

**VIVEKANANDHA  
COLLEGE OF ARTS AND SCIENCES FOR WOMEN**

**ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).  
(Affiliated to Periyar University, Approved by AICTE,  
Re-Accredited with 'A' Grade by NAAC)  
Recognized under section 2(f) &12(B) of UGC ACT 1956,  
An ISO 9001:2008 (Certificate institution)**



**DEPARTMENT OF MICROBIOLOGY**

**M.Sc APPLIED MICROBIOLOGY**

**SYLLABUS & REGULATIONS**

**FOR CANDIDATES ADMITTED FROM**

**2016 - 2017 ONWARDS**

**UNDER AUTONOMOUS & CBCS PATTERN**

**VIVEKANANDHA EDUCATIONAL INSTITUTIONS**

**Angammal Educational Trust**

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**M.Sc., APPLIED MICROBIOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**1. SCOPE OF MICROBIOLOGY**

The Mission of the Department of Microbiology is to impart education and carry out research in various areas of Microbiology. There is an excellent combination of courses in both traditional microbiology and modern molecular biology. The facilities in the department are totally committed to provide highest quality of education for the rural students at Post-graduate and Research levels.

The world around us is full of organisms that are too small to be seen with the naked eye. These microbes live in a wide range of habitats from hot springs to the human body and the depths of the ocean. They affect each and every aspect of life on earth. Microbes have always affected our health, food and environment and they will play an important role in the big issues that we may face in the future: climate change, renewable energy resources; healthier lifestyles and controlling diseases.

Because microbes have such an effect on our lives, they are a major source of interest and employment to thousands of people. Microbiologists study microbes: where they occur, their survival strategies, how they can affect us and how we can exploit them. Before microbiologists can solve the problems caused by microbes, or exploit their amazing powers, they have to find out about the detailed workings of microbial cells. This basic knowledge of cell genetics, structure and function can then be used in applied microbiology as well as in other areas of biology.

Microbiology imparts knowledge about the importance of micro-organisms as experimental tools in basic research, biochemical and genetic studies. There is an increasing demand for trained microbiologists in pollution control organizations, food processing, pharmaceutical and fermentation industries, industrial effluent treatment plants and in various national and international research institutes.

**2. SALIENT FEATURES**

- ❖ Course is specially designed for a higher level career placement.
- ❖ Special guest lecturers from industrialists will be arranged.
- ❖ Enables students to gain a professional degree
- ❖ Special industry orientations and training are parts of the degree course.
- ❖ Project work is included in the syllabus to enhance conceptual and deductive skills.

### **3. OBJECTIVES OF THE COURSE**

The specific objectives of the programme are:

- To equip the Postgraduate students with a sound knowledge of the fundamental principles involved in the study of microbiology.
- To produce graduates that would make impact in the diverse fields of human endeavor considering the ubiquitous nature of microorganism and the wide-ranging applications of the knowledge of microbiology.
- To provide focus for a career in various fields of Applied Science including Medicine, Pharmacy, Mining, Biotechnology, Industrial Production, Environmental Management, Agriculture and even the Computer industry.

### **4. CONDITIONS FOR ADMISSION**

#### **4.1 ELIGIBILITY CONDITIONS FOR ADMISSION**

Candidate who has passed the B.Sc., degree in any Life Sciences [Microbiology / Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Animal Science/ Applied Animal Science and Animal Biotechnology/ Biochemistry/ Bioinformatics/ Biology/ Life Sciences/ Home Science/ Food Science and Nutrition/ BHMS/ BSMS/ BAMS/ BUMS/ Chemistry with Botany or Zoology as Allied Subjects of this University or any other University accepted by the Syndicate as equivalent there to shall be eligible for admission to M.Sc., Degree Course in Applied Microbiology.

### **5. ELIGIBILITY FOR THE AWARD OF DEGREE**

A candidate shall be eligible for the award of the degree only if she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed, earning 90 credits and fulfilled such conditions as have been prescribed therefore.

### **6. DURATION OF THE COURSE**

The duration of the course is for two academic years consisting of four semesters.

