➢ Understand the concepts involved in the cultivation and diagnosis of viruses.

Semester –V						
Course code:	**Core X**	**L**	**T**	**P**	**C**	**H/W**
23BMC5C2	**Clinical Immunology**		**T**	**-**	**4**	**5**

Objectives	➢ Provide knowledge on the human immune system and immune response. ➢ Understand the mechanism of antigen- antibody interaction ➢ Inculcate recent clinical immunodiagnostic methods and monoclonal antibodies production for treating most of the human diseases.
Unit -I	**Introduction to Immune System:** History and scope of Immunology. Microflora of normal human body. **Lymphoid organs:** Primary and Secondary lymphoid organs. **Immune Cells -** Lymphoid cells (B-lymphocytes, T-lymphocytes and Null cells), Mononuclear cells (Phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cells.
Unit-II	**Antigen:** Types and properties, haptens, adjuvants, antigenicity and immunogenicity. **Immunity:-**Types of immunity- Innate immunity and Acquired immunity, immunization. **Immune response**-Humoral and cell mediated immunity and their interaction. **MHC:** Properties, class I and class II. Antigen processing and presentation.
Unit III	**Immunoglobulins:** Structure, types, properties and biological functions. **Antigen- Antibody interactions:** Precipitation, agglutination and complement fixation. **Hybridoma Technology:** monoclonal antibody production. **Vaccines:** types and principles in vaccine development**-** DNA vaccines, subunit vaccines- Recombinant vaccines.
Unit IV	**Immunity to infection:** Hypersensitivity reactions:- causes, mechanism and types of hypersensitivity reactions. **Transplantation** – Immunologic response graft rejectionmechanism and prevention of graft rejection.
Unit V	**Immunochemical Techniques: Immunodiffusion**- Radial and ouchterlony double immunodiffusion, Immuno-electrophoresis, **Immunofluorescence:** principle, types, uses and limitations. Principle, technique and applications of RIA and ELISA.

Reference and Textbooks:

1. Emily P. Wen, Ronald Ellis and Narahari S. Pujar, (2014). "Vaccine Development and Manufacturing" (1st ed), Wiley.
2. Judith A. Owen, Jenni Punt, Sharon A. Stranford (2013). *Kuby Immunology*. (7th ed). W. H.Freeman and Company.
3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt (2017). *Roitt'sEssential Immunology*, (13th ed). John Wiley & Sons, Ltd.
4. Abul, K. Abbas Andrew H. H. Lichtman& Shiv Pillai. (2015). Basic Immunology, Functions and Disorders of the Immune System (5th ed). Elsevier.
5. Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew and Cornelia M. Weyand, (2013). "Clinical Immunology-Principles and Practice" (5th ed) Elsevier.
6. Joseph, A. Bellanti. (2016). Immunology IV: Clinical Applications in Health and Disease. Washington, DC: Georgetown University School of Medicine.

Outcomes	➢ The students after completing the course would be aware of structure and functions of immune system. ➢ Aware of immunity to various pathogens ➢ Able to understand the concepts and mechanism behind antigen-antibody interactions, hypersensivity reactions and immunochemical reactions.

Semester –V						
Course code: 23BMC5C3	**Core XI**	**L**	**T**	**P**	**C**	**H/W**
	Recombinant DNA Technology and Molecular Diagnostics		T		4	4

Objectives	➢ Endow with knowledge on the role of enzymes in rDNA technology. ➢ Know the gene cloning strategies and construction of DNA libraries ➢ Make acquainted with the synthesis of recombinant products and molecular diagnostic methods ➢ Understand the concepts of polymerase chain reaction in diagnostics.
Unit -I	**Introduction to rDNA technology:** History of rDNA technology. **Tools used in rDNA technology: Enzymes:** Ribonuclease-H (RNase-H), Klenow enzymes or klenow Fragment, SI Nuclease, Taq DNA Polymearse, Restriction Endonucleases, Terminal Nucleotidyl Transferase, Alkaline Phosphatase, Polynucleotide Kinase, DNA ligase, T4 DNA ligase and Methyl transferase. **Ligation**: definition and process. **Coupling Tools-** Linkers and Adaptors.
Unit-II	**Gene cloning:** Strategies in gene cloning. **Plasmids –** Introduction and classification**. Gene cloning vectors:** pBR322, pUC, ColE1 plasmid**.** Cosmids and phagemid as vectors**.** Shuttle vectors, Expression vectors. **Application and limitations of vectors**.
Unit III	**Direct Gene transfer techniques:** Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication and Liposome fusion. *Agrobacterium* mediated gene transfer. **Selection of recombinant Bacteria:** Direct selection, Insertional inactivation, Blue-white colony selection and colony hybridization. **Genetically Engineered Microorganisms (GEMOs)**. **Production of Healthcare products from GEMOs**-Insulin, Human growth hormone, Interferons, Blood products and Vaccines.
Unit IV	**Polymerase Chain Reaction (PCR)**: History, definition, types and applications. **DNA sequencing: -** Maxam-Gilbert's and Sanger's method, Automated sequencing. **Construction of DNA libraries:** Genomic and cDNA libraries: Preparation and uses. Screening of libraries by colony hybridization and colony PCR. Chromosome walking and jumping**.**
Unit V	**Molecular diagnostic methods**: RAPD, RFLP techniques, DNA Finger Printing and DNA Foot Printing techniques, Fluorescence In-Situ Hybridization (FISH), Molecular beacons and Real Time PCR.

Reference and Textbooks:-

1. Brown TA. (2006). *Gene Cloning and DNA Analysis*. (5th ed). Blackwell Publishing, Oxford, U.K
2. James D. Watson, Micheal Gilman, Mark Zoller, 2001. Recombinant DNA (2nd ed). W.H. Freemanand Company, New York.
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, (7th ed). Blackwell Publishing, Oxford, U.K.
4. Dubey, R.C. 2001. A Text Book of Biotechnology .S. Chand & Company Ltd, (1st ed). Ramnagar,New Delhi
5. Sambrook J, Fritsch EF and Maniatis T. (2001). *Molecular Cloning-A Laboratory Manual*. (3rd ed).Cold Spring Harbor Laboratory Press.
6. Verma, P. S., & Agrawal, V. K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution &Ecology (1st ed.). S .Chand and company Ltd.
7. Satyanarayana. U, (2008), Biotechnology. Books and Allied (p) Ltd.

Outcomes	➢ The students are be able to understand the concepts and methods in rDNA technology ➢ Enable the students to know about cloning vectors. ➢ Acquire knowledge on the construction of DNA libraries and DNA sequencing and an applications of rDNA technology ➢ The students are being able to diagnose the genetic diversity and gene pattern by molecular methods.

Semester-V						
Course code: 23BMC5P1	**Core Practical XII**	**L**	**T**	**P**	**C**	**H/W**
	Lab in Bacteriology, Virology and Clinical Immunology			P	4	4

Objectives

- Familiarize with microbiological techniques applied in the clinicallaboratories
- Perform the basic techniques to identify the antibiotic sensitivity
- Understand about effect of environmental condition on microbes

1. Collection, coding and transport of clinical specimens for microbiological Examinations
2. Examination of bacterial flora of skin by swab method
3. Preparation of media for culturing autotrophic and heterotrophic microorganisms – algal medium, mineral salts medium , nutrient agar medium, MacConkey agar and Blood agar.
4. Biochemical tests: IMViC, TSI, Urease, Catalase, Oxidase, Hydrogen sulphide, Starch hydrolysis, coagulase, nitrate reduction tests and sugar fermentation test.
5. Isolation and identification of upper respiratory tract, gastro intestinal bacterial pathogen – *Streptococcus pyogenes, Staphylococcus aureus, Salmonella*, *Shigella, Klebsiella, E.coli, Pseudomonas, Vibrio.*
6. Isolation and identification of clinically important yeast and molds – *Candida albicans*, *Cryptococcus neoformans*, *Fusarium* spp. and *Aspergillus* spp.
7. Perform antibacterial sensitivity by Kirby-Bauer method.
8. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
9. Turbidometric measurement of bacterial growth.
10. Separation of amino acids and sugar by paper chromatography.
11. Demonstration
    a. Cultivation of virus in chick embryo method.
    b. Cultivation of virus in cell culture
    c. Plaque assay
12. Identification of blood group by ABO Blood grouping and Rh typing.
13. Evaluation of total erythrocyte count (RBC) and WBC count.
14. Identification of immune cells in a blood smear.
15. Examination of differential count of blood cells.
16. Evaluation of erythrocyte Sedimentation Rate (ESR).
17. Haemoglobin estimation Shalli's method.
18. Immuno diffusion- radial immune diffusion and ouchterlony double immunodiffusion.

Reference and Textbooks:-

1. Rajan.S, Manual for Medical Laboratory Technology (2012), Anjanaa Book House, Chennai.
2. Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers
3. Rajan.S and Selvi Christy (2012).- Experimental procedures in Life Sciences, Anjanaa Book house, Chennai.
4. Jawetz and Melnick, (2002). Review of Medical Microbiology, Lange, New York.
5. Morag C Timbury, (2002). Notes on Medical Microbiology and Immunology, ChurchillLivingstone, London
6. David Greenwood, Richard Slack, John F Peutherer, (2002). Medical Microbiology, 16thedition, Churchill, Livingstone, London
7. Lisa Anne Shimeld, Delmar, (1999). Essential of Diagnostic Microbiology, New York.

Outcomes

After completion of the course, students are expected to be able to:

- Able to isolate and identify the pathogen from the clinical samples.
- Knowledge in the analysis of antibiotic sensitivity.
- Understand the role of environmental factors affecting bacterial growth.

Semester – V						
Course code: 23BMC5E1	**DSE-I**	**L**	**T**	**P**	**C**	**H/W**
	Basics of Bioinformatics		T		3	5

Objectives	➢ To provide an- in depth study on Bioinformatics ➢ To create the students to understand sequence alignments, genome analysis, sequence analysis and protein analysis ➢ To familiarize the tools used in Bioinformatics
Unit –I	**Introduction to Genes and Proteins**: Genome Sequences - ORFs, Genes, Introns, Exons, Splice Variants. DNA Structure: Watson & Crick Model. Amino acid: Definition and Structure, Triplet Codon; Protein Structure: Secondary, Tertiary, Quaternary
Unit-II	**Introduction to Bioinformatics and Biological Databases:** Definition and scope of Computational Biology and Bioinformatics**. DNA and protein databases –** preliminary level analysis of DNA and protein sequences using bioinformatics tools. Examples of related tools (FASTA, BLAST), databases (GENBANK, PUBMED, PDB) and softwares (RASMOL, Ligand explorer). Applications of Bioinformatics.
Unit III	**Pairwise sequence alignments:** Sequence similarity, identity, and homology. Global and local alignment, Dot plots for sequence comparison, Dynamic programming, BLAST and PSI-Blast, Application of Blast tool, Concept of Scoringmatrix (PAM and BLOSUM).
Unit IV	**Multiple sequence alignments:** Progressive Alignment Algorithm (ClustalW), Application of multiple sequence alignment. **Phylogenetic analysis**: Definition anddescription of phylogenetic trees, primer on computational phylogenetic analysis. **Visualization of proteins structure:** Protein Data Bank. Ramachandran plot.
Unit V	**Structural Bioinformatics:** Tertiary structure Prediction methods (Homology modeling,Fold recognition and ab-initio method). Molecular dynamics and simulation study of protein, Force field concepts. Molecular Docking (Basic concepts). Drug target identification and Drug design.

Reference and Textbooks

1. Claverie, J.M. and Notredame C. (2003) Bioinformatics for Dummies. Wiley Editor.
2. Durbin R., Eddy S., Krogh A. and Mithchison G. (2007) Biological Sequence Analysis,Cambridge University Press.
3. Lesk, A.M. (2005), Introduction to Bioinformatics. Oxford University Press.
4. Rastogi S.C., Mendiratta N. and Rastogi P. Bioinformatics: methods and applications,genomics, proteomics and drug discovery, Prentice Hall India Publication.
5. Pradeep and Sinha Preeti. Foundations of Computing, BPB publications
6. Primrose and Twyman. Principles of Genome Analysis & Genomics. Blackwell
7. Mount, D.W. (2004), Bioinformatics: Sequence and Genome Analysis. CSHL Press.
8. PhilBourne and Helge Weissig, (2009) Structural Bioinformatics, Wiley-Blackwell
9. Leech Andrew, (2001) Molecular Modelling: Principles and applications (2^{nd} ed) Prentice Hall

Outcomes	After completion of the course students are expected to be able to: ➢ Understand the different tools for data analysis and apply the appropriate tool for data processing. ➢ Know the whole genome analysis methods and the computational tools used for sequence analysis. ➢ Acquire knowledge on Homology modeling of protein

Semester –V						
Course code: 23BMC5E2	**DSE-II**	**L**	**T**	**P**	**C**	**H/W**
	Food and Dairy Microbiology		T		3	5

Objectives	➢ To transmit information on the scope and development of food microbiology ➢ To make awareness among the students about the food quality analysis and the role ofgovernment organizations involved in food quality control. ➢ To provide an overview on food spoilage organisms- Food borne diseases- to understandinfection process and food-borne outbreaks.
Unit -I	**Microbiology of foods**: Role, and Significance of Microorganisms in Foods- Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi & viruses. **Factors affecting the growth of microorganisms**: Intrinsic factors (Nutrient Content, Redox Potential, pH and Buffering Capacity), water activity and Extrinsic factors (Relative Humidity and Temperature) influence the growth and survival of microorganisms in foods.
Unit-II	**Microbial spoilage of food:** Fruit and vegetables. Spoilage of meat and meat products – Bacon and Ham. Spoilage of milk and milk products – butter and canned foods. **Food- intoxications:** *Staphylococcus aureus, Clostridium botulinum* and mycotoxins. **Food infection:** *Bacillus cereus, Vibrio parahaemolytics, Escherichia coli, Salmonella, Shigella, Yersinia enterocolitica, Listeria monocytogenes and Camphylobacter jejuni.*
Unit III	**Principles of food preservation:** general principles and application methods – asepsis, removal of microorganisms, anaerobic conditions, high temperature, low temperature, osmotic pressure, drying and food additives. **Chemicals-** organic acids. **Radiation** – UV light, irradiation. Advanced microbiological method for examination of foods.
Unit IV	**Microbial Fermentation:** Bread making, Alcoholic Beverages. **Production of fermented dairy products**: Cheese, yoghurt, butter milk, sour cream. **Fermented vegetables**; Sauerkraut, pickles, olives and soy sauce. **Microorganisms as food**- single cell protein.
Unit V	**Quality and safety assurance:** Quality and safety assurance in food and dairy industry Good manufacturing practice, hazard analysis and critical control point (HACCP) concept. FDA, AGMARK, Bureau of Indian Standards (BIS).

Reference and Textbooks:-

1. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi.
2. Frazier, W.C. 1978. Food Microbiology (3rd ed), McGraw Hill.
3. Adams, M. R. and Moss, M.O. 1995. Food Microbiology, (4th ed) McGraw Hill, New York.
4. Jay, J.M.2000 Modern Food Microbiology 6th Ed. Aspen Publication, USA.
5. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, (3rd Ed). Wiley Publishers.
6. Brain J. Wood. Microbiology of Fermented Foods. Volume I and II Elsevier Applied SciencePublication.
7. Prescott, L.M., Harley, J.P. and Helin, D.A. (2008). Microbiology (5th ed). New York: McGrawHill.
8. Joshi V. K and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology,Biochemistry and Technology (VOL II).

Outcomes	➢ The students are able to know the role of microorganisms in food (beneficial as well as harmful) and also the factors influencing their growth. ➢ The students can be easily understood in depth the techniques/process involved in theproduction of microbial products in food and dairy industries. ➢ Able to identify the key problems and prospects in food processing and preservation ofperishable food products and also understand the microbial hazards involved in food spoilage.

Semester – VI						
Course code: 23BMC6C1	**Core XIII**	**L**	**T**	**P**	**C**	**H/W**
	Clinical Parasitology and Mycology	**-**	**T**	**-**	**4**	**6**

Objectives	➢ Obtain the knowledge on parasitic infections and their diagnostic techniques. ➢ Know about the structure and functions of fungi and the action of fungal toxins ➢ Understand the characteristics of helminthes and nematodes
Unit -I	**Introduction** and definitions, common pathogenic effects of human parasites - host parasite relationship. General diagnostic procedures for parasitic infections (direct methods and indirect methods). Immunology of parasitic infections, and Prophylaxis.
Unit-II	**Protozoology**: General characters, morphology, life cycle, epidemiology, pathogenesis - clinical sign, and control measures of amoebae (*Entamoeba histolytica),* Flagellates (Haemoflagellates-I – Leishmania, Haemoflagellates-II-Trypanosomes), Sporozoites (Plasmodium,) and ciliates (Balantidium).
Unit III	**Medical Mycology:** General properties structure and classification of fungi, structure and applications. Mycotic infections such as superficial mycosis, cutaneous mycosis, subcutaneous mycosis, systemic mycosis (dimorphic, endemic mycosis).
Unit IV	**Actinomycetes** infections, hypersensitivity due to fungi, mycotoxins, and antifungal chemotherapy. Clinical symptoms, Lab diagnosis and treatment of fungal infections.
Unit V	Helminthology and Nematodology: General characters, morphology, life cycle, epidemiology, pathogenesis - clinical sign, and control measures of Platyhelminthes (flat warm- *Taenia solium*, trematode), Nemathelminthes (round worm- *Ascaris lumbricoides*,). Nematodes (*Wuchereria bancrofti*,).

Reference and Textbooks

1. Cook GC, (1996). Manson's Tropical Diseases, 20th edition, WB Saunders.
2. Chiodini PL, (2000). Atlas of Medical Helminthology and Protozoology – 4th Edition, Churchill Livingstone, London.
3. Chatterjee, K.D, (1890). Parasitology, 12 Edition, Chatterjee Medical Publishers,Calcutta
4. Murray, Patrick R. Baron. Jorgensen. Pfaller. Yolken, Robert H. (2003). Manual of clinical microbiology, ASM Press, Washington.
5. A.Ballows et al., (1998). Laboratory diagnosis of infectious diseases, Volume 1,Springer-Vertlag, New York.

Outcomes	➢ Able to understand the effects of human parasites and their diagnosticmethods. ➢ Able to prevent the parasitic and helminthic infections. ➢ Acquire depth knowledge on the role of mycotoxins and other fungal toxins.

Semester – VI						
Course code: 23BMC6C2	**Core XIV**	**L**	**T**	**P**	**C**	**H/W**
	Clinical Bioinstrumentation and Diagnostics		T		4	6

Objectives	To impart knowledge on ➢ Fundamentals of medical instruments based on physiological parameter and biological system ➢ Concepts of ECG and EEG ➢ Various medical instruments for biomedical applications.
Unit –I	**Fundamental of medical instrumentation:** Sources of biomedical Signals: Generalized medical instrumentation block diagram. **Classification of medical instruments based ondifferent principles**: Based on application (diagnostic, therapeutic, Imaging, analytical), Based on physiological parameter and bio-potential, Based on Biological system, Based on different departments in the hospital.
Unit-II	**Electrocardiograph**: ECG - Block diagram, working principle; **Electroencephalograph** – EEG-Block diagram, working principle; **Electromyograph** - EMG -Block diagram, working principle. Techniques of heart rate measurement: Average heart rate meter, Instantaneous heart rate meter; Measurement of pulse rate; Blood Pressure measurement - Direct method & Indirect method (Sphygmomanometer), Manual & automatic BP Instrument; Measurement of respiration rate.
Unit III	**Pneumography**: Impedance pneumography - Apnoea monitor. **Oxygen Saturation measurement** (Oxymetry) - Ear oxymeter &Pulse oxymeter. Spirogram: Lung volumes and capacities (Respiratory volumes), Spirometry - Basics Spirometer, Wedge Spirometer, Ultrasonic Spirometer. Audiometers: Hearing transducers, Types of audiometers, Hearing aid - Conventional & Digital
Unit IV	**Spectroscopy** – Basic principles, Instrumentation and application of Visible, ultraviolet (UV) and Infra red (IR). Centrifugation – Basic Principle of Centrifugation, Types of centrifuge and rotors. Instrumentation of Ultracentrifuge (Preparative, Analytical) and Rate-Zonal centrifugation.
Unit V	**Chromatography**: Basic principles, Instrumentation and application of Paper Chromatography, Adsorption Chromatography, TLC, GC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography.

Reference and Textbooks:-

1. Khandpur. R. S., (2004). *Handbook of Biomedical Instrumentation*, Prentice Hall of India,New Delhi
2. Cromwell, (2007) *Biomedical Instrumentation and Measurements*, Prentice Hall of India, New Delh,.
3. Arthur C. Guyton(2012): *Textbook of Medical Physiology*, Prism Books (Pvt) Ltd &W.B.SaundersCompany,12th edition,
4. Joseph J. Carr and John M. Brown (2004), *Introduction to Biomedical EquipmentTechnology*, Pearson Education India, Delhi,.
5. Jacobson B and Webster J G (1999) *Medical and Clinical Engineering* – Prentice Hall of India New Delhi.
6. John. G. Webster. (2011).*Medical Instrumentation, Application and Design*, Fourth Edition. Wiley &sons, Inc, New York.

Outcomes	After completion of the course, students are expected to be able to: ➢ Identify the need of understanding human anatomy and physiology system ➢ Select the suitable acquisition method for analyzing biomedical signal and vital parameter measurement. ➢ Apply the knowledge of biomedical instruments to practical applications ➢ Categorize the parameter monitoring techniques based on the application andrelevance.

Semester – VI						
Course code: 23BMC6P1	**Core Practical X**	**L**	**T**	**P**	**C**	**H/W**
	Lab in Clinical Parasitology, Mycology and Bioinstrumentation		**-**	**P**	**4**	**6**

Objectives

- Know to isolate genomic and plasmid DNA from bacteria
- Determine the ability of microorganisms to produce mutants.
- Become familiar with gradient plate method for isolating antibiotic resistant mutants.
- Provide knowledge to identify fungi isolated from clinical specimens

1. Isolation of Auxotrophic Antibiotic Resistant mutant by Induced mutagenesisin Bacteria by Replica plating technique.
2. Microscopic examination of stool specimens for ova & parasites
3. Dip stick test for Malaria
4. Isolation and identification of common pathogenic fungi from clinical specimens.
5. Perform antibacterial sensitivity by Kirby-Bauer method.
6. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
7. Turbidometric measurement of bacterial growth.
8. Separation of amino acids and sugar by paper chromatography.
9. Demonstration

a) Cultivation of virus in chick embryo method.

b) Cultivation of virus in cell culture.

c) Plaque assay.

Reference and Textbooks:-

7. De Robertis EDP and De Robertis EMF (2006) *Cell and Molecular Biology* (8th ed.)., Lippincott Williams and Wilkins, Philadelphia
8. Karp G (2010) *Cell and Molecular Biology: Concepts and Experiments* (6th ed.)., JohnWiley & Sons.Inc.
9. Sambrook J and Russell DW. (2001). *Molecular Cloning: A Laboratory Manual* (4th ed.)., Cold Spring Harbour Laboratory press.
10. Krebs J, Goldstein E, Kilpatrick S (2013). *Lewin's Essential Genes* (3rd ed.)., Jones and Bartlett Learning
11. Gardner EJ, Simmons MJ, Snustad DP (2008). *Principles of Genetics*. (8th ed.)., Wiley-India
12. A.Ballows et al., (1998). Laboratory diagnosis of infectious diseases, Volume 1,Springer-Vertlag, New York.

Outcomes

- Able to perform isolation of nucleic acids and its confirmation by gel electrophoresis.
- Understand the principles of inducing mutation.
- Students will be familiar with the identification of pathogenic organism fromclinical samples.

Semester – VI						
Course code: 23BMC6E1	**DSE-III**	**L**	**T**	**P**	**C**	**H/W**
	Agricultural Microbiology		T		3	5

Objectives	➢ Make the students understand the role of microbes in agriculture ➢ Give an overview on plant microbe interaction. ➢ Understand infection process and control measures. ➢ Know the importance and applications of biofertilizers and biopesticides
Unit –I	**Soil Microbiology:** Physio-chemical properties of soil. **Microbial interactions** - mutualism, commensalism, amensalism, synergism, parasitism, predation and competition. **Microbial interactions between plants**– phyllosphere, mycorrhizae, rhizosphere and rhizoplane organisms.
Unit-II	**Plant pathogenic microorganisms:** pathogens, symptoms and control measures Algal, fungal, bacterial, viral, mycoplasma, Nematode diseases and symptoms. Phenolic compounds. Interactionof plant pathogens with host. **Definition and History of Biopesticides-** Viral (NPV, CPV & GV), bacterial (*Bacillus thuringiensis* & *Pseudomonas* sp), Fungal (*Entomophthora mucosa* & *Verticillium* sp.), Protozoan (*Mattesia* sp & *Lambornella* sp).
Unit III	**Biofertility:** Azotobacter sp and Azospirillum sp and their functions - Cyanobacteria (BGA) and their associations in Nitrogen fixation. Phospahte solubilizing microbes. Mycorhizae and plant growth promoting rhizobacteria (PGPR). **Biofertilizer production: -** Role of biofertilizers. Quality control (BIS specification), marketing, Evaluation of field performance and economics of production. Role of biofertilizer in integrated nutrient management. Regulation and standards, Marketing and Monitoring field performance.
Unit IV	**Biological Nitrogen fixation: Nitrogen fixers-** free living nitrogen fixing bacteria and cyanobacteria, symbiotic nitrogen fixing bacteria and cyanobacteria. **Symbiotic nitrogen fixation:-**nodule formation and mechanism of nitrogen fixation**. Assimilation of Ammonia:** reductive amination, catalytic amidation and transamination. **Nitrate Assimilation:** reduction of nitrate to nitrite.
Unit V	**Microbial transformations of minerals**: Carbon, Nitrogen, Phosphrous, sulphur, iron and other elements - Chemistry, cycles, mineralization and immobilization and oxidation/reduction.

Reference and Textbooks

1. Atlas, R.M. and Bartha, R. (1992). Microbial Ecology: Fundamentals and Applications. (III Ed) Benjamin Cummings, Redwood City.CA.
2. Subba Rao, N. S. (1995). Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Gupta, S.K.2014 Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India.
4. Subba Rao, N. S. (1997). Biofertilizers in Agriculture and Forestry, III Ed., Oxford & IBH Publishing Co.Pvt.Ltd., New Delhi.
5. Mark Wheelis, (2010). Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
6. Gaur, A.C., (1999). Microbial technology for Composting of Agricultural Residues by Improved Methods, 1stprint, ICAR, New Delhi.
7. Glick, B.R. AND Pasternak, J.J (1994). Molecular Biotechnology, ASM Press, Washington DC.

Outcomes	After completion of the course, students are expected to be able to: ➢ Understand the role of microbes in the different cycles and their role in agriculture ➢ Be familiar with biological nitrogen fixation in symbiotic and non symbioticassociations with plants. ➢ Know the value, production, application in pest control and crop response ofbiofertilizers and biopesticides.

Semester - VI						
Course code: 23BMC6E2	**DSE-IV**	**L**	**T**	**P**	**C**	**H/W**
	Environmental Microbiology		T		3	5

Objectives	➢ Provide the student with an understanding of the current views of microbial association invarious environments. ➢ Evaluate the continuing roles played by microbes in the environment. ➢ Recognize microorganisms as indicators of alteration of an ecosystem. ➢ Understand microbial processes aimed to solve environmental problems.
Unit –I	**Soil characteristics**: Composition of Lithosphere, Soil Microbes, Factors influencing soil microbial population. The soil environment-Distribution and abundance, generic groups and nutrition of bacteria, actinomycetes, fungi, algae, protozoa and viruses. **Biogeochemical cycling:** Carbon cycling, nitrogen cycling, Phosphorus cycling and sulphur cycling. Ecological groups based on oxygen requirement, nutrition, temperature, habitat (soil, water & air).
Unit-II	**Microbial analysis of drinking water:** Tests for coliforms (presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. **Aeromicrobiology:** Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.
Unit III	**Waste management:** Utilization of solid and liquid waste pollutants for production of Single-Cell protein. **Sewage Treatment:-** Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment - primary, secondary and tertiary treatments (Trickling filters, activated sludge process and Oxidation lagoons.
Unit IV	**Bioremediation & Microbial leaching:** Polluted heterogeneous environment. Indicator organisms for pollution and abatement of pollution. **Bioremediation** – Types and uses - Genetically Engineered microbes for Bioremediation. **Microbial leaching:** In situ & Ex situ methods –copper and uranium mining.
Unit V	**Biosafety & Environmental monitoring**: Environmental regulations - Biohazards - Types of hazardous emission – Biosafety measures - Biomonitority of waste water toxics - Monitoring of Genetically Engineered Microbes in the Environment.

Reference and Textbooks:-

1. Atlas, R.M. and Bartha, R. 1992. Microbial Ecology: Fundamentals and Applications. (III Ed) Benjamin Cummings, Redwood City.CA.
2. Subba Rao, N. S. 1995. Soil Microbiology. IV Ed. Oxford & IBH Publishing Co. Pvt. Ltd. NewDelhi.
3. Raina M. Maier, Ian L. Pepper and Charles P. Gerba. 2000. Environmental Microbiology. Academic Press. New York.
4. Clescri, L.S., Greenberk, A.E. and Eaton, A.D.1998. Standard Methods for Examination of and Waste Water, 20th Edition, American Public Health Association.
5. Mara. D and Horan. N 2003. The Handbook of Water and Waste Water Microbiology. Academic.Press, California.
6. Brock, T.D, Smith, D.W. and Madigan M.T 1984, Biology of Microorganisms. (4th ed) PrenticeHall Int. Inc., London.

Outcomes	After completion of the course, students are expected to be able to: ➢ Understand on soil characteristics and biogeochemical cycling ➢ Be familiar with the microbial analysis of drinking water and Aeromicrobiology ➢ Know the different aspects of waste management and sewage Treatment systems ➢ Acquire knowledge on bioremediation and microbial leaching

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ESSENTIAL REASONING AND QUANTITATIVE APTITUDE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">PCS</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td colspan="2">Course Code</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="3">23BMC6S1</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">1</td><td>1</td><td colspan="2">-</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Develop Problem solving skills for competitative examinations
• Understand the concepts of averages , simple interest , compound interest</td></tr>
<tr><td colspan="2">UNIT-I:</td><td colspan="6">Quantitative Aptitude: Simplifications=averages-Concepts –problem-Problems on numbers-Short cuts- concepts –Problems</td></tr>
<tr><td colspan="2">UNIT-II:</td><td colspan="6">Profit and Loss –short cuts-Concepts –Problems –Time and work -Short –uts -Concepts -Problems.</td></tr>
<tr><td colspan="2">UNIT-III:</td><td colspan="6">Simple interest –compound interest- Concepts- Prolems</td></tr>
<tr><td colspan="2">UNIT-IV:</td><td colspan="6">Verbal Reasoning : Analogy- coding and decoding –Directions and distance –Blood Relation</td></tr>
<tr><td colspan="2">UNIT-V:</td><td colspan="6">Analytical Reasoning :Data sufficiency
Non-Verbal Reasoning : Analogy ,Classification and series</td></tr>
<tr><td colspan="2"></td><td colspan="6"></td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Studnets relating the concepts of compound interest and simple interest</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1.”Quantitative Aptitude” by R.S aggarwal ,S.Chand & Company Ltd 2007</td></tr>
<tr><td colspan="2"></td><td colspan="6"></td></tr>
<tr><td colspan="2">Website and e-Learning Source</td><td colspan="6">https://nptel.ac.in</td></tr>
</table>