

**BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 24.**

**B.Sc. MICROBIOLOGY – Course Structure under CBCS**

**(For the candidates to be admitted from the academic year 2005-2006 onwards)**

Semester	Course Title	Instru. Hours / Week	Credit	Exam Hours	Marks		Total
					Int.	Extn.	
I	Language Course – I (LC)	6	4	3	25	75	100
	English Language Course - I (ELC)	6	4	3	25	75	100
	Core Course – I (CC) – Fundamentals of Microbiology	6	4	3	25	75	100
	Core Course – II (CC) - Practicals – Fundamentals of Microbiology	3	-	*	-	-	-
	First Allied Course –I (AC) – Biochemistry	5	3	3	25	75	100
	First Allied Course –II (AC) - Practical – Biochemistry	2	-	*	-	-	-
	General Interest Course (GIC)	2	2	3	25	75	100
II	Language Course – II (LC)	6	4	3	25	75	100
	English Language Course – II (ELC)	6	4	3	25	75	100
	Core Course – II (CC) - Practicals- Microbial metabolism	3	4	3	25	75	100
	Core Course – III (CC) - Microbial Metabolism	6	4	3	25	75	100
	First Allied Course – II (AC) - Practicals: Biochemistry	3	3	3	25	75	100
	First Allied Course – III (AC) – Biochemistry	5	3	3	25	75	100
	III	Language Course – III (LC)	6	4	3	25	75
English Language Course - III (ELC)		6	4	3	25	75	100
Core Course – IV (CC) - Introductory Virology		6	4	3	25	75	100
Core Course – V (CC) - Medical Microbiology		4	-	*	-	-	-
Second Allied Course – I (AC) – Biostatistics – Theory		5	3	3	25	75	100
Second Allied Course – II (AC) - Practicals: Biostatistics		3	-	*	-	-	-

IV	Language Course –IV (LC)	6	4	3	25	75	100
	English Language Course – IV (ELC)	6	4	3	25	75	100
	Core Course – V (CC) - Medical Microbiology	2	4	3	25	75	100
	Core Course - VI (CC) – Immunology	6	4	3	25	75	100
	Core Course – VII (CC) – Practical – Virology, Medical Microbiology and Immunology	3	-	**	-	-	-
	Second Allied Course – II (AC) - Practicals: Biostatistics	2	3	3	25	75	100
	Second Allied Course - III (AC) – Computer Application in Biology	5	3	3	25	75	100
V	Core Course – VII (CC) - Practical – Virology, Medical Microbiology and Immunology	3	4	3	25	75	100
	Core Course – VIII (CC) – Agricultural and Environmental Microbiology	6	4	3	25	75	100
	Core Course – IX (CC) - Practical – Agricultural and Environmental Microbiology	6	4	3	25	75	100
	Core Course – X (CC) – Microbial Genetics	3	-	*	-	-	-
	Elective Course – I (EC)	4	3	3	25	75	100
	Elective Course – II (EC)	4	3	3	25	75	100
	Elective Course – III (EC)	4	3	3	25	75	100
VI	Core Course – X (CC) – Microbial Genetics	3	4	3	25	75	100
	Core Course – XI (CC) – Molecular Biology	6	4	3	25	75	100
	Core Course – XII (CC) – Food and Industrial Microbiology	6	4	3	25	75	100
	Core Course – XIII (CC) – Microbial Biotechnology	6	4	3	25	75	100
	Core Course – XIV (CC) - Practical – Food and Industrial Microbiology, Molecular Biology and Microbial Biotechnology	6	4	3	25	75	100
	Elective Course – IV (EC)	4	3	3	25	75	100

The Department of Microbiology will offer the following Elective Courses (ECs)

- I. Bioethics
- II. Bioinoculants
- III. Mushroom Technology
- IV. Microbial Diseases

I & II For Microbiology students  
 III & IV For other students

\* Examination at the end of even semester

\*\* Examination at the end of fifth semester

## **Core Course I – FUNDAMENTALS OF MICROBIOLOGY**

### **UNIT – I**

Introduction – Definition, scope and history of microbiology. Difference between the prokaryotic and eukaryotic microorganisms. Classification of microorganisms – general principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept. Classification and characterization of bacteria according to Bergey's Manual of Systematic Bacteriology (9<sup>th</sup> edition). Basic understanding of classification of viruses, algae, fungi and protozoa.

### **UNIT – II**

Microbiology : Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and electron microbiology. Principles of staining : Nature of dyes, types of staining – simple, differential, negative and spore staining, Sterilization : Principles and methods – physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorites).

### **UNIT – III**

General characteristics and nature of Archaeobacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae and fungi, Viruses.

### **UNIT – IV**

Microbial cell : Ultrastructure of bacteria, subcellular structures and cell envelope – slime, capsule, cell wall, pili, flagella, cell inclusions, biosynthesis of bacterial cell wall, cell membrane – Biomembrane, liposomes – membrane transport – diffusion, active and passive transport and osmoregulation.

### **UNIT – V**

Culture techniques: Types of media simple, defined, enriched and transport media with specific examples for each type. Methods of maintenance and preservation of cultures.

### **Reference:**

Constantine J. Alexopoulos and Charles W.Mims.(1993). Introductory Mycology(3rd edition).Wiley Eastern Ltd, New Delhi.

Elizabeth Moore-Landecker.(1996). Fundamentals of the fungi.(4<sup>th</sup> edition).Prentice Hall International, Inc, London.

Gerhardt. P. Murray R. Ce., Wood W.A., and Kreig N.R.(edtr.) (1994). Methods for General and Molecular Bacteriology – American Society for Microbiology, Wasington D.C.

Goodfellow M., and O'Donnell A.C. (1994). Chemical Methods in Prokaryotic Systematics – John Wiley & Sons, New York.

Heritage, J Evans, E. G. V. and Killington,R.A. (1996). Introductory Microbiology, Cambridge University press.

Holt J.S., Krieg N.R., Sneath P.H.A. and Williams S.T (1994). Bergey's Manual of Determinative Bacteriology. (9<sup>th</sup> edition) – William & Wilkins, Baltimore.

James G. Cappuccino and Natalie Sheman.(1996). Microbiology-A laboratory manual.(4<sup>th</sup> edition).The Benjamin/Cummings publishing company Inc, California.

John webster.(1993). Introduction to Fungi.(2<sup>nd</sup> edition).Cambridge University Press, Cambridge.

Lansing M. Prescott., John P. Harley and Donald A.Klein.(2003). Microbiology (5<sup>th</sup> edition) McGraw Hill, New York.

Larry Mc Kane and Judy Kandel.(1996). Microbiology-Essentials and applications. (2nd edition). Mc Fraw Hill Inc, New York.

Michael T. Madigan, Jhon M. Martinko and Jack Parker. (1997). Brock Biology of Microorganisms.(8<sup>th</sup> edition).Prentice Hall International Inc, London.

Moselio Schaechter. and Joshua Leaderberg. (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.

Salle, A.J. (1996). Fundamental principles of Bacteriology.(7<sup>th</sup> edition).Tata McGraw-Hill publishing company Ltd, New Delhi.

### **Core Course II (CC) – Practicals – Fundamentals of Microbiology**

1. Microscope and its operation
2. Preparation of culture media, Cleaning of glasswares and sterilization methods – autoclaving and hot air
3. Experimental demonstration of ubiquitous nature of microorganisms.
4. Quantification of microbial population.
5. Observation of permanent slides to study the structural characteristics of algae (*Anabena*, *Nostoc*, *Scytonema*, *Spirulina* *Oscillatoria*), fungi (*Pythium*, *Rhizopus*, *Saccharomyces*, *Pencillium*, *Sapergillus*, *Agaricus*) and protozoa (*Entamoeba hystolytica* and *Plasmodium spp.*).
6. Isolation of microorganism from soil, water and air.
7. Pure culture techniques a. Streak plate, b. Pour plate, c. Spread plate.
8. Test for motility of bacteria – Hanging drop method and semi solid media.
9. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining.
10. Isolation and cultivation of fungi.

**Reference:**

James G. Cappucina, Natalie Sherman. (1996). Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.)

Mackie and McCartney. (1989). Practical Medical Microbiology, Churchill Livingston.

Albert Balows, Hens G. Truper., Martin Dworkin, Wim, Hardses, Karl-heinz Schoeifer (eds). (1992). A Hand book on the biology of bacteria, ecophysiology, isolation, identification and applications, Springer Verlag.

**FIRST ALLIED COURSE– I (AC) – BIOCHEMISTRY****UNIT – I**

Carbohydrate – Definition, detailed classification, structure of glucose, biological significance, digestion and absorption – Methods of estimations – Colorimetric.

**UNIT – II**

Proteins – Definition, classification and structure (Primary, secondary, tertiary), Amino acids – Structure, classifications (Essential and nonessential, protein and non-protein amino acids).

**UNIT – III**

Lipids: Definition, classification, structure, properties and functions, methods of estimation – Gravimetric.

**UNIT – IV**

Nucleic acids – DNA structure, form and functions – RNA types structure and functions

**UNIT – V**

Vitamins – Introduction – Fat soluble vitamins ( A,D,E, & K) water soluble vitamins (B Complex & C) sources, functions and deficiency syndromes of Vitamins B complex and C.

**Reference:**

Dawn, B.Markus, (1994). Biochemistry. Harwal Publishing, New York.

Donald voet and Judith voet. (1990). Biochemistry. John Wiley and Sons, New York.

Henry, R. Mahler and Eugene, H. Cerdesz, (1966). Biological Chemistry. Harper International Edition, New York.

Stryer, L. (1995). Biochemistry. 4<sup>th</sup> Ed. W.H. Freeman and Company, New York.

William, J. Marshall and Stephan, K. Bangert. (1995). Clinical Biochemistry – Metabolic and Clinical Aspects – Churchill Livingston, New York.

## FIRST ALLIED COURSE – II (AC)– PRACTICAL – BIOCHEMISTRY

1. Quantitative Analyses – Estimation of carbohydrates – Estimation of amino acids and proteins – Estimation of lipids.
2. Quantitative Analyses – Estimation of sugars(Benedicts' method) – Estimation of amino acid (Ninhydrin method) – Estimation of ascorbic acid (from biological sample) – Estimation of calcium (from biological sample).
3. Analysis of urine – albumin, urea, sugar.

### Reference:

Keith Wilson and John Walker. (1995). Principles & Techniques of Practical Biochemistry.(4<sup>th</sup> edition).Cambridge University press, Britain.

Oser, B.L.Hawks, (1965). Physiological Chemistry, TATA Mc Graw Hill.

Shawn O' Farrell and Ryan T. Ranallo. (2000). Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia.

Strolov, B.A. Makavora, V.C.(1989). Laboratory manual in Biochemistry. MIR Publisher, Moscow.

### CORE COURSE – II (CC) Practicals - Microbial Metabolism

1. Bacterial growth curve: Cell count/viable count/absorbance(total count)
2. Carbohydrate fermentation tests: a. Glucose, b. Lactose, c. Sucrose, e. Mannitol.
3. Biochemical test for identification of bacteria: a. Indole test, b.Methyl red, c. Voges Proskaru test, d. Citrate utilization, e. TSI agar test, f. Urease, g. Catalase, h. Oxidase.

### Reference:

Bucker, J.M., Caldwell, G.A. Zachgo, E.A. (1990). A Laboratory course. Academic press.

James G.Cappuccino and Natalie Sherman.(1996). Microbiology-A Laboratory Manual.(4<sup>th</sup> edition).The Benjamin /Cummings publishing company, New York.

Russell F.Bey.(2001). Microbiology Laboratory Manual Brooks/Cole, Australia.

Samuel singer.(2001).Experiments in Applied Microbiology Academic press-A Harcourt Science and Technology company, California.

Susan Isaac. and David Jennings.(1995). Microbial culture, Bios Scientific publishers Ltd, UK.

### CORE COURSE III (CC) MICROBIAL METABOLISM

#### UNIT – I

Nutrition and growth of microorganisms: Nutritional types of microorganisms, nutritional requirements. Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals, Physiology of growth – Significance of various phases of growth. Growth measurements – batch, continuous and synchronous.

#### UNIT – II

Bacterial enzymes – classification, properties, coenzymes and cofactors, isozymes.

#### UNIT – III

Metabolism of carbohydrates : Anabolism – photosynthesis – oxygenic – anoxygenic, synthesis of carbohydrate – catabolism of glucose – Embden Mayer – Hoff – Parnas pathway – Pentose pathway, Krebs's cycle (TCA) – electron transport system and ATP production.

#### **UNIT – IV**

Metabolism of protein – metabolic pathways of nitrogen utilization, urea cycle, synthesis of amino acids, peptides, proteins.

#### **UNIT – V**

Anaerobic – Respiration and fermentations. Anabolic and catabolic processes of lipids.

#### **Reference:**

- Doelle, H.W. (ed.) (2005). Microbial Metabolism, Academic Press.  
Gerhart, G., (1986). Bacterial Metabolism, Springer Verlag.  
Hall D.C., and Rao K.K. (1995). Photosynthesis – Cambridge University Press.  
Lansing M. Prescott, John P., Harley and Donald A.Klein. (2003). Microbiology. (5<sup>th</sup> edition). McGraw-Hill company, New York.  
Mathews C.K., and Holde K.E.V (1996). Biochemistry – The Benjamin/Cummings Publishing company, Inc., New York.  
Murray R.K. Granner M.D., Mayes P.A. and Rodwell V.W (1990) Biochemistry – Prentice Hall International Inc., London.  
Salle, A.J. (1996). Fundamental principles of Bacteriology (7<sup>th</sup> edition). Tata McGraw-Hill publishing company limited, New Delhi.  
Stryer L. (1995). Biochemistry (4<sup>th</sup> edn.) W.H. Freeman and company, New York.  
Zubey C.L. Parson W.W., and Vance D.E. (1994) Principles of Biochemistry – Wim.C. Brown Publishers, Oxford, England.

### **FIRST ALLIED COURSE – III – BIOCHEMISTRY**

#### **UNIT – I**

Blood – origin of blood cells, composition characterization and coagulation.

#### **UNIT – II**

Cytochemistry – structure and biochemical composition of cell wall and plasma membrane – fluid mosaic model. Trilaminar model, receptor concept, sodium potassium pumps.

#### **UNIT – III**

Endocrine glands – pituitary, thyroids, parathyroid, pancreas, adrenal, testis and ovary. Hormones – Definition – classification, functions, diseases associated with deficiency (or) excess of hormones.

#### **UNIT – IV**

General account and biosynthesis major and accessory plant pigments – chlorophylls, carotenoids, phycobilins and anthocyanins.

#### **UNIT – V**

Phytohormones and plant's secondary metabolites – structure and functions of auxin, gibberellins, cytokinins and abscisic acid – alkaloids and flavanoids.

**Text Book Recommended:**

1. Stryer, L. 1995. Biochemistry. 4<sup>th</sup> Ed. W.H. Freeman and Company, New York.

**Reference:**

1. Donald Voet and Judith Voet. 1990. Biochemistry. John Wiley and Sons, New York.
2. Henry, R. Mahler and Eugene, H. Cerdesz, 1966. Biological Chemistry. Harper International Edition, New York.
3. Hubert, Styer, 1995. Biochemistry – Freeman and Company, New York.
4. Dawn, B. Markus, 1994. Biochemistry. Harwal Publishing, New York.
5. William, J. Marshall and Stephan, K. Bangert. 1995. Clinical Biochemistry – Metabolic and Clinical Aspects – Churchill Livingstone, New York

**CORE COURSE IV (CC) - INTRODUCTORY VIROLOGY****UNIT – I**

Introduction – Definition, History of virology. General properties of viruses – cultivation of Viruses – Structure and replications viruses – classification of Viruses.

**UNIT - II**

Virus: Assay, purification and characterization of viruses, separation and characterization of viral components and quantification of viruses.

**UNIT – III**

Bacterial Viruses – structure of bacteriophage, The Lytic life cycle (T-Even coliphages) – Lysogenic life cycle (*Escherchia coli*, *Phage Lambda*).

**UNIT – IV**

Plant Viruses, common plant viral diseases : TMV, Bunchy top of banana, satellite virus, Viroid – Double stranded DNA virus – Assay methods.

**UNIT – V**

Animal viruses : morphology, pathogenesis and laboratory diagnosis of prions, Rinder pest, Blue tongue, Raniket dion, Foot and Mouth Disease. Human Viruses – Herpes, HIV, Hepatitis Viruses. Viral Vaccines. Prevention and treatment of viral diseases. Antiviral agents.

**Reference:**

Alan J. Cann. (1997). Principles of Molecular virology. (2nd edition). Academic press, California.

Ann Giudici Fettner. (1990). The Science of Viruses. Quill, William Marrow, New York.

Dimmock N.J.Primrose S.B.(1994). Introduction to Modern Virology. IV edition. Blackwell scientific Publications, Oxford.

James, C. Cappuccino. (1996). Microbiology. The Benjamin/Cummings Pub. Co. California.

Morag, C. Timbury (1994). Medical Virology. X edition. Churchill Livingstone.

Nicklin, J. Greame-Cook and Killington, R. (2003). Instant Notes in Microbiology.(2nd edition). Viva Books private limited, New Delhi.

Robert I. Krasner. (2002). The microbial challenge: Human Microbe Interactions, American society for Microbiology, Washington.

Roger Hull.2002.Mathews' Plant Virology.(4thEdition).Academic press-A Harcourt Science and technology company, New York.

Topley & Wilson's(1990). Principles of Bacteriology, Virology and Immunity. VIII edition Vol.IV Virology, Edward Arnold, London.

## CORE COURSE – V (CC) – MEDICAL MICROBIOLOGY

### UNIT – I

Normal microbial flora of the human body, Host-microbe interactions – virulence factors of microbes. Invasiveness and pathogenicity. Non-specific resistance factors.

### UNIT – II

Diagnostic Microbiology – collection and transport of specimen for Microbiological examination – General methods for isolation and identification of bacteria. Typing of bacterial isolates. Sero-diagnosis.

### UNIT – III

Clinical symptoms. Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following bacterial infections (a) Streptococcal infections, (b) Staphylococcal infections, (c) Meningitis, (d) Tuberculosis, (e) Leprosy, (f) Gastrointestinal disorders – typhoid, cholera, bacillary dysentery, (g) Sexually transmitted diseases – syphilis, gonorrhoea. (h) Anaerobic wound infection – tetanus, gas gangrene.

### UNIT – IV

Clinical symptoms. Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following viral infections (a) respiratory diseases, common cold, influenza, measles, mumps and rubella. (b) neurological diseases – encephalitis (Dengue, Japanese encephalitis), Rabies (c) Liver diseases : Hepatitis A,B,C,D & E (d) Immunodeficiency diseases, AIDS, CMV (Cytomegalovirus) Herpes simplex viruses.

### UNIT – V

Clinical symptoms. Epidemiology, pathogenesis, laboratory, prevention and treatment of the following fungal and protozoan infections (a) Fungal – superficial, subcutaneous and systemic mycoses, (b) Protozoan: Amoebiasis, Malaria, Leishmaniasis, (c) Helminths – Filariasis, Ascariasis, Zoonotic diseases, Hospital acquired infections.

### Reference:

David Greenwood, Richard C.B. Slack and John F. Peutherer.(1992). Medical Microbiology.(14<sup>th</sup> edition). ELBS with Churchill Livingstone.

E. Joan Stokes, G. L. Ridgway and M. W. D. Wren (1993). Clinical Microbiology. 7<sup>th</sup> edition. Edward Arnold. A division of Hodder and Stoughton.

Huge W.B. and Russell A.D.(1989). Pharmaceutical Microbiology. IV edition. Blackwell Scientific Publication, Oxford.

J. C. Collee, J.P., Duguid, A. C. Fraser, B.P. and Marimon (1989). Mackie and McCartney Practical Medical Microbiology – 13<sup>th</sup> Edition, Churchill Livingstone.

Joan Stokes, E. Ridgway, G. L and Wren, M.W.D. (1993). Clinical Microbiology(7<sup>th</sup> edition). Edward Arnold.A division of Hodder and Stoughton.

Schaechter, M. Medoff, G. and Eisenstein, B.C.(1993). Mechanism of Microbial Diseases. 2<sup>nd</sup> edition. Williams & Wilkins, Baltimore.

Topley / Wilson's (1990). Principles of Bacteriology, Virology and Immunity, VIII edition, Vol.III Bacterial Diseases, Edward Arnold, London.

## SECOND ALLIED COURSE – I (AC) – BIOSTATISTICS

### UNIT – I

Introduction to biostatistics – Definition, statistical methods, biological measurement, kinds of biological data, functions of statistics and limitation of statistics.

### UNIT – II

Collection of data, sampling and sampling design, classification and tabulation, types of representations, graphic – bar diagrams, pie diagrams and curves.

### UNIT – III

Measures of central tendency, mean, median, mode, geometric mean

### UNIT – IV

Measures of dispersion and variability, changes. Deviations – Quartile deviation, mean deviation, standard deviation, coefficient of variation, Lorenzen's curve.

### UNIT – V

Skewness, Kurtosis, Moments, Meaning, test of skewness, characteristics of dispersion and skewness, measures of skewness, objectives, Karl Perarson's coefficient of skewness, Bocolley's coefficient of skewness, Kellye's coefficient of skewness. Kurtosis, measures, moments.

**Packages** – Biostatistics SPSS programme

### Reference:

1. Fundamental of Biostatistics Bemad Rosner, Duxbury Press, 4<sup>th</sup> Bt & DSK ed. (June 1995)
2. Principles of Biostatistics Maicello Pagano, Kimberlee Gauvreau, Duxberry Press 2<sup>nd</sup> Ed. 2000.
3. Statistical & Data Handling Skills in Biology, Roland Ennos 1999, Prentice Hall
4. Biostatistical Analysis 4<sup>th</sup> Ed. Jerrold Zar, Pearson Education
5. Introduction to Biostatistics & Research Methods – 4/e. Sundar Rao & Richard Prentice Hall
6. An Introduction to biostatistics a manual for students in health sciences, P.S.S. Sundar Rao, J. Richard., Prentice Hall & India.

## **SECOND ALLIED COURSE II (AC) PRACTICALS – BIOSTATISTICS**

1. Collection of data, sampling designs, tabulation and graphic representation using biological materials.
2. To find mean, mode, median, coefficient of variance using biological materials.
3. Tests of significance
  - '*t*' test
  - '*chi*' square
  - standard error and standard deviation.
4. t TEST, chi square, statistical error, standard deviation also, to be practically done through SPSS programme. [statistical Package for Social Sciences].

## **SECOND ALLIED COURSE – III (AC) – COMPUTER APPLICATIONS IN BIOLOGY**

### **UNIT – I**

Introduction to Computers – History of Computers – its developing technology and generation of Computers – Operating Systems – Windows, Unix – Hardware, Software, disc operating systems.

### **UNIT – II**

Working of Internet – Local area and wide area network – Types of files – HTML, TXT, PDF – Search engines and its types and applications.

### **UNIT – III**

Introduction to informatics, bioinformatics – its history and its development - Biological database – NCBL, EMBL, DDBJ.

### **UNIT – IV**

Chemiinformatics – its history and its development – Applications Cheminformatics – Drug designing (any cancer drug)

### **UNIT - V**

Applications of Bioinformatics, Brief outline on Genomics, Proteomics, Patenting rights.

### **References:**

1. Statistical methods in Biology, Norman T.J. Bailey – Cambridge Edition
2. Primer for Biostatistics, S.A. Glanty – Mc Graw Hill

## **CORE COURSE – V (CC) – MEDICAL MICROBIOLOGY**

### **UNIT – I**

Normal microbial flora of the human body, Host-microbe interactions – virulence factors of microbes. Invasiveness and pathogenicity. Non- specific resistance factors.

### **UNIT – II**

Diagnostic Microbiology – collection and transport of specimen for Microbiological examination – General methods for isolation and identification of bacteria. Typing of bacterial isolates. Sero-diagnosis.

### **UNIT – III**

Clinical symptoms. Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following bacterial infections (a) Streptococcal infections, (b) Staphylococcal infections, (c) Meningitis, (d) Tuberculosis, (e) Leprosy, (f) Gastrointestinal disorders – typhoid, cholera, bacillary dysentery, (g) Sexually transmitted diseases – syphilis, gonorrhoea. (h) Anaerobic wound infection – tetanus, gas gangrene.

### **UNIT – IV**

Clinical symptoms. Epidemiology, pathogenesis, laboratory diagnosis, prevention and treatment of the following viral infections (a) respiratory diseases, common cold, influenza, measles, mumps and rubella. (b) neurological diseases – encephalitis (Dengue, Japanese encephalitis), Rabies (c) Liver diseases : Hepatitis A,B,C,D & E (d) Immunodeficiency diseases, AIDS, CMV (Cytomegaloviruses) Herpes simplex viruses.

### **UNIT – V**

Clinical symptoms. Epidemiology, pathogenesis, laboratory, prevention and treatment of the following fungal and protozoan infections (a) Fungal – superficial, subcutaneous and systemic mycoses, (b) Protozoan: Amoebiasis, Malaria, Leishmaniasis, (c) Helminths – Filariasis, Ascariasis, Zoonotic diseases, Hospital acquired infections.

### **Reference:**

David Greenwood. Richard C.B. Slack and John F. Peutherer.(1992). Medical Microbiology.(14<sup>th</sup> edition). ELBS with Churchill Livingstone.

E. Joan Stokes, G. L. Ridgway and M. W. D. Wren (1993). Clinical Microbiology. 7<sup>th</sup> edition. Edward Arnold. A division of Hodder and Stoughton.

Huge W.B. and Russell A.D.(1989). Pharmaceutical Microbiology. IV edition. Blackwell Scientific Publicaiton, Oxford.

J. C. Collee, J.P., Duguid, A. C. Fraser, B.P. and Marimon (1989). Mackie and Mc Carteny Practical Medical Microbiology – 13<sup>th</sup> Edition, Churchill Livingstone.

Joan stokes, E. Ridgway, G. L and Wren, M.W.D. (1993). Clinical Microbiology(7<sup>th</sup> edition). Edward Arnold.A division of Hodder and stoughton.

Schaechter, M. Medoff, G. and Eisenstein, B.C.(1993). Mechanism of Microbial Diseases. 2<sup>nd</sup> edition. Williams & Wilkins, Baltimore.

Topley / Wilson's (1990). Principles of Bacteriology, Virology and Immunity, VIII edition, Vol.III Bacterial Diseases, Edward Arnold, London.

## **CORE COURSE – VI (CC) IMMUNOLOGY**

### **UNIT – I**

Introduction: Terminologies – History of Immunology – Immunohematology, Blood groups, Blood transfusion – Rh – incompatibilities – immunity – types of immunity – innate and acquired.

### **UNIT – II**

Immune systems: Anatomy of lympho- reticular system – Primary lymphoid organ. Secondary lymphoid tissue – cells of the immune system – detailed aspects of T and B cells – receptors – activation and function.

### **UNIT – III**

Antigens: Types, properties, haptanes – adjuvants – vaccines – types –toxids antitoxins, Immunoglobulins – structure types and properties. Theories of antibody production.

### **UNIT – IV**

Antigen – antibody reactions – in vitro methods; Agglutination – Precipitation, Complement fixation, Immunofluorescence, ELISA, RIA, in vivo methods; Skin tests – immune complex tissue demonstrations.

### **UNIT – V**

Hypersensitivity reactions – antibody mediated, Type I anaphylaxis, Type II – Antibody dependent cell cytotoxicity, Type III – immune complex reactions – respective diseases and immunologic methods of diagnosis – cell mediated immune responses – Lymphokines, Cytokines. Type IV – Hypersensitivity reactions, MHC and transplantation.

### **Reference:**

Abul K. Abbas. Andrew H. Lichtman and Jordan S.Pober.(1994). Cellular and Molecular Immunology.(2nd edition).W.B. Saunders company, Philadelphia.

Charles A. Janeway,Jr. Paul Travers. Mark Walport and Donald Capra,J.(1999). Immunobiology-The immune system in health and disease.(4<sup>th</sup> edition).Current Biology Publications, London.

Donald M. Weir, John, Stewart, (1993). Immunology VII edition. ELBS, London.

Donald M. Weir and John Stewart.(1993).Immunology.(7<sup>th</sup> edition).ELBS,UK.

Eli Benjamin, Richard Coico and Geoffrey Sunshine.(2000). Immunology-A short course.(4th edition).John Wiley and sons, New York.

Ivan Roitt. Jonathan Brostoff and David Male. (2002). Immunology(6<sup>th</sup> edition).Elsevier science Ltd., New York.

Janis Kuby (1994). Immunology. (2<sup>nd</sup> edition). W.H. Freeman and company,New York.

Lesile Hudson, Frank C.Hay, 1989. III edition. Practical Immunology. Blackwell Scientific Publication.

Mackett M. and Wiliamson J.D.1995. Human vaccines and vaccination. BIOS Scientific Publishers.

Patrick,S and Larkin, M.J.1995.Immunological and molecular aspects of bacterial virulence. Jhon Wiley and sons, England.

Playfair,J.H.L.1996.Immunology at a glance.(6th edition). BlackwellScience, London.

Richard A., .Goldsby Thomas J. Kindt and Barbera A. Osborne. (2000). Kuby Immunology.(4<sup>th</sup> edition).W.H. Freeman and company, New York.

Richard M. Hyde (1995). Immunology III edition. National Medical series, Williams and Wilkins. Hardward Publishing company.

Richard M. Hyde.(1992). Immunology-The National Medical series for independent study.(2nd edition).Harwal publishing, Pennsylvania.

William E. Paul (1993). Fundamental Immunology. II edition, Raven press, New York.

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## **CORE COURSE – VIII (CC) – AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**

### **UNIT – I**

Concepts of microbial ecology: Relationship between microorganism and different environments land, water and air. Microorganism inhabiting extreme environments. Microbiology of air – organisms in air, distribution and sources. Droplet nuclei, aerosol, assessment of air quality, solid – liquid – impingement methods. Brief account of air borne transmission of harmful microbes.

### **UNIT – II**

Types of aquatic ecosystems: fresh water – ponds, lakes, streams. Marine habitats – estuaries, mangroves, deepsea, hydrothermal vents, salt pans, coral reefs. Zonations – upwelling – eutrophication – food chain. Potability of water – microbial assessment of water quality – water purification – brief account of water – borne diseases.

### **UNIT – III**

Types of wastes – characterization of solid and liquid wastes. Solid waste treatment – saccharification – gasification – composting, Utilization of solid wastes – food (SCP, mushroom, yeast); fuel (ethanol, methane, hydrogen); fertilizers (composting).

### **UNIT – IV**

Liquid waste treatment. Treatment methods – primary –secondary (anaerobic – methanogenesis; aerobic- tricking activated sludge – oxidation pond – tertiary treatment. Utilization of liquid wastes – food (SCP, Yeast) – fuel (methane), fertilizers (Cyanobacteria).

### **UNIT – V**

Biodeterioration: Deterioration of paper, leather, wood, textiles, metal corrosion, mode of deterioration, organisms involved, its disadvantages and mode of prevention.

**Reference:**

Baker, W.C. and Herson, D.S.(1994). Bioremediation – McGraw Hill Inc., New York

Blackie.(1998). Plant Molecular Biology.(2<sup>nd</sup> edition).ChapmanHall,New York.

Burns, R.C. and Slater, J.H. (1982). Experimental Microbial Ecology – Blackwell Scientific Publications, Oxford, London.

Christon J.Hurst. (2002). Manual of Environmental Microbiology.(2<sup>nd</sup> edition).American Society for Microbiology,Washington.

Duncan Mara and Nigel Horen. (2003). The Handbook of water and waste water Microbiology.Academic press-An imprint of Elsevier.

Ec Eldowney, S., Hardman, D.J. and Waite, S. (1993). Pollution : Ecology and Biotreatment – Longman Scientific Technical

Gareth M. Evans and Judith C. Furlong. (2003). Environmental Biotechnology-Theory and Application, John Wiley and sons Ltd.

Marshall, K.C. (1985). Advances in Microbial Ecology. Vol-8. Plenum press.

Munn,C.B. (2004). Marine Microbiology-Ecology and Applications.Bios Scientific publishers, New York.

William M., Lewis Jr., James F. Saunders. David W. Crumpacker. Sr. and Charles Brebdecke., (1994). Ecologica Studies – Vol 46.

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**CORE COURSE – IX (CC) PRACTICALS – AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**

1. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
2. Microbial assessment of air quality – open plate method and air sampler-technique.
3. Isolation and counting of faecal bacteria from water.
4. Different tests for water borne pathogens.

Indole test

Methyl Red test

Voges- Proskauer

Citrate utilization

1. Soil Analysis

PH, chlorides, nitrate, calcium, magnesium and total phosphorus.

Demonstration:

Plasmid isolation

Phage isolation

Isolation of cyanobacteria from water (any two), *Rhizobium* from legume nodule.

Demonstration of some important plant, animal and human Viruses (Photographs, diagram, etc.)

**Reference:**

Atlas, R.M. and Bartha, R. (1993). Microbial Ecology: Fundamentals and Applications, 3<sup>rd</sup> Ed., Benjamin and Cummings Pub. Co. New York.

David M. Sylvania, Jeffry J. Fuhrmann, Peter Hastell, David A. Zuberer, 1st Ed. Prentice Hall.

James G. Cappuccino and Natalie Sherman. (1996). Microbiology-A Laboratory Manual(4<sup>th</sup> edition).The Benjamin publishing company, New York.

Jeanne Dijkstra and Cees P.de Jager.1998.Practical Plant Virology.Springer-Verlag Berlin Heidelberg, Germany.

Paul, I.A., and Clark, F.E. (2000). Soil Microbiology and Biochemistry, 2<sup>nd</sup> Ed. Academic press.

Rangaswamy, G. and Bagyaraj, D.J. (2001). Agricultural Microbiology, 2<sup>nd</sup> Ed. Prentice Hall of India Pvt. Ltd., New Delhi.

Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia.

Schaechter, M. Medoff, G. and Eisenstein, B.C. (1993). Mechanism of Microbial diseases. 2<sup>nd</sup> edition. Williams & Wilkins, Baltimore.

Subba Rao, N.S. (2002). Soil Microbiology, 4<sup>th</sup> Ed. (soil Microorganisms and plant growth), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

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**CORE COURSE – X (CC) MICROBIAL GENETICS**

**UNIT – I**

History – experiments of Hershey Chase and Griffith, DNA as the genetic material – discovery of DNA structure – RNA as a genetic material – Genetic code.

**UNIT – II**

Organization and functioning of genetic material – Bacterial and viral. Details of *E.coli* chromosome. Brief account of plasmid – structure – types. Replication of DNA – rolling circle model – theta. Model. Replication of RNA – reverse transcriptase.

**UNIT – III**

Concept of gene – Lac operon, tryptophan operon, attenuation control – promoters – repressors – gene expression and regulation.

**UNIT – IV**

Gene transfer mechanisms – conjugation – transformation – transduction.

## **UNIT – V**

Mutagenesis – mutation – mutants – phenotypic mutants – genotypic mutants – IS elements – transposons – repair mechanism, Carcinogenicity testing.

### **Reference:**

Daniel L. Hartl and Elizabeth W. Jones.(2001). Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.

David Frifelder.(1990). Microbial Genetics, Narosa publishing house, New Delhi.

Friedberg E.C., Walker C.C., Siede W. (1995). DNA repair and mutagenesis – ASM Press.

Gardner E.J., Simmons M.J., Snustad D.P. (1991). Principles of Genetics. John Wiley & sons.

Jeremy M. Dale. (1998). Molecular Genetics of Bacteria (3<sup>rd</sup> edition).John Wiley and sons,New York.

Larry Synder and Wendy Champness. (2003). Molecular Genetics of Bacteria (2<sup>nd</sup> edition). American Society for Microbiology, Washington.

Lodish, H., Baltimore, D. Berk, A. Zipsury, S.L., Matsudaira, P. Darnell, J. (1995). Molecular Cell Biology. Scientific American Books.

Malor Sr, Cronan Jr. JE. Freifelds D (1994). Microbial Genetics. Jones and Bartlett Publishers.

Maxine Singer and Paul Berg. (1991).Genes & Genomes. University science books, California.

Monroe W.Stickberger.2003.Genetics(3rd edition).Prentice/Hall of India Pvt. Ltd., NewDelhi.

Old, R.S. and Primrose, S.B. (1989). Principles of Gene Manipulation, 4<sup>th</sup> Ed., Blackwell Scientific Publications, London.

## **CORE COURSE – XI (CC) – MOLECULAR BIOLOGY**

### **UNIT – I**

Nucleic acids: Structure of DNA and RNA, Types and forms – DNA, t-RNA, r-RNA, m-RNA – Definition and functions.

### **UNIT – II**

Vectors – plasmids, phages and cosmids, Ti-plasmid, pBR322, pSC101, pUC. Structure and assay methods.

### **UNIT – III**

Enzymes – Nucleases, ligases, polymerases, DNA modifying enzymes, Topoisomerases – their uses and applications.

### **UNIT – IV**

Gene and its manipulation techniques – Definition of a gene, structure, cloning techniques, genomic library, C-DNA, expression systems. Gene rearrangement by RNA and DNA splicing.

### **UNIT – V**

Nucleic acid and protein hybridization technique – Southern, Northern and Western methods of hybridization. DNA amplification techniques – PCR. DNA fingerprinting and its applications.

**Reference:**

Blackburn CM, Gait MJ. (1996). Nucleic acids in Chemistry and Biology – Oxford University Press.

Eckstein F, Lilley D.M. (1996). Catalytic RNA – Springer – Verlag.

Eckstein F, Lilley DM. (1992). Nucleic acids and Molecular Biology – Springer – Verlag.

Freifelder D. (1991). Molecular Biology. Narosa Publishing Home

Friedberg EC, Walker GC, Siede W. (1995). DNA repair and Mutagenesis. ASM press.

George M. Malacinski. And David Freifelder. (1998). Essentials of Molecular Biology 93<sup>rd</sup> edition). Jones and Bartlett publishers, UK.

James D. Watson. Michael Gilman. Jan Witkowski and Mark Zoller. (2001). Recombinant DNA. Scientific American Books, New York.

Lewin, B. (2000). Genes VII. Oxford University press.

Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J. (1995). Molecular Cell Biology. Scientific American Books.

Maloy S.R, Cronan Jr. JE, Freifelder D. (1994). Microbial Genetics. Jones and Bartlett Publishers.

Michael Blackburn and Michael J. Gait. (1996). Nucleic acids in chemistry and Biology. (2<sup>nd</sup> edition). Oxford University press.

Old, R.S. and Primrose, S.B. (1989). Principles of Gene Manipulation, 4<sup>th</sup> Ed., Blackwell Scientific Publications, London.

Richard M. Twyman. (2003). Advanced Molecular Biology (1<sup>st</sup> edition). Viva Books private Ltd, New Delhi.

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**CORE COURSE – XII (CC) – FOOD AND INDUSTRIAL MICROBIOLOGY**

**UNIT – I**

Historical development of Industrial Microbiology, Industrially important microorganisms, Major classes of products and processes. Improvement of Industrially important microbial stains.

**UNIT – II**

Design of a fermenter, types of fermenters and basic functions. Fermentation media formulation strategies, economical means of providing energy, carbon, nitrogen, vitamin and mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams, types of fermentation.

**UNIT – III**

The recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, ultrafiltration, drying, cell immobilizations and its applications.

#### **UNIT – IV**

Microbial products of pharmaceutical value – raw materials, organism and Industrial processes involved in the production of penicillin, Vitamin B<sub>12</sub> and rabies vaccine.

#### **UNIT – V**

Microbial products of industrial value – raw materials, organism and Industrial processes involved in the production of ethanol, vinegar, amylase, protease, glutamic acid. Recycling and safe disposal of industrial wastes through microbes.

#### **Reference:**

Click, B.R., .Pasternak, J.J. (1994). Molecular Biotechnology – ASM Press.

Demain A.L. Solomon, N.A. (1986). Manual of Industrial Microbiology and Biotechnology. ASM Press

Prave, P. Faust, V, Sitting, W., Sukatsch, D.A. (1987). Fundamentals of Biotechnology. ASM Press.

Reed. G. (1982). Prescott and Dunn's Industrial Microbiology. Macmillian Publishers.

Sikyta, B.(1983). Methods in Industrial Microbiology, Ellis Horwood limited.

Stanbury, P.F. Whitaker, A. Hall, S.J. (1995). Principles of Fermentation Technology, Pergamon Press.

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### **CORE COURSE – XIII (CC) – MICROBIAL BIOTECHNOLOGY**

#### **UNIT – I**

Biotechnology – Definition – concepts – history and development.

#### **UNIT – II**

Enzyme production technology through microbes: Problems and applications – enzyme immobilization and its applications.

#### **UNIT – III**

Microalgal technology – Industrial cultivation methods of *Spirulina* – biotechnological potentials of microalgae – food – feed – fuel production – pharmaceutically valuable compounds from microalgae.

#### **UNIT – IV**

Principles and applications of recombinant DNA technology and strain improvement (rDNA technology).

#### **UNIT – V**

Production of biotechnological products. Food-SCP (algae, yeast, mushroom). Biofertilizer – (*Cyanobacteria*, *Rhizobia*, *Azospirillum*, *Azotobactre*, *Frankia* , VAM). Bioinsecticide (*Bacillus thuriengiensis*). Fuel – ethanol. Pharmaceuticals – antigens, interferons, vaccines, insulin, hormones, gene therapy methods. Hybridomas and monoclonal antibodies.

**Reference:**

Desmond, S.T. Nicholl (2002). An Introduction to Genetic Engineering.(2<sup>nd</sup> edition).Cambridge university press.

Eric Grace.(1997). Biotechnology unzipped-promises and realities. Joseph Henry press, Washington.

Glick, B.R. and Pasternak, J.J. (2001). Molecular Biotechnology, ASM press, Washington DC.

Helen Kreuzer and Adrienne Massey.(1996). Recombinant DNA and Biotechnology, American Society for Microbiology, Washington.

Old R.W. and S.B.,Primrose. 1994. Principles of Gene Manipulation, 4<sup>th</sup> Ed., Blackwell Scientific Publications, London.

Prave, P., Paust, V., Sitting, W. and Sukatasch, D. 2000. Fundamentals of Biotechnology. VCH verlagsgesellschaftfr - mbH, Weinhkeim.

Trean, M.D, Boffey, S. Coulding K.H. and Stanbury, P. (1990). Biotechnology – The basic principles – Tata McGraw Hill edition.

Watson, J. D. Gilman, M., Witkowski, J., Zoller, M. (1992). Recombinant DNA- 2<sup>nd</sup> edition, Scientific American Books.

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**CORE COURSE – XIV (CC) – PRACTICALS – FOOD AND INDUSTRIAL MICROBIOLOGY, MOLECULAR BIOLOGY AND MICROBIAL BIOTECHNOLOGY**

Assessment of milk quality by methylene blue reduction test

Wet mount preparation of spoiled bread, tomato, grapes, potato.

Whole cell immobilization – alginate – polyurethane foam.

Estimation of citric acid and ethanol

Demonstration of fermenting ability of yeast

Observation of food samples to study *Leuconsostoc* sp. *Lactobacillus* sp., *Streptococcus lacti* and *Saccharomyes* sp.

Demonstration

Transformation techniques

Isolation of auxotrophic mutants.

Preparation of fermented food – Youghurt, cheese

Cultivation of cyanobacteria.

**Reference:**

Alan S. Gerstein. (2001). Molecular Biology problem solver. Wiley-Liss-A Jhon wiley and sons publication, New York.

Anton D.L. Akkermans. Jan Dirk Van Elsas. and Frans J. De Bruijn. (1995). Molecular Microbial Ecology Manual. Kluwer Academic publishers.

Aurubels et al., (1998). Current protocols in Molecular Biology, John Wiley.

Baker, K.H. and Herson, D.S. (1994). Bioremediation – McGraw Hill Inc., New York.

Benson, H.J. (1994). Microbiological Applications, Wm, C. Brown Publishers, Oxford.

Collina, C.H. and Lyne, P.M. (1985). Microbiological methods – Butterworths, London.

Dharmalingam, K. (1986). Experiments with M13. Mc Millan India Ltd., Madras.

EcEldowney, S. Hardman, D.J. and Waite, S. (1993). Pollution: Ecology and Biotreatment. Longman Scientific Technical.

Jeffrey H. Miller. (1992). A short course in Bacterial Genetics. Cold Spring Harbor Laboratory press.

Old, R.W. and S.B. Primrose. (1994). Principles of Gene Manipulation, 4<sup>th</sup> Ed., Blackwell Scientific Publications, London.

Sambrook, J. Fritsch, E. F. And Maniatis, T. (1989). Molecular cloning- A Laboratory Manual (2<sup>nd</sup> edition). Cold Spring Harbor Laboratory press, U.S.A.

Tuan, R.S. (1997). Recombinant Gene Expression Protocols – Humana Press.

Watson, J.D. Gilman, M. Witkowaki, J. and Zoller M. (1992). Recombinant DNA Scientific American Books.

## **ELECTIVE COURSE – I (EC) BIOETHICS**

### **UNIT I:**

General Ethical Concerns: The use of nature , Different views of Nature, Dynamic Nature, Interfering with Nature, Integrity of Species; Reducing Genetic Diversity ; Biological Warfare; Public perception of Science.

### **UNIT II:**

Medical Ethics., History and Culture: The Hippocratic tradition:A Profession , Philanthropy, Do no harm. Adoption to the Oath by Western Medicine. Competing Ethical Traditions; Retaining the Hippocratic Oath.

### **UNIT III:**

Status of Human Embryo: Human Embryonic Development; Ethics through Embryo Development: Fertilization, The Fetus and feeling pain; Scientific Research on Human Embryos: Experimental goals of Human Embryo Research, Human Development; How much Embryo Experimentation in Ethical?

### **UNIT IV:**

Animal Rights: Making New Strains of Animal: Ethical limits of Animal use: Religious Views of Animal status; Philosophical views of Animal status; Regulations.

### **UNIT V:**

Human Gene Therapy: Ethics of Somatic Cell Gene Therapy: Efficiency of treatment; Safety of Transferred Genes; Protecting Human life; Affect on family life; Economic factors; When we should use Gene therapy?

### **References:**

Nancy, S. Jecker., Albert R. Johnson, Robert A. Pearlman. Bioethics: An Introduction to history, methods and practice (1997). Sudbury, M.A.; Jones and Barlett Publishers.

Tom, L. Beauchamp., Childress, F. Principles of biomedical ethics, 5<sup>th</sup> Edition, Oxford Univerisity Press. 2000.

## **ELECTIVE COURSE – II (EC) – BIOINOCULANTS**

### **Unit – I**

General account of the microbes used as biofertilizers for crop plants and their advantages.

**Symbiotic N<sub>2</sub> fixers :** *Rhizobium* - Isolation, characterization, identification, Classification, inoculum production and field application.

**Frankia** - Isolation, characterization – actinorrhizal nodules – non-leguminous crop symbiosis.

**Unit – II** Non – Symbiotic N<sub>2</sub> fixers – *Azospirillum* – Free living - *Azotobacter* – free isolation, characterization, mass inoculum production and field application.

**Unit – III** Symbiotic N<sub>2</sub> fixers – Cyanobacteria, *Azolla* – Isolation, characterization, mass multiplication – Role in rice cultivation – Crop response – field application - immobilization.

**Unit – IV** Phosphate solubilizers – Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

**Unit – V** Mycorrhizal bioinoculants – classification – importance of mycorrhizal Ectomycorrhizae – Endomycorrhizae – Ectendo mycorrhizae – Taxonomy of mycorrhizae – Isolation of VA mycorrhizae – Quantification and assessment of VAM in roots – Mass inoculum production of VAM – field applications of Ectomycorrhizae and VAM.

### **Reference:**

Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.

Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.

Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

Subba Rao N.S. (1988) Biofertilizers in Agriculture and forestry Oxford and IBH Publishing Co., Ltd., New Delhi.

## **ELECTIVE COURSE – III (EC) – MUSHROOM TECHNOLOGY**

**Unit – I** Introduction – history – scope of edible mushroom cultivation – Types of edible mushroom available in India – *Calocybe indica*, *Volvariella Volvacea*, *Pleurotus* sp., *Agaricus bisporus*

**Unit – II** Pure culture – preparation of media (PDA and Oatmeal agar media) sterilization – Preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on petriplates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

**Unit – III** Cultivation Technology : Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood – inoculation loop – low cost stove – sieves – Culture rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves.

**Unit – IV** Storage and nutrition : Short term storage – Long term storage (scanning, Pickles, papads, drying, storage in salt solutions) – Nutrition : Proteins, amino acids, mineral elements.

Nutrition : Carbohydrates – Crude fiber content, vitamins.

**Unit – V** Food preparation, Types of foods prepared from mushroom - soup, cutlet, omelette, samosa, pickles, curry.

Research Centres – National level and Regional Level

Cost benefit ratio – Marketing in India and abroad – Export value

### **Reference:**

Marimuthu et al., (1991) Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore.

Nita Bahl (1988) Hand book of Mushrooms, II edition, Vol.I & II.

Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press.

Shu-Ting Chang, Philip G. Miles, Chang, S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2<sup>nd</sup> ed, CRC press.

Swaminathan M. (1990) Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore.

Tewari and Pankaj Kapoor S.C. (1988) Mushroom cultivation, Mittal Publications, Delhi.

## ELECTIVE COURSE – IV (EC) – MICROBIAL DISEASES

### Medical Microbiology

#### Unit I – Introduction

Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline; contributions made by eminent scientists. Classification of medically important microorganisms; Normal microbial flora or human body; role of the resident flora; normal flora and the human host.

#### Unit II –

Chemical conditions and diagnosis of the following diseases.

#### Bacteria

Disease	Pathogen
a. Pneumonia	<i>Streptococcus pneumoniae</i>
b. Whooping –cough	<i>Bordetella pertussis</i>
c. Meningitis	<i>Haemophilus influenzae</i>
d. Diphtheria	<i>Corynebacterium diphtheriae</i>
e. Pulmonary Tuberculosis	<i>Mycobacterium tuberculosis</i>
f. Leprosy	<i>Mycobacterium leprae</i> .

#### Unit III -

Chemical conditions and diagnosis of the following diseases.

Disease	Pathogen
g. Typhoid	<i>Salmonella typhi</i>
h. Cholera	<i>Vibrio cholerae</i> .
i. Tetanus	<i>Clostridium tetani</i>
j. Syphilis	<i>Treponema pallidum</i>
k. Gonorrhoea	<i>Neisseria gonorrhoeae</i>
l. Dental caries	<i>Streptococcus mutans</i>
m. Dysentery	<i>Shigella dysenteriae</i>
n. Bacterial food poisoning	<i>Shigella dysenteriae</i>
o. Gastroenteritis	<i>Clostridium botulinum</i>
p. Zoonotic disease and their control	<i>Escherichia coli</i>

#### Unit IV – Classification of pathogenic bacteria

*Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Neisseria*, *Corynebacterium bacillus*, *Clostridium*, Non sporing Anaerobes, Organisms belonging to *Enterobacteriaceae*, *Vibrios*, Non fermenting gram negative bacilli *Yersinia*; *Haemophilus*; *Bordetella*, *Bucella*; *Mycobacteria*, *Spirochaetes*, *Actinomycetes*, *Rickettsiae*, *Chlamdiae*.

## **Unit V – Viral, protozoan and helminth – Common diseases**

Virus: Small pox, Influenza, Measles, Poliomyelitis, Common cold (Rhino virus), Hepatitis, *Encephalitis*, Rabies, AIDS. Protozoa: Amoebiasis – *Entamoeba histolytica*, Malaria – *Plasmodium vivax*, *P. malariae*. Helminths: Liverfluke – *Fasciola hepatica*, Filariasis – *Wuchereria bancrofti*. Hospital acquired infection: Hospital infections Principles of control committee – functions; Hospital waste disposal – Ethical committee – functions.

### **Reference:**

Collee, J.G., Duguid, J.P., Fraser, A.G. and Macrimoin, B.P. (1989). Mackie and McCartney Practical Medical Microbiology, 13<sup>th</sup> edition. Churchill Livingstone.

David Greenwood, Richard CD., Slack, John Forrest Peutherer. (1992). Medical Microbiology. 16<sup>th</sup> edition. ELBS with Churchill Livingstone.

Joan Stokes, E., Ridgway GL and Wren MWD (1993). Clinical Microbiology, 7<sup>th</sup> edition, Edward Arnold. A division of Holder and Stoughton.

Tom Parker, M., Leslie H. Collier (1990). Topley & Wilson's Principles of Bacteriology, Virology and Immunity (VIII Edition).

## ELECTIVE COURSE – IV (EC) – MICROBIAL DISEASES

### Medical Microbiology

#### Unit I – Introduction

Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline; contributions made by eminent scientists. Classification of medically important microorganisms; Normal microbial flora or human body; role of the resident flora; normal flora and the human host.

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e. Pulmonary Tuberculosis	<i>Mycobacterium tuberculosis</i>
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Chemical conditions and diagnosis of the following diseases.

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g. Typhoid	<i>Salmonella typhi</i>
h. Cholera	<i>Vibrio cholerae</i> .
i. Tetanus	<i>Clostridium tetani</i>
j. Syphilis	<i>Treponema pallidum</i>
k. Gonorrhoea	<i>Neisseria gonorrhoeae</i>
l. Dental caries	<i>Streptococcus mutans</i>
m. Dysentery	<i>Shigella dysenteriae</i>
n. Bacterial food poisoning	<i>Shigella dysenteriae</i>
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#### Unit IV – Classification of pathogenic bacteria

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### **Reference:**

Collee, J.G., Duguid, J.P., Fraser, A.G. and Marimoin, B.P. (1989). Mackie and McCartney Practical Medical Microbiology, 13<sup>th</sup> edition. Churchill Livingstone.

David Greenwood, Richard CD., Slack, John Forrest Peutherer. (1992). Medical Microbiology. 16<sup>th</sup> edition. ELBS with Churchill Livingstone.

Joan Stokes, E., Ridgway GL and Wren MWD (1993). Clinical Microbiology, 7<sup>th</sup> edition, Edward Arnold. A division of Holder and Stoughton.

Tom Parker, M., Leslie H. Collier (1990). Topley & Wilson's Principles of Bacteriology, Virology and Immunity (VIII Edition).

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