## 7. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

## 8. SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory External marks	=	75
<b>Part A</b>	=	<b>25 Marks (5 x 5)</b>
<b>Part B</b>	=	<b>50 Marks (5 x 10)</b>
Internal marks	=	25
<b>Total Marks</b>	=	<b>100</b>
<b>Time</b>	=	<b>3 Hrs.</b>

### The following procedure will be followed for Internal Marks

#### **Theory - Internal Marks**

Theory best average of two tests	10 Marks
Attendance	5 Marks
Seminar	5 Marks
Assignment	5 Marks
<b>Total</b>	<b>25 Marks</b>

#### **Practical - Internal Marks**

Practical best average of two tests	30 Marks
Attendance	5 Marks
Observation Note	5 Marks
<b>Total</b>	<b>40 Marks</b>

**Project- Internal Marks,**

Presentations [Two reviews 20+20]	40 Marks
Project Report	40 Marks
Viva - Voce	20 Marks
<b>Total</b>	<b>100 Marks</b>

**Break-up Details for Attendance**

<b>Below 75%</b>	<b>No Marks</b>
<b>76 to 80%</b>	<b>1 Marks</b>
<b>81 to 85%</b>	<b>2 Marks</b>
<b>86 to 90%</b>	<b>3 Marks</b>
<b>91 to 95%</b>	<b>4 Marks</b>
<b>96 to 100%</b>	<b>5 Marks</b>

**9. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS**

- (i) Candidates shall register their names for the first semester examination after the admission in the PG courses.
- (ii) Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) semester subjects.
- (iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time. Provided in case of

## **SCHEME OF CURRICULUM – M.Sc. in APPLIED MICROBIOLOGY**

candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the college from time to time.

### **10. PASSING MINIMUM**

- a) There shall be no Passing Minimum for Internal.
- b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- d) Grading shall be based on overall marks obtained (Internal + External).

### **11. CLASSIFICATION OF SUCCESSFUL CANDIDATES**

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the first class. All other successful candidates shall be declared to have passed in second class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in first class with distinction, provided they pass all the examinations (theory papers, practical, project and viva-voce) prescribed for the course in the first appearance.

### **12. GRADING SYSTEM**

The term grading system indicates a 7- point scale of evaluation of the performances of students in terms of marks obtained in the Internal and External examination, grade points and letter grade.

(For the candidates admitted during the academic year 2014-2015 onwards)

Sem	Subject code	Course	Subject title	Hrs/ week	Credit	Int. marks	Ext. marks	Tot. marks
<b>I</b>	14P1AMB01	Core-I	General Microbiology	6	5	25	75	100
	14P1AMB02	Core-II	Microbial Genetics & Molecular Biology	6	5	25	75	100
	14P1AMB03	Core-III	Molecular Immunology	6	5	25	75	100
	14P1AMB04	Core-IV	Pharmaceutical Chemistry	6	5	25	75	100
	14P1AMBP01	Core-V Practical	Practical-I	6	4	40	60	100
			<b>Total</b>	<b>30</b>	<b>24</b>	<b>140</b>	<b>360</b>	<b>500</b>
<b>II</b>	14P2AMB05	Core-VI	Medical Bacteriology & Mycology	6	5	25	75	100
	14P2AMB06	Core-VII	Medical Virology & Parasitology	6	5	25	75	100
	14P2AMB07	Core-VIII	Food and Dairy Microbiology	6	5	25	75	100
	14P2AMBP02	Core-IX Practical	Practical-II	6	4	40	60	100
	14P2AMBE01	Elective-I	Should be selected from the list	6	4	25	75	100
			<b>Total</b>	<b>30</b>	<b>23</b>	<b>140</b>	<b>360</b>	<b>500</b>
<b>III</b>	14P3AMB08	Core-X	Soil & Environmental Microbiology	5	4	25	75	100
	14P3AMB09	Core-XI	Genetic Engineering & Gene Technology	5	4	25	75	100
	14P3AMB10	Core-XII	Microbial Technology	5	4	25	75	100
	14P3AMB11	Core-XIII	Advances in Microbiology	5	4	25	75	100
	14P3AMBP03	Core-XIV -Practical	Practical-III	5	4	40	60	100

	14P3BTED01	EDC	Plant and Animal cell culture techniques	4	4	25	75	100
	14P3AMBI01	-	Internship Programme	2 weeks	2	40	60	100
			Human rights	1	1	25	75	100
			<b>Total</b>	<b>30</b>	<b>27</b>	<b>230</b>	<b>570</b>	<b>800</b>
<b>IV</b>	14P4AMB12	Core-XV	Bioinformatics and Biostatistics	6	5	25	75	100
	14P4AMBE02	Elective-II	Should be selected from the list	6	4	25	75	100
	14P4AMBE03	Elective-III	Should be selected from the list	6	4	25	75	100
	14P4AMBPR01	Core-XVI	Project work	12	4	40	60	100
			<b>Total</b>	<b>30</b>	<b>17</b>	<b>115</b>	<b>285</b>	<b>400</b>
<b>Overall Total</b>				<b>120</b>	<b>91</b>	<b>625</b>	<b>1575</b>	<b>2200</b>

### SEVEN POINT SCALE (As per UGC notification, 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
<b>'O'= Outstanding</b>	<b>5.50-6.00</b>	<b>75-100</b>
<b>'A'= Very Good</b>	<b>4.50-5.49</b>	<b>65-74</b>
<b>'B' = Good</b>	<b>3.50-4.49</b>	<b>55-64</b>
<b>'C'= Average</b>	<b>3.00-3.49</b>	<b>50-54</b>
<b>'D'= Below Average</b>	<b>1.50-2.99</b>	<b>35-49</b>
<b>'E'= Poor</b>	<b>0.50-1.49</b>	<b>25-34</b>
<b>'F'= Fail</b>	<b>0.00-0.49</b>	<b>00-24</b>

### 13. RANKING



Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the first appearance will not be eligible for ranking.

#### **14. PATTERN OF QUESTION PAPER**

PART A (200 words): Answer All the Questions (Internal choice) **5 x 5 = 25 Marks**

PART B (500 words): Answer All the Questions (Internal choice) **5 x 10 = 50 Marks**

#### **15. PROCEDURE IN THE EVENT OF FAILURE**

If a candidate fails in particular subjects, she may reappear for the examination in the concerned subject in subsequent semester and shall pass the examination.

#### **16. COMMENCEMENT OF THESE REGULATIONS**

These regulations shall take effect from the academic year 2014-15 (i.e) for the students who are to be admitted to the first year of the course during the academic year 2014-15 and thereafter.

#### **17. TRANSITORY PROVISION**

Candidates who were admitted to the PG course of Microbiology before 2014 – 2015 shall be permitted to appear for the examinations under those regulations for a period of two years i.e., upto and inclusive of the examination of Apr/May 2016. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

#### **ELECTIVE SUBJECTS**

- 1. Advances in Life Sciences**
- 2. Microbial Nanotechnology**
- 3. Entrepreneurship in Microbiology**
- 4. Medical Laboratory Technology**
- 5. Biomedical Engineering**
- 6. IPR, Biosafety and Ethics**
- 7. Biofertilizer technology**

#### **EXTRA DISCIPLINARY COURSE**

- 1. Microbial Nanotechnology**
- 2. Entrepreneurship in Microbiology**
- 3. Medical laboratory technology**
- 4. General Botany**

**SEMESTER –I**  
**14P1AMB01**  
**Credit - 5**

**CORE-I**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **GENERAL MICROBIOLOGY**

### **Objectives:**

- To study the history of microbiology, microscopy and culture techniques.
- To gain knowledge about microbial taxonomy.
- To understand the ultrastructure of bacterial cell.
- To become familiar with microbial physiology.
- To gain knowledge about sterilization and antimicrobial chemotherapy.

The contents of this course would enlighten the students to understand the development of microbiology, microbial taxonomy, bacterial anatomy, microbial physiology and control of microorganisms.

### **UNIT I**

**(12 Hours)**

Introduction – Development of Microbiology and the early discoveries - Pure culture techniques - Microscopy and staining techniques – Culture media and Cultivation techniques - Preservation of microbes.

### **UNIT II**

**(12 Hours)**

Microbial taxonomy – Definition and Systematics, Nomenclature rules and identification, hierarchical organization. Classification systems – Artificial and Phylogenetic. Whittaker's five kingdom approach – Carl Von Linne classification. Major characteristics used in taxonomy – Numerical and chemotaxonomy of microorganisms – Genomic tools used in Diversity – DNA bar coding – Classification of Cyanobacteria.

### **UNIT III**

**(12 Hours)**

Bacteria: Morphological types – Halophiles, Archaeobacteria and L-forms. Cell wall and Cell membrane synthesis, Capsule, Flagella and Pili - Cytoplasmic inclusions. Bacterial chromosomes and plasmids. Endospore – types - structure and function, Heat shock proteins and its importance – Quorum sensing and Quenching.

### **UNIT IV**

**(12 Hours)**

Bacterial growth – Factors affecting growth - Microbial metabolism – Aerobic and Anaerobic respiration – Energy yielding process – TCA cycle – Gluconeogenesis – Fermentation - Photosynthesis – Cyclic and Non-cyclic photophosphorylation. Light reaction in Cyanobacteria.

## UNIT V

(12 Hours)

Sterilization and Disinfection – Assay of antimicrobial agents and its quality control Antimicrobial chemotherapy - Antibiotics – Classification and mode of action - Antimicrobial resistance - Molecular basis of Antibiotic resistance and its importance in therapy.

### Text Books

1. Pelczar MJ, Chan ECS and Kreig NR (2008). **Microbiology**. 5<sup>th</sup> Edition, Tata McGraw Hill-Hill Education Pvt. Ltd., New Delhi.
2. Stainer RY, Ingraham JL, Wheelis ML and Painter P.R (1987). **General Microbiology**, 5<sup>th</sup> edition, MacMillan Education Ltd., London.
3. Dubey RC and Maheswari DK (2005). **A Textbook of Microbiology**, revised muticolour Edition, Published by S. Chand Company Limited. New Delhi.
4. Purohit, SS (2006). **A Text Book of Microbiology**, 1<sup>st</sup> Edition. Agrobios, India.

### Reference Books

1. Prescott LM, Harley JP and Klein DA (2005). **Microbiology**. 7<sup>th</sup> edition, McGraw Hill, New York
2. Brige EA (1992). **Modern Microbiology**. Win C. Brown Publishers, Dubuque, U.S.A.
3. Kathleen Park Talaro (2011). **Foundations in Microbiology**. 8<sup>th</sup> Edition, McGraw-Hill Higher Education.
4. **Salle AJ (2007). Fundamental Principles of Microbiology**. 7<sup>th</sup> Edition, Mc.Graw Hill , Inc. New Delhi.

**SEMESTER –I**  
**14P1AMB02**  
**Credit - 5**

**CORE-II**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **MICROBIAL GENETICS AND MOLECULAR BIOLOGY**

### **Objectives:**

- To understand DNA and RNA as genetic material.
- To gain knowledge about DNA replication and repair mechanism.
- To understand the molecular basis of mutation and carcinogenicity testing.
- To become familiar with the molecular aspects of gene expression.
- To gain knowledge about plasmids and transposons.

The contents of this course will help the students to understand DNA and RNA as genetic material, gene transfer mechanism in bacteria, replication, transcription, translation, mutation, plasmids and transposons.

### **UNIT – I**

**(12 Hours)**

Evidences for DNA as the genetic material – Importance of bacteria and viruses in genetics - RNA as genetic material – Gene transfer in bacteria - Transformation –Transduction – Conjugation – Hfr - Organization of Bacterial genes.

### **UNIT – II**

**(12 Hours)**

DNA replication - molecular mechanisms of DNA Replication - bidirectional and rolling circle replication – DNA recombination - DNA repair mechanism - excision repair, SOS repair and mismatch repair.

### **UNIT – III**

**(12 Hours)**

Mutation – types of mutation – Mutagens - molecular basis of mutation – Wobble hypothesis – Hot spot – site specific mutagenesis – expression of mutagenesis. Detection and isolation of mutants, mutant selection – Carcinogenicity testing.

### **UNIT – IV**

**(12 Hours)**

Molecular aspects of gene expression – Transcription and translation processes – Post transcriptional modifications - Genetic code. Gene regulation in bacteria – lac, trp and ara Operons. Gene regulations in Yeast – galactose utilization.

### **UNIT – V**

**(12 Hours)**

Plasmids - properties and types - replication - episomes – cosmids – phagemids - Insertion sequences - mechanism, complex and compound transposons - T10, T5 and retroposon. Transposons of *E.coli*, Bacteriophage and Yeast.

### **Text Books**

1. Malacinski (2015). **Freifelder's Essential of Molecular Biology**, 4<sup>nd</sup> Edition, Jones and Bartlett Student Edition.
2. Ajoy Paul (2007). **Text Book of Cell and Molecular Biology**. 1<sup>st</sup> Edition, Books Allied (P) Ltd., Kolkata.
3. David R Hyde (2010). **Genetics and Molecular biology: With Fundamentals of Biostatistics**. 1<sup>st</sup> Edition, Tata Mc Graw Hill P.Ltd., New Delhi
4. Lodish, H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J (2016). **Molecular Cell Biology**. 8<sup>th</sup> Edition. Macmillan Learning.

### **Reference Books**

1. Weaver RF (2011). **Molecular Biology**. 5<sup>th</sup> Edition. Mc Graw Hill Education
2. Tamarin RH (2004). **Principles of Genetics**. 7th Edition, Tata Mc Graw-Hill P. Ltd., New Delhi.
3. Gardner, Simmons MJ and Snustad DP (2006). **Principles of Genetics**, 8<sup>th</sup> edition, John Wiley and Sons.
4. Peter J Russell (1994). **Fundamentals of Genetics**. 3<sup>rd</sup> Edition, Harper Collins

## **MOLECULAR IMMUNOLOGY**

### **Objectives:**

- To understand cells and organs of the immune system and host parasite relationship.
- To gain knowledge about antigens and immunoglobulins.
- To become familiar with antigen-antibody reactions.
- To gain knowledge about major histocompatibility complex.
- To understand transplantation, immunodeficiency disorders and autoimmune diseases.

The contents of this course will help the students to understand cells and organs of immune system, antigens, antibodies, host-microbe interactions, immunotechniques and immunodiagnosis.

### **UNIT I**

**(10Hours)**

Historical background and scope of immunology- Cells and organs of immune system - Host parasite relationship - Innate immunity - Acquired immunity – Humoral and Cell Mediated Immunity – physiology of immune response.

### **UNIT II**

**(12 Hours)**

Antigens - properties, Adjuvant, Epitopes – B cell and T cell Epitopes, Haptens, and Super antigens. Immunoglobulin - classes and functions – Immunoglobulin super family – Monoclonal antibodies - production and its applications.

### **UNIT III**

**(13 Hours)**

Antigen and Antibody reaction - Properties of Ag and Ab reaction – Types and applications. Immunofluorescence, RIA, ELISA and Flow cytometry- Immunohaematology – Cytotoxicity assay - Hyper sensitivity reactions - Complement system - activation and regulation.

### **UNIT IV**

**(13 Hours)**

Major Histocompatibility Complex - structure and function of Class I, Class II and Class III molecules - antigen processing and presentation, T and B cell receptors - activation of T and B lymphocytes – cytokines.

### **UNIT V**

**(12 Hours)**

Transplantation immunology - GVH reactions - Mechanism of graft rejection – Immune suppression. Immunological tolerance - Tumor immunology – tumour antigen – immunotherapy of malignancy - Immunodeficiency disorders and autoimmune diseases. Vaccines - DNA vaccines.

### **Text Books**

1. Kindt TJ, Osborne BA and Goldsby RA (1993). **Kuby Immunology 6<sup>th</sup> Edition**. W.H. Freeman and Company, New York.
2. Annadurai B (2008). **A Textbook of Immunology and Immunotechnology**. 1<sup>st</sup> Edition. S Chand & Co. Ltd., New Delhi.
3. Ananthanarayanan Rand Panicker CK (2005). **Text Book of Microbiology**. 7<sup>th</sup> Edition. Oriental Longman Publications, Hyderabad.
4. Rao CV (2012) **Immunology**. 2<sup>nd</sup> Edition, Narosa Publishing House Pvt.Ltd.

### **Reference Books**

1. Delves PJ, Martin SJ, Burton DR, Roitt IM (2011). **Roitt's Essential Immunology** 12<sup>th</sup> edition, Wiley-Blackwell Publisher.
2. Tizard IR (1995). **Immunology: An Introduction**. 4<sup>th</sup> Edition. Saunders College Publishers, USA
3. Paul WE (2012). **Fundamental Immunology**. 7<sup>th</sup> Edition. Lippincott Williams & Wilkins, Philadelphia.
4. Janeway CA, Travers P, Walport M and Shlomchik MJ (2001). **Immunobiology**. 5<sup>th</sup> Edition. Garland Science, New York.



**SEMESTER –I**  
**14P1AMB04**  
**Credit - 5**

**CORE-IV**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **PHARMACEUTICAL CHEMISTRY**

### **Objectives:**

- To understand basic chemistry.
- To gain knowledge about macromolecular structures.
- To become familiar with mode of action of drugs.
- To gain knowledge about drug metabolism.
- To gain knowledge about bioassays.

The contents of this course will help the students to understand basic chemistry, macromolecular structures, mode of action of drugs, drug metabolism, evaluation of drugs in biological fluids and medical importance of metals.

### **UNIT I**

**(12 Hours)**

Basic Chemistry concepts - Standard periodic table of the chemical elements - Atomic structure: Atom - Ion - Electron - Proton - Neutron - Atomic orbital – Molecular orbital - Chemical element - Valence - Atomic nucleus - Isotope. Bonding: Chemical bond - Ionic bond - Covalent bond - Metallic bond - Hydrogen bond – Intermolecular force - Dipole - Electron pair - Unpaired electron.

### **UNIT II**

**(12 Hours)**

Macromolecular structures – Conformation of monomers and polymers. Chemical composition of cells – Molecular components of the cells – chemical structure of carbohydrate, lipids, proteins, nucleic acids and heteromacromolecules.

### **UNIT III**

**(12 Hours)**

Chemical structure, mode of action and applications - Penicillin, Chloramphenicol, Tetracycline. General properties and drug action of Sulphonamides – Sulphadiazine, Sulphapyridine, Sulpathiazole, Sulphafurazole.

### **UNIT IV**

**(12 Hours)**

Drug metabolism - Routes of drug administration, Biotransformation - phase I and phase II reactions - bioavailability - Excretion of drugs and their metabolites. Adverse drug reactions. Principles of toxicity, evaluation and determination of LD 50, ED 50 and TD 50. Therapeutic index.

## UNIT V

(12 Hours)

Evaluation of drugs in biological fluids - bioassays, microbiological assays, radio immunoassays. Medical importance of magnesium, aluminium, phosphorus, silver, gold and iron.

### Text Books

1. Gajapathy D and Sasikala A (1995). **Pharmaceutical chemistry**. R.T. Publications, Vellore.
2. Lakshmi, S., (1995). **Pharmaceutical chemistry**. 1st Edition. Sultan Chand and Sons Publications, New Delhi.
3. Raje VN (2015). **Pharmaceutical Chemistry I and II**. 2<sup>nd</sup> Edition. CBS Publishers, New Delhi.
4. Satoskar RS, Bhandarkar SD and Rege NN (2009). **Pharmacology and Pharmacotherapeutics**. 21<sup>st</sup> Edition. Popular Prakashan Pvt. Ltd., Mumbai.

### Reference Books

1. Ghosh MN (2015). **Fundamentals of Experimental Pharmacology**. 6<sup>nd</sup> Edition. Hilton & Company, Kolkata.
2. Rang HP, Ritter JM, Flower RJ and Henderson G (2016). **Rang and Dale's Pharmacology**. 8<sup>th</sup> Edition. Elsevier Churchill Livingstone, New York.
3. Cooper JR, Bloom FE and Roth RH (2003). **The Biochemical Basis of Neuropharmacology**. 8th Edition. Oxford University Press, Chennai.
4. Purohit SS, Saluja AK and Kakrani HN (2007). **Pharmaceutical Microbiology**. Agrobios, (India), New Delhi.

**SEMESTER –I**  
**14P1AMBPO1**  
**Credit - 4**

**CORE - V**  
**Total Number of Hours: 45**  
**6 Hours/ Week**

### **PRACTICAL - I**

#### **1. Basic Laboratory Techniques for Isolation and Cultural characterization of Microorganisms.**

- Isolation of Pure cultures using Spread Plate, Pour Plate or Streak Plate techniques
- Preparation of culture media- Basal, differential, enriched, enrichment, selective and transport media.
- Cultural characteristics of Microorganisms.

#### **2. Microscopy**

- Microscopic Examination of Living cell Preparations. (Motility Determination).
- Microscopic Measurement of Microorganisms. (Micrometry).

#### **3. Bacterial Staining techniques**

- Preparation of Bacterial Smears.
- Simple Staining.
- Negative Staining.
- Differential staining - Gram Staining and Acid Fast Staining (Ziehl Neelsen Method).
- Special Staining - Spore Stain (Schaeffer-Fulton Method) and Capsule Stain.

#### **4. Cultivation of Microorganisms**

- Effect of Temperature, UV, pH and disinfectants
- Effect of Atmospheric Oxygen on growth.
- Anaerobic Cultivation of Microorganisms.
- Bacterial Growth Curve.

#### **5. Biochemical tests for identification of bacteria.**

- Carbohydrate Fermentation.
- Triple Sugar Iron Agar Test
- IMViC Test
- Hydrogen Sulfide Test
- Urease Test
- Nitrate Reduction Test
- Catalase Test
- Oxidase Test
- API system of Bacterial analysis

#### **6. Physical and Chemical Agents for the control of Microbial Growth.**

- Physical Agents: Moist Heat
- Chemical Agents: Antibiotic sensitivity test - Kirby- Bauer and Stokes methods

#### **7. Isolation and Purification of chromosomal / plasmid DNA and RNA**

- Confirmation of nucleic acid by spectral study.
  - Agarose gel electrophoresis of DNA.
- 8. Isolation of Mutants**
- Effect of UV radiations to study the survival pattern of *E. coli*.
  - Isolation of antibiotic resistant mutants by chemical mutagenesis.
  - Isolation of Streptomycin resistant mutant.
  - Isolation of Auxotrophic mutants
- 9. Isolation of Coli phage from Sewage**
- 10. Study of Bacterial Recombination (Demo)**

- Bacterial Conjugation
- Bacterial Transformation
- Isolation of P1 Phage

**11. Antigen Antibody Reactions**

***Precipitation methods:***

- Immunodiffusion
- Immunoelectrophoresis.

***Agglutination methods:***

- Haemagglutination – ABO Blood Grouping and Rh Typing
- Active Agglutination-Widal Test

***Passive Agglutination- RA Test***

- ASO Test
- CRP Test
- RPR Test.

**Enzyme Linked Immuno Sorbent Assay- HIV and HBsAg detection.**

**Reference Manuals**

1. Sundaraj T and Aswathy S (2002). **Microbiology Laboratory Manual**. 1<sup>st</sup> Edition. Chennai.
2. Dubey RC and Maheshwari DK (2012). **Practical Microbiology**. 3rd Edition. S.Chand & Company Ltd., New Delhi.
3. Baron EJ and Tenover FC (1995). **Diagnostic Microbiology**. Blackwell Scientific Systems. UK.
4. Aneja KR (2010). **Experiments in Microbiology, Plant pathology and Biotechnology**. 4<sup>th</sup> Edition, New age International publishers, Chennai.
5. Horold J Benson (2014). **Microbiological Applications, Laboratory manual in General Microbiology**. 13<sup>th</sup> Internal Edition, WCB McGraw-Hill, Boston.

6. Cappuccino JG and Sherman N (2014). **Microbiology: A Laboratory Manual**. 10<sup>th</sup> Edition, Pearson Benjamin Cummings, San Francisco.
7. Myers and Koshis (2001). **Manual of Diagnostic Procedures In Medical Microbiology/Serology Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamilnadu.**
8. Kalaichelvan PT (2008). **Microbiology and Biotechnology - A Laboratory manual**. 5<sup>th</sup> Edition, MJP Publishers, A unit of Tamilnadu Book House, Chennai.
9. Rose NR, Hamilton RG and Detrick B (2002). **Manual of Clinical Laboratory Immunology**. 6<sup>th</sup> Edition, ASM Press, New York.

**SEMESTER –II**  
**14P2AMB05**  
**Credit - 5**

**CORE-VI**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **MEDICAL BACTERIOLOGY AND MYCOLOGY**

### **Objectives:**

- To gain knowledge about specimen collection for bacteriological examination.
- To understand the diseases caused by Gram positive organisms.
- To gain knowledge about the diseases caused by Gram negative organisms.
- To study the laboratory diagnosis of fungal infections.
- To gain knowledge about fungal diseases.

The contents of this course will help the students to understand important bacterial and fungal diseases with reference to etiology, pathogenesis, laboratory diagnosis, control and treatment.

### **UNIT I (10 Hours)**

Collection and transport of clinical specimens for microbiological examination – Isolation of pathogenic bacteria from clinical specimens – Molecular mechanism of bacterial pathogenesis – Two component system - Normal flora of human beings.

### **UNIT II (16 Hours)**

Morphology, Classification, Culture characters, Pathogenicity, Laboratory diagnosis, Control and treatment of following organisms - *Staphylococci*, *Streptococci*, *Neisseriae*, *Corynebacteria*, *Mycobacterium tuberculosis*, *Clostridia* and *Bacillus*.

### **UNIT III (16 Hours)**

Morphology, Classification, Culture characters, Pathogenicity, Laboratory diagnosis, Control and Treatment of following organisms. *Escherichia*, *Klebsiella*, *Salmonella*, *Shigella*, *Proteus*, *Vibrio*, *Pseudomonas*, *Haemophilus*, *Treponema* and *Leptospira*.

### **UNIT IV (08 Hours)**

Morphology and classification of fungi - Isolation, identification and diagnosis of fungi from clinical specimens - Antifungal agents - Sensitivity tests - Mycotoxins.

### **UNIT V (10 Hours)**

Morphology, Classification, Culture characters, Pathogenicity, Laboratory diagnosis, Control and Treatment of following organisms. Dermatophytosis – Sporotrichosis – Mycetoma - Blastomycosis - Histoplasmosis – Candidiasis – Cryptococcosis - Aspergillosis.

### **Text Books**

1. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**. 9<sup>th</sup> Edition, Orient Blackswan Private Limited.
2. Chakraborty P (2015). **A Text Book of Microbiology**. New Central Book Agency (P) Ltd., Kolkata.
3. Sathish Gupte (2013). **The Short Textbook of Medical Microbiology and Parasitology** 10<sup>th</sup> Edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
4. Arora DR and Arora BB (2014). **Medical Mycology**. CBS Publishers and Distributors Pvt. Ltd., New Delhi.

### **Reference Books**

1. Monica Cheesbrough (2003). **District Laboratory Practice in Tropical Countries**. Part 1 and 2. Low-Price Edition, Cambridge University Press.
2. Jawetz E and JL Melnic (2001). **Medical Microbiology**, 22<sup>nd</sup> Edition, Tata Mc Graw-Hill, New Delhi.
3. Greenwood D, Slack RB and Peutherer JF (2002) **Medical Microbiology**. 16th Edition, Churchill Livingstone, London
4. Mehrotra RS and KR Aneja (2010). **An Introduction to Mycology, 4<sup>th</sup> edition**, Reprinted and Published by new age International (P) Limited, New Delhi.
5. Jagadish Chander (2009). **A Text Book of Medical Mycology**, 3rd Edition, Mehta Publishers, New Delhi.

**SEMESTER –II**  
**14P2AMB06**  
**Credit - 5**

**CORE-VII**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **MEDICAL VIROLOGY AND PARASITOLOGY**

### **Objectives:**

- To gain knowledge about general properties of viruses.
- To understand the diseases caused by arthropod borne and rodent borne viruses.
- To gain knowledge about the diseases caused by pox, adeno, herpes and hepatitis viruses.
- To understand protozoan diseases.
- To gain knowledge about diseases caused by helminthes.

The contents of this course will help the students to understand important diseases caused by viruses and parasites with reference to etiology, pathogenesis, laboratory diagnosis, control and treatment.

### **UNIT I (10 Hours)**

General Properties of viruses - Detection of viruses and antigens in clinical specimens - Serological diagnosis of virus infections. Cultivation of viruses - Vaccines and Interferons - Antiviral agents.

### **UNIT II (10 Hours)**

Arthropod borne and rodent borne viral diseases - Picorna viruses, Rabies, Orthomyxo and Paramyxo viruses.

### **UNIT III (12 Hours)**

Pox, Adeno, Herpes, Varicella Zoster, CMV, Epstein – Barr Viruses, Hepatitis viruses, HIV Viruses, Oncogenic viruses - Viral vaccines- Preparation and their immunization schedule.

### **UNIT IV (14 Hours)**

Introduction to Medical Parasitology - Classification, Protozoa – *Entamoeba* sps – *Plasmodium* sps, *Leishmania* sps- *Trypanosoma* sps – *Giardia* sps – *Trichomonas* sps – *Balantidium* sps.

### **UNIT V (14 Hours)**

Platyhelminthes - *Taenia* - *Fasciola* - *Paragonimus* - *Schistosoma*. Nematelminthes - *Ascaris* - *Ankylostoma* - *Enterobius* - *Trichuris* - *Wuchereria* -. Laboratory techniques in Parasitology. Examination of faeces for ova and cysts - Concentration methods. Blood smear examination for Parasites. Cultivation of Protozoan Parasites.



### **Text Books**

1. Saravanan P (2006). **Virology**. 1<sup>st</sup> Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
2. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**. 9<sup>th</sup> Edition, Orient Blackswan Private Limited.
3. Chakraborty P (2015). **A Text Book of Microbiology**. New Central Book Agency (P) Ltd., Kolkata.
4. Subhash Chandra Parija (2004). **Text Book of Medical Parasitology**. 2nd Edition, All India Publishers and Distributors, New Delhi.

### **Reference Books**

1. Dimmock NJ and Primrose SB (1994). **Introduction to Modern Virology**. 4<sup>th</sup> Edition, Blackwell scientific Publications, Oxford.
2. Jawetz, Melnick and Adelberg, (2010). **Medical Microbiology** (25<sup>th</sup> edition) McGraw Hill Publications.
3. Flint JS and Skalka AM, Enquist LW and Racaniello VR (2015). **Principles of Virology**. 4<sup>rd</sup> Edition, ASM Press, New York.
4. Chatterjee KD (2009). **Medical Parasitology**. 13<sup>th</sup> Edition, CBS Publishers and Distributors Pvt Ltd., New Delhi.

**SEMESTER –II**  
**14P2AMB07**  
**Credit -5**

**CORE-VIII**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **FOOD AND DAIRY MICROBIOLOGY**

### **Objectives:**

- To gain knowledge about food spoilage and food preservation.
- To gain knowledge about microbiology of food and food products.
- To understand food borne diseases.
- To become familiar with food fermentation.
- To gain knowledge about dairy microbiology.

The contents of this course would enable students to learn about food spoilage, food borne diseases, milk borne diseases, food fermentation, preservation, food hygiene and control

### **UNIT I (12 Hours)**

Food Microbiology – Introduction - Importance of food microbiology - Types of microorganisms in food spoilage, Source of contamination - Factors influencing microbial growth in food. Food preservations - principles – high temperature – low temperature – food additives.

### **UNIT II (12 Hours)**

Microbiology of food and food products - Contamination, spoilage and preservation of cereals and cereal products, sugar and sugar products, Vegetables and fruits, meat and meat products – fish and other sea foods, egg and poultry.

### **UNIT III (12 Hours)**

Food borne diseases, Intoxication and Food poisoning – *Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Mycotoxins, Protozoan and Viral food borne diseases.

### **UNIT IV (10 Hours)**

Food fermentations methods of fermentations and organisms used - bread, wine, beer. Fermented vegetables, