

**BHARATHIAR UNIVERSITY, COIMBATORE:641 046**  
**B.Sc. MICROBIOLOGY DEGREE COURSE**  
**SCHEME OF EXAMINATION (revised) CBCS PATTERN**  
**(AFFILIATED COLLEGES)**

(For the students admitted from the academic year 2016 – 2017 batch onwards)

Part	Study Components	Course title	Ins. hrs/ week	Examinations				Credit
				Dur.Hrs.	CIA	Marks	Total Marks	
	<b>Semester I</b>							
I	Language – I		6	3	25	75	100	4
II	English – I		6	3	25	75	100	4
II	Core Paper I - Fundamentals of Microbiology		6	3	25	75	100	4
	Practical I and Viva Voce		4	-	-	-	-	-
	Allied A : Paper I – Biostatistics and Computer Applications I		4	3	20	55	75	3
	Allied Practical		2	-	-	-	-	-
IV	Environmental Studies #		2	-	-	50	50	2
	<b>Semester II</b>							
I	Language – II		6	3	25	75	100	4
II	English – II		6	3	25	75	100	4
III	Core Paper II - Bioinstrumentation – Principles and Applications		4	3	25	75	100	4
	Core Paper III - General Biology		3	3	25	75	100	4
	Core Practical I and Viva Voce		3	3	30	45	75	3
	Allied A : Paper II - Biostatistics and Computer Applications II		4	3	20	55	75	3
	Allied Practical		2	3	20	30	50	2
IV	Value Education – Human Rights #		2	3	-	50	50	2
	<b>Semester III</b>							
I	Language – III		6	3	25	75	100	4
II	English – III		6	3	25	75	100	4
III	Core Paper IV - Microbial Diversity		<b>3</b>	3	25	75	100	4
	Core Practical II		<b>4</b>	-	-	-	-	-
	Allied B: Paper I – Biochemistry I/Zoology I		4	-	20	55	75	3
	Allied Practical		2	-	-	-	-	-
IV	Skill based Subject I – Medical Laboratory Technology – Clinical Laboratory Technology		3	3	20	55	75	3
	Tamil @ / Advanced Tamil# (OR) Non-major elective - I (Yoga for Human Excellence) # / Women’s Rights #		2	3	50		50	2

<b>Semester IV</b>							
I	Language – IV	6	3	25	75	100	4
II	English – IV	6	3	25	75	100	4
III	Core Paper V –Microbial Physiology	4	3	25	75	100	4
	Core Practical – II	3	6	30	45	75	3
	Allied B : Paper II – Biochemistry II/Zoology II	4	3	20	55	75	3
	Allied Practical	2	3	20	30	50	2
IV	Skill based Subject 2 - Medical Laboratory Technology – Diagnostic Microbiology I (Bacteriology and Serology)	3	3	20	55	75	3
	Tamil @ /Advanced Tamil # (OR) Non-major elective -II (General Awareness #)	2	3	50		50	2
<b>Semester V</b>							
III	Core Paper VI - Microbial Genetics	5	3	25	75	100	4
	Core Paper VII – Principles of Immunology	5	3	25	75	100	4
	Core Paper VIII– Food Microbiology	4	3	25	75	100	4
	<b>Core Paper IX–Medical Microbiology</b>	4	3	25	75	100	4
	Elective 1	4	3	25	75	100	4
	Core Practical – III	5	3	-	-	-	-
IV	Skill based Subject 3 – Medical Laboratory Technology – Diagnostic Microbiology II (Virology and Mycology, Parasitology)	3	3	20	55	75	3
<b>Semester VI</b>							
III	Core Paper X – Industrial Microbiology	4	3	25	75	100	4
	Core Paper XI – Environmental and Agricultural Microbiology	4	3	25	75	100	4
	Core Paper XII – Virology	4	3	25	75	100	4
	Core Practical – III	6	9	40	60	100	4
	Elective – II	4	3	25	75	100	4
	Elective – III	4	3	25	75	100	4
IV	Skill Based Subject 4 - Diagnostic Microbiology – Practical	4	3	30	45	75	3
V	Extension Activities @	-	-	-	-	50	2
	Total					3500	140

Students should undergo an institutional training for a continuous period of 15 days before semester VI

@ No University Examinations. Only Continuous Internal Assessment (CIA)

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<b>List of Elective papers (Colleges can choose any one of the paper as electives)</b>		
Elective – I	<b>A</b>	Recombinant DNA Technology - I
	<b>B</b>	Applied Plant Biology
	<b>C</b>	Entomology
Elective – II	<b>A</b>	Recombinant DNA Technology – II
	<b>B</b>	Enterpreneurial Microbiology
	<b>C</b>	Bio-Molecules
Elective - III	<b>A</b>	Bionanotechnology
	<b>B</b>	Dairy Microbiology
	<b>C</b>	Medical Biochemistry

**Note: In semester V the title of the Core paper IX Recombinant DNA Technology has been changed as medical Microbiology.**

**SEMESTER - I**  
**CORE PAPER I: FUNDAMENTALS OF MICROBIOLOGY**

**UNIT – I**

History and Scope of Microbiology – Spontaneous generation theory – conflict – Contribution of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Waksman, John Tyndall, Paul Ehrlich, Watson & Crick and Miescher.

**UNIT – II**

Microscopy– Principles and application – Bright field, Darkfield, Phase contrast, Fluorescence, SEM & TEM- Specimen preparation of Electron microscopy.

**UNIT- III**

Structure and organization of bacterial cell wall: Gram positive and Gram Negative bacterial cell wall. Staining – Principles - Types of staining– Simple, Differential (Gram, Spore, AFB), Capsule staining (Negative), Giemsa Staining, LPCB, KOH Mount.

**UNIT – IV**

Sterilization and Disinfection- Principles- Methods of Sterilization – Physical methods – Dry heat- Moist heat, Filtration (Membrane & HEPA) - Radiation – Chemical Sterilization -Chemical agents Mode of action – Phenol coefficient test- Sterility testing.

**UNIT – V**

Culture & Media preparation - Solid and Liquid- Types of Media – Semi-Synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media, Natural components as media and Special Purpose Media (one eg for each type). Anaerobic culture technique – Wright's tube, Roll tube, McIntost fildes jar method. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate.

**References**

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.
4. William Claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
5. Wilson. K and Goulding. K.H. 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
6. Tauro P., Kapoor, K.K. Yadav,K.S. An introduction to Microbiology first Edition ,New Age International Publishers.

**SEMESTER -II**  
**CORE PAPER II: BIOINSTRUMENTATION**  
**PRINCIPLES AND APPLICATIONS**

**UNIT – I**

Buffers, Molar and Normal solutions, pH meter, pH electrodes- colomel and glass electrode.

**UNIT – II**

Principles and Applications of Autoclave, Hot air oven, Incubator, Laminar air flow chamber / Biosafety cabinets, BOD incubator, Metabolic shaker, Incinerator.

**UNIT -III**

Centrifugation: Principle- Types of Centrifuges – Low speed, High speed, Ultra centrifuge. Applications of Centrifuge. Lyophilizer.

**UNIT –IV**

Colorimetry, Turbidometry, Spectrometry – UV & Visible Spectrophotometer. Flame Photometry.

**UNIT-V**

Chromatography – Paper, Thinlayer, Column, Ion-exchange, Gas and HPLC. Electrophoresis – SDS – PAGE and Agarose gel electrophoresis.

**References**

1. Gedder, A. and L. E. Balser, John Wiley and Sons, Principles of applied Biomedical instrumentation.
2. Upadhyay & Upadhyay. Biophysical Chemistry. 2010 Edition. Himalaya Publishing House.
3. Dean, Willard and Merrit, Instrumental Methods of analysis Asian Ed.
4. Fritschen, L. J and L. W. Gay, Springer, Verlag, Environmental Instrumentation, 1979, New York.
5. Boyer, Rodney, F. Benjamin and Cummins, Modern Experimental Biochemistry. 2nd Edition.
6. E.Padmini., Biochemical Calculations and Biostatistics (2007) Books and Allied (P) Ltd., First Edtn.

**SEMESTER -II**  
**CORE PAPER III: GENERAL BIOLOGY**

**UNIT – I**

Ultrastructure of Eubacteria- Cell membrane- Extra mural layer - Slime – Capsule – Cytoplasmic inclusions – Mesosomes – Nuclear material – Reserve materials - Pigments – Cell appendages – Flagella – Pili.

**UNIT – II**

Ultrastructure and functions of Eukaryotic cell organelles – Cell wall – Cell membrane - Mitochondria – Chloroplast – Endoplasmic reticulum – Golgi complex – Nucleus – Ribosomes – Other cell inclusions and Flagella.

### UNIT III

Cell division in Bacteria – Binary fission - Cell division in Eukaryotes – Mitosis and Meiosis. Reproduction in Microbes.

### UNIT IV

Botany: Ultrastructure of plant cell. General characters of Thallophyta, Bryophyta, Pteridophyta, Angiosperms and Gymnosperms. Plant Adaptations in Hydrophytes, Xerophytes, Halophytes.

Economic Botany: Economic importance of Cereals – Ragi, Pulses – Cow Pea, Beverage – Coffee, Oil – Sunflower, Biodiesel – Jatropha. Horticulture: Importance, Propagating methods of horticultural plants – Cutting, Layering, Grafting.

### UNIT V

Zoology: Ultrastructure of Animal cell. General characteristics of Vertebrate and Invertebrate. Human physiology-Digestive system and Respiratory system. Economic zoology: Aquaculture, Sericulture, Apiculture.

### References

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheelis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentice Hall. Yy
4. Jain V.K. (2000) Fundamentals of Plant Physiology, 5th edition. S.Chand & Co Ltd; New Delhi.
5. Pandey B.P. (2007) Plant Anatomy, S. Chand & Co. De, New Delhi.
6. Reddy, S.M. (2010) University Botany – 2. Gymnosperms, Plant Anatomy, Genetics, Ecology. New Age International Publishers, New Delhi.
7. Nayar, M.P. Ramamurthy, K. & Agarwal, V.S. (1989) Economic Plants of India. Botanical Survey of India, Calcutta – 700 001.159 pp.
8. Ekambarantha Ayyar, and Ananthkrishnan, T.N. 1993 Outlines of Zoology, Vol. I & II Viswanathan and co Madras.
9. Sambasiviah I, Kamalakara Rao. A.P. Augustine Chellappa, S [1983] Text Book of Animal Physiology, S. Chand & Co., New Delhi.

## **SEMESTER II CORE PRACTICAL 1**

1. Laboratory precautions
2. Preparation of cleaning solutions
3. Culture media preparation – Liquid and Solid medium
4. Selective and differential media: Mac conkey and Blood agar
5. Methods of sterilization
6. Pure culture techniques – Pour plate, Spread plate and Looping method
7. Streaking techniques: Simple, Quadrant and continuous
8. Enumeration of Bacteria, Fungi and Actinomycetes from soil
9. Determination of Motility – Hanging drop & SIM agar
10. Cultural characteristics of Microorganisms - Colony morphology on Nutrient agar
11. Slants, Nutrient broth
12. Maintenance and preservation of cultures
13. Staining of Bacteria - Simple, Negative, Gram, Spore, Fungal wet mount –LCB - Slide culture method.
14. Paper chromatography
15. Thin layer chromatography

### **References**

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. William Claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
4. Wilson. K and Goulding. K.H. 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
5. Tauro P., Kapoor, K.K. Yadav,K.S.An introduction to Microbiology first Edition ,New Age International Publishers.
6. James Cappuccino. Microbiology: A Laboratory Manual (10th Edition).

## **SEMESTER –III CORE PAPER IV: MICROBIAL DIVERSITY**

### **UNIT – I**

Taxonomy – Principles – Modern approaches – Numerical, Genetic, Serotaxonomy and Chemotaxonomy. Introduction to Microbial Classification and Taxonomy- Taxonomic Ranks Organization of II edition of Bergey's Manual of Systematic Bacteriology-

### **UNIT - II**

Outline classification and characteristics of Archebacteria, proteobacteria, Methanogens, Halophiles, Theroacidophiles and Actinobacteria.

### **UNIT – III**

Taxonomy & General Characteristics of Fungi - Life Cycle of Aspergillus, Mucor, Rhizopus and Penicillium - Modes of reproduction & its economic importance .

### **UNIT – IV**

Algae – Morphology & General Characters – Basic knowledge on its reproduction & its economic importance.

Protozoa – General characteristics and the economic importance of Sarcodina, Mastigophora, Rhizopoda, Ciliata, Sporozoa.

### **UNIT – V**

Virus- Morphology, General characteristics, Classification (Baltimore classification) and Multiplication of viruses. The structure of viruses- virion size- General structure properties- helical capsids, icosohedral capsid- nucleic acids- Viral envelopes and enzymes.

### **References**

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.
4. Atlas & Atlas. Microbiology. Pearson Publications. 4<sup>th</sup> Edition.

## **SEMESTER – IV**

### **CORE PAPER V: MICROBIAL PHYSIOLOGY**

#### **UNIT – I**

Nutrition: Nutritional requirements of Microorganisms – Autotrophs, Heterotrophs, Photoautotrophs, Chemoautotrophs, Copiotrophs, Oligotrophs. Transport Mechanisms Diffusion – Facilitated Diffusion, Active Transport – Group Translocation. Phagocytosis – Pinocytosis.

#### **UNIT – II**

Different phases of growth – Growth curve – Generation time – factors influencing Microbial growth – Temperature, pH, Pressure , Salt concentration , Nutrients – synchronous growth and continous cultivation . Diauxic growth. Sporulation – Endospore formation in bacteria.

#### **UNIT -III**

Metabolism – EMP – HMP – ED pathways – TCA cycle- Electron transport chain – Oxidative and Substrate level phosphorylation.

#### **UNIT- IV**

Anaerobic respiration – sulphur , nitrogenous compounds and CO<sub>2</sub> as final electron Acceptor - Fermentation – alcoholic, propionic and mixed acid fermentation. Lactic acid fermentation.

#### **UNIT- V**

Photosynthesis – Oxygenic and Anoxygenic , Carbon dioxide fixation, Biosynthesis of bacterial cellwall, Biosynthesis of aminoacids ( Glutamic acid family )- Bioluminescence.

### **References**

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.



2. David White. The Physiology and Biochemistry of Prokaryotes. Oxford University Press. 4<sup>th</sup> Edition. 2011.
3. Tortora, Funke and Case. Microbiology - An Introduction. Books a la carte Edition. 11<sup>th</sup> Edition
4. Doelle. H.W.1975.Bacterial Metabolism. 2nd edition. Academic Press.
5. Moat. A.G. J.W.Foster. 1988. Microbial physiology. 2nd edition. Springer – Verlag.
6. Caldwell. D.R.1995, Microbial physiology and Metabolism. WmC Brown Publishers, England.

### **SEMESTER IV CORE PRACTICAL II**

1. Protein estimation ( Lowry *et al* / Bradford )
2. Estimation of Carbohydrates( DNSA method)
3. Micrometry
4. Measurement of Microbial growth –Turbidity methods – Determination of Generation time, Neubaur Counting chamber.
5. Influence of pH and Temperature on bacterial growth.
6. Cultivation of anaerobic Microorganisms – Wrights tube – McIntosh fildes jar  
Physiological characterization:
7. Indole, MR, VP, Citrate utilization tests
8. Carbohydrate fermentation tests – TSI – H<sub>2</sub>S production
9. Catalase – Oxidase – Urease – Nitrate
10. Starch hydrolysis, Gelatin and Casein hydrolysis tests
11. Observation of representative forms of Algae – Diatoms – Chlamydomonas - Volvox – Cyanobacteria – Oscillatoria – Nostoc – Anabaena.
12. Observation of representative forms of Fungi – Aspergillus - Pencillium – Rhizopus – Yeast.
13. Observation of representative forms of Parasites – *Entamoeba* , *Plasmodium*, *Ascaris*, *Taenia*.

#### **References:**

1. James Cappuccino. Microbiology: A Laboratory Manual (10th Edition).
2. Tiwari, G. S. Hoondal, Laboratory Techniques In Microbiology & Biotechnology. Swastik publishers. 2005.
3. William Claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3. Wilson. K and Goulding. K.H. 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4. Tauro P., Kapoor, K.K. Yadav,K.S.An introduction to Microbiology first Edition, New Age International Publishers.
5. Kannan. N. Laboratory Manual in General Microbiology. Panima Publishing Corporation. New Delhi. 2<sup>nd</sup> Edition.

**SEMESTER -V**  
**CORE PAPER VI - MICROBIAL GENETICS**

**UNIT-I**

DNA and RNA as genetic material, Characters of a genetic material, Chemistry & Molecular structure of DNA, Topology of DNA, Structure and types of RNA. Bacterial chromosome, Organization of genes in prokaryotes & Eukaryotes.

**UNIT-II**

Replication of DNA – Replication in prokaryotes & Eukaryotes –Mechanism & enzymology of replication – Theta replication & Rolling circle replication.

**UNIT-III**

Transcription in prokaryotes and Eukaryotes – enzymology and molecular mechanism, Post transcriptional modifications. – Genetic code – Translation of proteins – enzymology and molecular mechanism, Post translational modifications. Regulation of gene expression in prokaryotes – Operon concept – lac & trp Operon.

**UNIT-IV**

Mutation - spontaneous and induced Mutagen & Mutagenesis – DNA repair mechanism.

**UNIT-V**

Genetic exchange – Transduction (specialized & generalized), Transformation, Conjugation - Hfr mapping, genetic recombination.

**References**

1. Gardner, E. J, Simmons, M J & D P Snustard ,1991 , Principles of Genetics, 8<sup>th</sup> edition. John Wiley & Sons.NY.
2. David Freifelder .S, 1987 Microbial Genetics, Jones & Bartlett, Boston.
3. Robert H .Tamarin. Principles of Genetics, 5th edition, WmC Brown Publishers.
4. Lewin.B, 1990. Genes, 6th edition, Oxford University Press.
5. Klug .W.S. & Cummings, MR, 1996, Essentials of Genetics, Mentics Hail. NewJersey.

**SEMESTER -V**  
**CORE PAPER VII - PRINCIPLES OF IMMUNOLOGY**

**UNIT- I**

History and Scope of Immunology - The basis of defence mechanisms - Cell and Organs involved in immune system - Phagocytosis.

**UNIT- II**

Types of immunity – Antigen – Antibody – types - Complement pathways - Classical and Alternate – Immunoglobins - structure and functions.

**UNIT- III**

Allergy and Hypersensitivity - Classification types and Mechanisms – Immunodeficiency diseases.

**UNIT -IV**

Autoimmunity mechanisms and autoimmune response diseases: RA, SLE and Myasthenia Gravis. - Monoclonal antibodies and its applications (Hybridoma technology)

**UNIT –V**

Immunohematology - Blood transfusion - ABO grouping - Rh factor - Tissue transplantation- HLA typing - Mechanism of acceptance and rejection.

**References**

1. Kuby.J.1997 . Immunology,W.H.Freeman, NY
2. Tizard,I R 1998.Immunology An Introduction ,Second edition.W.B.Saunders,Philadelphia.
3. Roitt, IM 1991.Essentials of Immunology, Seventh edition. Blackwell Scientific Publications.
4. Nandhini Shetti,1993. Immunology, Introductory Text Book.New Age International Limited.

**SEMESTER –V**  
**CORE PAPER VIII - FOOD MICROBIOLGY**

**UNIT – I**

Food and Microorganisms – Important microorganisms in food (Bacteria, Mold and yeasts) ; Factors affecting the growth of microorganisms in food – pH, moisture, oxidation – Reduction potential , Nutrient content and Inhibitory substances and biological structure.

**UNIT – II**

Principles of food preservation – General principles and application methods – Asepsis - Techniques of removal – use of temperature (low & high). Drying, radiation and chemical preservatives.

**UNIT -III**

Spoilage of food - cereals, vegetables, fruits, egg and milk – canned foods and sea foods.

**UNIT-IV**

Fermented food – pickled cucumber, saurkraut- soysauce, Bread, Idli – Fermented dairy products – Yoghurt and cheese.

#### **UNIT- V**

Food borne diseases & Food Quality control Measures – Food poisoning and Food borne infections – Bacterial and Mycotoxins- Investigation of food poisoning outbreaks- food standards, quality control. HACCP, FDA, WHO.

#### **References**

1. Frazier. W.C and D.C Westhoff . 1978. Food Microbiology . 3rd ed. Tata Macgraw Hill publishing Co., New Delhi.
2. Jay,J.M .1991 . Modern Food Microbiology 4th edition , Van Nostra and Rainhokdd Co.
3. Adams. M. R and M. D Moss . 1995. Food Microbiology . New Age International limited.
4. Roday. S. Food Hygeine and Sanitation. Tata Mcgraw Hill Publications.1998.

### **SEMESTER –V CORE PAPER IX**

#### **MEDICAL MICROBIOLOGY**

#### **UNIT- I**

Infections- sources of infections- Types of infections- methods of infections - Definitions- Epidemic, Pandemic, Endemic diseases- Epidemiology of Infectious diseases, Infectious diseases cycle- Investigation of epidemics- control of epidemics.

#### **UNIT- II**

Morphology, Pathogenicity and laboratory diagnosis- Gram positive & negative coccus - *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pneumococcus* and *Neisseria sp.*

#### **UNIT- III**

Morphology, Pathogenicity and laboratory diagnosis- Gram positive organisms- *Bacillus anthracis*, *Corynebacterium diphtheriae*, *Clostridium botulinum*, *Clostridium tetani*

#### **UNIT- IV**

Morphology, Pathogenicity and laboratory diagnosis- Gram negative Organisms - *Escherichia coli*, *Klebsiella*, *Proteus*, *Salmonella*, *Shigella*, *Pseudomonas*, *Vibrio cholerae*.

#### **UNIT –V**

Morphology, pathogenicity and laboratory diagnosis- *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Treponema pallidum*, *Leptospira*, *Chlamydiae*, *Rickettsiae* & *Mycoplasma*.

#### **References**

1. Mackie and Mc catney, 1994, Medical Microbiology No I and II. Churchill Livingstone, 14th edition.

2. Ananthanarayanan R and CK Jayaram Panicker, 1994, Textbook of microbiology Orient Longman.
3. Chakraborty P 1995, A Text book of microbiology, New Central Book Agency Pvt Ltd. Calcutta.
4. Bailey and Scotts, 1994, Diagnostic Microbiology, 9th edition, Baron and Finegold CV Mosby Publications.
5. Jawetz E Melnic JL and Adelberg EA 1998, review of Medical Microbiology Lange Medical Publications, USA.

## **SEMESTER -VI**

### **CORE PAPER X – INDUSTRIAL MICROBIOLOGY**

#### **UNIT –I**

Fermentation- Definition & types - Submerged and Solid state.Fermentors & its types (Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation.

#### **UNIT -II**

Industrially important strains- Screening methods- Strain development for Improved yield- Mutation, Recombination and protoplasmic fusion.

#### **UNIT -III**

Production of beverages – beer and wine- vitamin B12 and Riboflavin – Antibiotics- penicillin and streptomycin- production of enzymes- Amylases and Proteases- methods of immobilization.

#### **UNIT- IV**

Single cell protein- Bakers yeast, spirulina- Details of mushroom development- Oyster Pleurotus) and Button (Agaricus) mushroom.

#### **UNIT -V**

Downstream process- Intercellular and extracellular- Centrifugation, filtration, Flootation-solvent extraction, precipitation- Breakage of cells- physical and Chemical methods.

#### **References**

1. Stanbury P T and Whitaker 1984, Principles of Fermentation Technology, Pergamon Press. NY
2. Casida, L E JR 2007. Industrial Microbiology. New Age International Publishers.
3. Prescott and Rehm 1979. Industrial Microbiology. Wiley and Sons.
4. Nduka Okafor. Modern Industrial Microbiology and Biotechnology. 2007. CRC Press.
5. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. Industrial Microbiology: An Introduction. 2001. William Blackwell Publishers.
6. A.H. Patel. Industrial Microbiology. Macmillan India Publishers. 2011 Second Edition.
7. Crueger and Crueger. Biotechnology: A Textbook of Industrial Microbiology. Sinauer Associates Inc.,U.S.; 2nd edition edition (25 October 1991)

**SEMESTER -VI**  
**CORE PAPER XI**  
**ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY**

**UNIT -I**

Distribution of microorganisms in nature – Microbial communities in soil- Factors Influencing the microbial density in soil- zymogenous and autochthonous flora in Soil- Microbial associations – symbiotic proto cooperation, Ammensalism, Commensalism, Syntropism, Parasitism and Predation with suitable examples.

**UNIT -II**

Microbial decomposition; Cellulose, Hemicellulose, Lignin, Pectin and Chitin – Factors influencing degradation- Acetate utilization - bioconversion of organicwastes – sugarcane wastes- coir pith composition- composting, principles and Applications- conversion process.

**UNIT- III**

Microorganisms in the Decomposition of organic matter- Carbon cycle – Nitrogen Cycle - Nitrogen fixing microorganisms - Root nodule bacteria – non symbiotic Nitrogen fixers – biofertilizers in agriculture - Rhizobium and phosphate Solubilizers - Mycorrhizial association – Phosphorous cycle.

**UNIT- IV**

Water microbiology, algae, phytoplankton- eutrophication- Water Pollution (Microbiological) water treatment- Primary, secondary and tertiary. Drinking water- Potability- MPN technique.

**UNIT-V**

Aero microbiology- aerosol, droplet nuclei, air pollution- sources (Microbiological) – air quality analysis- air sampling devices.

**References**

1. Atlas R. M.and Bartha. R 1992, Microbial Ecology. Fundamental and application. 3rd edition Bengamin and Cummings.
2. Alexander A M 1987. Introduction to Soil Microbiology, 5th edition John Wiley and sons,
3. Alexander, A M 1974. Microbiology Ecology, John Willy & Sons.
4. Mitchell R 1974, Introduction to Environmental Microbiology, Prentice Hall Inc., Englewood Cliffs.
5. Rangasamy, G and D J Bagyaraj, Agricultural microbiology, Asia Publishing House, New Delhi.
6. Rheinhermer, G. 1986. Aquatic Microbiology , John Wiley and Sons , NY.
7. Grant. W. D. P . E. Long. 1981 Environmental Microbiology, Thomson Litho Ltd.

## **SEMESTER -VI** **CORE PAPER XII – VIROLOGY**

### **UNIT -I**

Early development of virology –cultivation of Viruses- virus purification and assays.

### **UNIT- II**

Reproduction of DNA phages- ds DNA lytic phages- lytic cycle of T4 phage The one step growth- adsorption to the host cell and penetration- synthesis of Phage nucleic acids and protein assembly of phage particles- release of phage particles. Example of ss DNA phage- OX 174- circle replication.

### **UNIT-III**

Lysogeny- Temperate bacteriophages- lambda phage- induction of lysogens- Generation of defective phages and their uses. Reproduction of RNA phages.

### **UNIT -IV**

Viruses of Eukaryotes- Reproduction of animal and plant viruses- Viruses of Algae, fungi and viruses- viruses and cancer.

### **UNIT- V**

Human viral infections- pathogenicity and diagnosis of Hepatitis (A, B). Mumps, AIDS, Rabies, Influenza, Measles, Rubella, Polio virus.

### **References**

1. Luria S.E. Darnel, J.E Jr. Baltimore. D and Campbell A. 1978. General Virology 3rd edition, Wiley and sons.
2. Prescott L.M, Harley, J.P Klein D.A. 1990. Microbiology Wm C Publishers.
3. Alan J. Cann. Principles of Molecular Virology. Academic Press; 5 edition (September 16, 2011).
4. John Carter. Virology: Principles and Applications. Wiley Publications. 2001 1<sup>st</sup> Edition.
5. Nicholas H. Acheson. Fundamentals of Molecular Virology. August 30, 2011. Wiley Publications.

## **SEMESTER VI** **CORE PRACTICAL III**

1. Isolation of Nucleic acids
2. Isolation of drug resistant mutants using UV and Chemical agents
3. Phenol Coefficient method
4. Isolation of *E. coli* plasmid DNA by agarose gel electrophoresis
5. Methylene blue reduction test
6. Microbial analysis of spoiled food –Bread and Vegetables
7. Identification of fungal food spoilers –*Aspergillus*, *Mucor*, *Penicillium*, *Rhizopus*
8. Direct microscopic examination of curd – observation of lactobacilli
9. Enzyme production and assay – protease and amylase
10. Alcohol production / wine

11. Immobilization- Demonstration
12. Isolation of free living nitrogen fixers –*Azotobacter* , *Azospirillum* – Phosphate solubilizers – *Rhizobium* from nodule
13. Isolation of coliphages.
14. Microscopic identification of clinically important fungi – *Candida albicans*, *Cryptococcus neoformans* and *Aspergillus*
15. MPN Technique – Detection of potability of water.

#### References:

1. James Cappuccino. Microbiology: A Laboratory Manual (10th Edition).
2. Tiwari, G. S. Hoondal, Laboratory Techniques In Microbiology & Biotechnology. Swastik publishers. 2005.
3. William Claus. G.W. 1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
3. Wilson. K and Goulding. K.H. 1986. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, London.
4. Tauro P., Kapoor, K.K. Yadav, K.S. An introduction to Microbiology first Edition, New Age International Publishers.
5. Kannan. N. Laboratory Manual in General Microbiology. Panima Publishing Corporation. New Delhi. 2<sup>nd</sup> Edition.

**SEMESTER III**  
**SKILL BASED SUBJECT I**  
**MEDICAL LABORATORY TECHNOLOGY**  
**CLINICAL LAB TECHNOLOGY**

#### UNIT – I

Methods of collection of urine, blood, sputum, stool etc. The techniques of preservation of samples. Separation of blood plasma and serum.

#### UNIT – II

Examination of urine: Sample collection, physical and chemical tests, principles and methods, microscopic examination- crystals, casts, sediments, pregnancy tests.

#### UNIT – III

Blood smear preparations: Staining differential WBC count-Peripheral blood smear examination and morphological abnormalities- Reticulocyte count- absolute eosinophil count- E.S.R, P.C.V, Blood indices - Platelet count: BT, CT, CRT- Prothrombin time, A.P.P.T, FDP estimation.

#### UNIT –IV

Tissue reception, labeling, fixation for different tissue and section cutting-Preparation of paraffin blocks (Dehydration, clearing, embedding, blocking)-Handling and care of microtome sharpening of razors, and section cutting-Preparation of common stains. H & E, congored, methyle violet, Leishman stain, Giesma, Papiaicolau, VG, PAS, PASM etc. and staining techniques-Mounting of museum specimens, record keeping, indexing of slides.



### **UNIT – V**

Examination of Stool - Indication, Collection, Container, Transport, Preservation for different types of fecal analysis; Physical, Chemical and Microscopic examination and its significance

#### **References**

1. Seiverd, Charles E. Hematology for Medical Technologies. 4th Ed. Lea & Febiger, U.S.,
2. C.F.A. Culling. Handbook of Histopathological and Histochemical Technique – Third Edition. Butterworths. London.
3. P.B. Godkar, Text Book of Medical Laboratory Technology, 2nd Edn. 2003. Bhalani Publication.
4. John A. Washington. Medical Microbiology. University of Texas Medical Branch at Galveston; 1996.
5. Talib. V.H. Handbook of Medical Microbiology. CBS Publishers. 2<sup>nd</sup> Edition. 2008.

## **SEMESTER IV SKILL BASED SUBJECT II DIAGNOSTIC MICROBIOLOGY – I (BACTERIOLOGY AND SEROLOGY)**

### **UNIT – I**

Selection, collection and transport of specimens – Blood, Urine, Sputum, CSF, Pus & Faeces – transport media and storage. Microscopic examination of specimen for Bacterial pathogens – simple, differential staining and motility.

### **UNIT – II**

Identification of organisms - Biochemical reaction – Sugar fermentation test - Susceptibility testing – MIC, E test - reporting of results & interpretation.

### **UNIT – III**

Serology – Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL) RPR and Hemaagglutination

### **UNIT – IV**

Precipitation (VDRL), Immunodiffusion – mono and double immunodiffusion, Immunoelectrophoresis (rocket, counter current). ELISA, Radioimmune assay (RIA)

### **UNIT – V**

Advanced techniques – automated methods – ELISA, RIA. Quantitative study of Antigen - Antibody reactions. Immunosensors. CD4, CD8 cell counting, Western blot analysis for HIV.

#### **References**

1. Diagnostic Microbiology, Bailey and Scott's., 1990. Eighth edition. The C.V. Mosby Company.
2. Medical laboratory techniques, Abdul Khader, 2003, First edition. Frontline Publications, Hyderabad.

3. Medical laboratory manual for tropical countries. Microbiology by Monica Chees Brough (ELBS). Tropical Health Technology, Butterworths, 1985.
4. Manual of Clinical Microbiology, Lenette, E., Balows, H.A., Hausler, W.J and Shadomy J., 1985. Bethesda American Society of Microbiology.

**SEMESTER V**  
**SKILL BASED SUBJECT III**  
**DIAGNOSTIC MICROBIOLOGY –II**  
**(VIROLOGY, MYCOLOGY AND PARASITOLOGY)**

**UNIT –I**

Laboratory methods in basic Mycology –Collection and transport of clinical specimens – Direct Microscopic examination, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing. Mycology: superficial infections- *Dermatophytes- Microsporum – Trichophyton, Epidermophyton- Madura mycosis-* Opportunistic fungal infections- *Candida albicans, Aspergillus, Mucor.*

**UNIT –II**

Laboratory methods for parasitic infections – Diagnostic techniques for faecal, gastrointestinal and urino-genital specimen. Parasitic diseases- *Entamoeba histolytica, Giardia, Taenia solium, Ascaris, Enterobius, Trichuris trichura, Plasmodium vivax, Wuchereria bancrofti.* Identification of Intestinal Protozoa – Amoeba, Blood protozoa – Malaria, Intestinal Helminthes: *Ascaris, Taenia, Entrobilus* and Blood Helminthes: *Wuchereria bancrofti.*

**UNIT -III**

Etiology and laboratory diagnosis of Urinary tract infection- Meningitis, Diarrhea, Respiratory tract infections. Pyogenic infections- *Staphylococcus* and *Pseudomonas*: Sexually Transmitted Diseases (Bacteria), Nosocomial infections - definition, sources and detection; phage typing, Bacteriocin typing.

**UNIT –IV**

Laboratory methods in basic Virology- Viral culture- Media and cells used – Specimen processing – isolation and identification of viruses. Detection of viral antigen (fluorescent antibody and solid phase immunoassays). Viral Serology- Special consideration- Hepatitis and AIDS.

**UNIT –V**

Antibiotics and chemotherapeutic agents- Mechanism of actions – Drug resistance – Antimicrobial susceptibility testing- Disc diffusion- Kirby Bauer method.

**References**

1. Diagnostic Microbiology, Bailey and Scott's., 1990. Eighth edition. The Mosby Company.
2. Medical laboratory techniques, Abdul Khader, 2003, First edition. Frontline Publications, Hyderabad.
3. Virology, Sawant, K.C., 2005, First edition, Dominant Publishers and distributors, Delhi.
4. Medical Parasitology, Rajesh Karykarte, Ajit Damla, 2004. Books and allied publishers Ltd. Kolkata.
5. Textbook of Medical Parasitology, Subash O. Barija , 1996. First edition. All India Publishers and Distributors Regd. 920 Poonamallee High Road, Chennai.
6. Rajesh Karyakarte and Ajith Damle (2005)Medical Parasitology, ooks and Allied(P)Ltd.

## **SEMESTER VI**

### **SKILL BASED SUBJECT IV PRACTICALS IN DIAGNOSTIC MICROBIOLOGY**

1. Collection, transport, processing of specimen and Identification of bacteria from clinical specimens –Urine, Blood, Sputum, Pus and Faeces.
2. Slide agglutination -Blood grouping
3. Tube agglutination- WIDAL
4. Precipitation – RPR
5. Immunodiffusion- Radial, Ouchterlony's
6. Immunoelectrophoresis- Rocket and Counter current
7. ELISA
8. SDS-PAGE
9. Observation of fungi- LCB or KOH mount

## **ELECTIVE I - A**

### **RECOMBINANT DNA TECHNOLOGY- I**

#### **UNIT- I**

Gene manipulation – Definition and Application, Restriction Enzymes, Discovery,Types and Mode of Action, Ligases and Methylases.

#### **UNIT –II**

Isolation - Purification of DNA (Chromosomal and Plasmid), Isolation and Purification of RNA, Chemical Synthesis of DNA, Genomic Library and cDNA Library.

#### **UNIT -III**

Vectors – Plasmid based Vectors- Natural (PSC101, PSF2124, PMB1), Artificial – pBR322 & pUC Construction: Phage based Vectors-  $\lambda$  (Lamda) phage Vectors and its Derivatives: Hybrid Vectors- Phagemid, Phasmid and Cosmid, BAC and YAC.

#### **UNIT -IV**

Gene Transfer Techniques: Physical – Biolistic Method, Chemical- Calcium chloride and DEAE Methods , Biological invitro package method - Screening and Selection of recombinants- Direct Method – Selection by Complementation, -Indirect Methods- Immunological and Genetic Methods.

#### **UNIT- V**

PCR , DNA Sequencing (Sanger's Method) Blotting (Southern, Western, Northern) Techniques, RFLP and Application, - RAPD and Application - Microarray. Protein Engineering.

#### **References**

1. Old. RW and Primrose, 1995 Principles of Gene Manipulation, 5th edition. Blackwell Scientific Publication, Boston.
2. Winnecker, E.D, 1987- From gene to clones, Introduction to Gene Technology, VCH Publication, FRG.
3. T.A Brown 1995, 3rd edition, An introduction to Gene Cloning ,Chapman and Hall .
4. Glick B.R and Pasternak J .J, 1994. Molecular Biotechnology. Principles and Application of recombinant DNA, ASM Press, Washington.

### **ELECTIVE I – B**

#### **APPLIED PLANT BIOLOGY**

##### **UNIT – I**

Plant Tissue culture – History, Plant tissue culture media, types, constituents and preparation of media, selection of suitable medium.

##### **UNIT – II**

Protoplast culture and somatic hybridization, production of Haploid plants, Somaclonal variations, Clonal propagation (micro propagation) germplasm conservation and cryopreservation.

##### **UNIT – III**

Genetic Engineering of plants – Gene transfer methods – vector mediated gene transfer, virus – mediated gene transfer, Direct or Vectorless DNA transfer.

##### **UNIT –IV**

Application of Transgenic plants – Resistance to biotic stresses – Insect resistance plant virus, bacteria and fungi resistance, abiotic stress – herbicide resistance plants.

##### **UNIT – V**

Molecular Marker Aided plant Breeding – Molecular markers, Molecular marker assisted selection, Arid & semi-arid plant Biotech, Green house & Green home technology.

#### **References:**

1. Dr. U. Sathyanarayana – Biotechnology. Books and Allied Publications
2. Winnacker, E.L. 1989: From genes to clones. Introduction to Gene Technology. VCH Weinheim.
3. Old, R.M. and S.B. Primrose. 1995. Principles of Gene Manipulation. Blackwell Scientific Publication. London.
4. Glick, B.K. and Pasternak, J.J. 1994. Molecular Biotechnology. Principles and applications of recombinant DNA. ASM Press, Washington.

## **ELECTIVE I – C ENTOMOLOGY**

### **Unit I**

Brief account of morphology, classification (Major orders) and development (Metamorphosis) of insects. Study of Insect Pest a. Agriculture pest – Grasshopper, Red Cotton bug, Gram pod borer, Cotton pink bollworm, Cotton spotted bollworm b. Medical pest – House fly, Mosquito, *Pediculus humanus* c. Veterinary pest – Stable fly, Dog tick, Bird lice d. Stored grain pest – Stored grain weevil, Flour moth e.

### **Unit II**

Beneficial and harmful insects. Economic importance of Honey bees, Silk worm and Lac insects, Dragon fly, Lady bird, beetle. Parasitic and predatory insects. Damages to plants, animals and Human by insects. Insects associated with Rice, Cholan and Pulses. Sugar cane, Cotton, Groundnut, Gingely and Cocount, Brinjal, Tomato and Lady's finger, Cardamom, Chillies, Tea and coffee, Mango and citrus.

### **Unit III**

Insect pests of stores grains - Insect vectors of plants, animals and man - other insects affecting the health of man and domestic animals. Application of management strategies for insect/mite pests of small grains, corn, cotton, rice, sorghum, stored products and sunflower; nature and symptoms of damage, life history and habits of common pests.

### **Unit IV**

Integrated Pest Management - pest and pest damage identification. Insect pest control methods (Physical, mechanical, biological and chemical. Insect Plant interactions. Insect animal interactions. Classification of insecticides and their modes of action.

### **Unit V**

Insect Vectors for Plant and Animal diseases. Three examples each. Molecular Entomology. Pesticides and environmental pollution - precautions in handling pesticides.

### **References:**

1. The Insects: An Outline of Entomology. 2010. by P. J. Gullen and P. S. Cranston. 4th edition. Blackwell Science Ltd.
2. How to Know The Insects. 1978 by Roger Bland and H. E. Jaques. 3rd edition. Waveland Press, Inc.

## **ELECTIVE II – A RECOMBINANT DNA TECHNOLOGY- II**

### **UNIT –I**

Microbial synthesis of commercial products-Proteins-Pharmaceuticals – Interferons - Human growth hormone- Antibiotics -Biopolymers.

### **UNIT –II**

Vaccines – Subunit vaccines, Edible vaccine, Recombinant vaccine – Monoclonal antibody. Gene therapy.

### **UNIT –III**

Transgenic plants-Ti plasmid – insect, virus, herbicide resistant plants – microbial insecticides – bacteria, fungi and viruses.

### **UNIT IV**

Transgenic animals – mice – retroviral method – DNA Microinjection method – embryonic stem cell method- Application-Transgenic - sheep – Transgenic fish .

### **UNIT -V**

DNA finger printing and its Application.Human Genome Project and History and its Application .

### **References**

1. Brown T.A 1995 An Introduction to gene cloning,3rd edition. Chapman and hall
2. Bernard. R Glick and Jack J Pasternak. 1994 Molecular biotechnology, Panima Publishing Corporation.
3. U.Sathyanarayana., Biotechnology Books and Allied (P) Ltd.,(2005)First Edition.

## **ELECTIVE II – B : ENTREPRENEURIAL MICROBIOLOGY**

### **UNIT I:**

Entrepreneur development, activity, Institutes involved, Government contributions to entrepreneurs, risk assessment. Industrial Microbiology, Definition, scope and historical development.

### **UNIT II:**

Microbial cells as fermentation products- Bakers yeast, food and feed yeasts, Bacterial Insecticides, Legume Inoculants, Mushrooms, Algae. Enzymes as fermentation products- Bacterial and Fungal Amylases, Proteolytic Enzymes, Pectinases, Invertases, and other enzymes.

### **UNIT III:**

Mushroom cultivation and Composting- Cultivation of *Agaricus campestris*, *Agaricus bisporus*, and *Volvariella volvaciae*; Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting, storage. Biofertilizers- Historical background,

Chemical fertilizers versus biofertilizers, organic farming. *Rhizobium* sp, *Azospirillum* sp, *Azotobacter* sp, as Biofertilizers.

#### **UNIT IV:**

Patents and secret processes, History of patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent. Patents in India and other countries. Fermentation Economics.

#### **UNIT V:**

Brewing- Media components, preparation of medium, Microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination, by products. Production of Industrial alcohol.

#### **References:**

1. Industrial Microbiology- L.E.Casida, jr, New age International publication.
2. Entrepreneurial Development in India- By Arora
3. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology- K.R.Aneja, New age International publication. S.Chand Publication 6th Edition

### **ELECTIVE II – C : BIO-MOLECULES**

#### **UNIT - I**

Carbohydrates: Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections. Monosaccharides-Reactions-Characteristics of aldehyde and ketone groups. Action of acids and alkalies on sugars. Reactions of sugars due to hydroxyl groups. Disaccharides- Structure, chemistry and function – Sucrose, Lactose, Maltose and Cellobiose. Trisaccharides-Structure of Raffinose. Polysaccharides. [Structures not required]. mopolysaccharides-starch, glycogen, cellulose, chitin, dextrin and inulin. Heteropolysaccharides-hyaluronic acid, chondroitin sulfate and heparin. Artificial sweeteners – Saccharin Aspartame, Monellin, Neohesperidine dihydrochalcone.

#### **UNIT - II**

Lipids; Definition, classification of lipids, simple compound and derived. Simple lipids- Physical and chemical properties of fats. Characterisation of fat – Saponification number, acid number, Iodine number and RM number. Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins. Derived lipids-Fatty acids-saturated and unsaturated. Essential fatty acids. Steroids-Structure of cholesterol, ergosterol and stigma sterol. Value of lipids in cardiovascular diseases (Atherosclerosis).

#### **UNIT- III**

Amino acids and peptides. Definition, amino acids as ampholytes. Structure and classification of amino acids based on chemical nature, chemical reaction of amino acids due to carbonyl and amino groups. Essential amino acids Peptides; Structure and properties. Identification of N and C terminal residues. Determination of primary structure of peptides-Glutathione, Oxytocin and Vasopressin.

#### **UNIT- IV**

Nucleic acids; Structure of Purines and Pyrimidines; Nucleotides and Nucleosides. DNA: double helix: A, B and Z forms; DNA denaturation and renaturation. RNA: types, unusual bases. DNA as genetic material Structure of chromatids, nucleosome and histones.

#### **UNIT- V**

Vitamins and Minerals Vitamins: Definition, Classification. Fat soluble vitamins-sources, structure and physiological functions; Water soluble vitamins-sources, structure and physiological functions. Minerals: Mineral requirement, essential macro minerals and essential micro minerals, sources and functions.

#### **References**

1. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students.
2. Deb, A.C., Fundamentals of Biochemistry, New Central Agency, Calcutta, 3rd Edition, 1989.
3. Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, CBS Publishers, 2nd Edition, 1993.
4. Lubert stryer, Biochemistry, Freeman and company, 4th Edition, 1995.
5. Rastogi S.C, V.N. Sharma, Anuradha Tanden, Concepts in molecular biology, 1993.
6. Jain J.L, Fundamentals of biochemist.

### **ELECTIVE III – A**

#### **BIONANOTECHNOLOGY**

##### **Unit I:**

Introduction- Definition, about Bionanomachines, Molecular Bionanotechnology. History of Bionanotechnology; Richard Feynman and his contributions. Biotechnology versus Bionanotechnology. Natural Bionanomachines.

##### **Unit II:**

Structural Principles of Bionanotechnology-Environment in which the Bionanomachines Functions. Principles behind design of Natural Bionanomachines- Covalent bonding, Dispersions and repulsion forces. Hydrogen bonding, Electrostatic Interaction, Hydrophobic effect. Hierarchical strategy in construction of Bionanomachines - Selfassembly, Self- organization. Concept of Molecular recognition.

##### **Unit III:**

Functional Principles of Bionanotechnology- Information storage- Nucleic acid, Ribosomes as assembler to construct proteins. Energetics- Energy from Light, electron transport pathways, electrochemical gradient. Biocatalysts- Enzymes and its regulation. Biomaterials. Biomolecular motors. Molecular sensing- Biosensors.

##### **Unit IV:**

Tools and technique required for Bionanotechnology- Recombinant DNA technology; site directed mutagenesis, Fusion proteins. X-Ray Crystallography, NMR, Electron Microscopy, Atomic force Microscopy. Bioinformatics- Molecular Modeling, Docking, Computer assisted Molecular design.



### **Unit V:**

Applications of Bionanotechnology- Nanomedicines; Immunotoxins, Liposomes as drug carriers, Gene therapy, Personalised Medicines; Lab on chip concept. DNA Computers, Artificial Life, Hybrid materials, Biosensors.

### **References:**

1. Goodsell - Bionanotechnology
2. Parag Diwan and Asish Bharadwaj, . - Nanomedicines Pentagon Press, 2006.
3. Vladimir P Torchilin, Nanoparticles as Drug Carriers. Imperial College Press, North Eastern University, USA. 2006

## **ELECTIVE III- B : DAIRY MICROBIOLOGY**

### **Unit I**

Milk - Introduction, composition,. Microorganisms in Milk – Bacteria, Yeasts, Moulds. Starter Cultures – Starter cultures their biochemical activities. (Streptococcus thermophilus, Lactobacillus bulgaricus) Dairy processing unit operations: Pasteurization, UHT treatment, homogenization, Membrane processing, storage, transportation and distribution of milk. Judging and grading of milk and its products.

### **Unit II**

Dairy Products Production : Overview and Fluid Milk Products, Concentrated and Dried Milk Products, condensed milk, evaporated milk, whole and skimmed milk powder, cultured Dairy Products: Whipped Cream, Ice Cream, Butter, Whey Products.

### **Unit-III**

Microbiology of fermented milk products - Acid fermented milks (acidophilus milk, yoghurt). Slightly acid fermented milks (Cultured butter milk), Acid-alcoholic fermented milk (Kefir). Fermented milk production with extended self life (labneh)). Milk borne diseases, antimicrobial systems in milk, sources for contamination of milk - bacterial with examples of infective and toxic types –, Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria. Mycotoxins in milk with reference to Aspergillus species.

### **Unit – IV**

Hygiene in Manufacturing Milk Products: Cleaning of Dairy Equipment - Instantization of milk and milk products. In-plant cleaning system. Dairy Processing Plant Sanitation. Probiotic Utilization and disposal of dairy by product – whey.

### **Unit V**

Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, WHO, EPA, HACCP, ISI. HACCP – Food safety, safety of dairy products, control of hazards.

### **References**

1. Fundamentals of Dairy Microbiology by Prajapati.

2. Dairy Microbiology by Robinson R.K.1990 Volume II and I. Elsevier Applied Science, London.
3. Applied dairy microbiology edited by Elmer Marth and James Steele.
4. Milk & Milk Products - Fourth edition - clarence henry eckles, Tata McGraw Hill publishing company Limited, New Delhi, 1957
5. Dey, S. 1994. Outlines of Dairy Technology. Oxford Univ. Press, New Delhi. MaCrae
6. Robinson, R.K. (2 vol. set). 1986. Modern Dairy Technology Elsevier Applied Science, UK.
7. Rosenthal, I. 1991. Milk and Milk Products. VCH, New York.
8. Warner, J.M. 1976. Principles of Dairy Processing. Wiley Eastern Ltd. New Delhi.
9. Yarpar, WJ. and Hall, C.W. 1975. Dairy Technology and Engineering AVI, Westport.

### **ELECTIVE III – C : MEDICAL BIOCHEMISTRY**

#### **Unit I**

Disorders of carbohydrate metabolism – Diabetes mellitus, Glucose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

#### **Unit II**

Disorders of lipids- Plasma lipo proteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's, ketone bodies,  $\beta$ -lipoproteinemia.

#### **Unit III**

Disorders of liver and kidney- Jaundice, fatty liver, normal and abnormal functions of liver and kidney, inulin and urea clearance.

#### **Unit IV**

Abnormalities in nitrogen metabolism- Uremia, hyperurecemia, porphyria and factors affecting nitrogen balance.

#### **Unit V**

Blood –composition and functions, properties and functions of haemoglobin. Blood clotting-disturbances in blood clotting mechanisms- haemorrhagic disorders, haemophilia, purpura, thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.

#### **References**

1. Fundamentals of biochemistry. A. C. Deb. 8<sup>th</sup> edition. New central book agency (p)ltd. India
2. Textbook of biochemistry with clinical correlations. Thomas M Deblin. 4<sup>th</sup> edition. A John Wiley and sons, Inc., publications., New York.
3. Biochemistry. U. Sathyanarayana. 2nd edition. Books and allied pvt ltd.
4. Fundamental of Biochemistry for medical students. Ambika Shanmugam. Revised edition(2003). Published by the Author, 17. III Cross street, west CIT nagar, Chennai-35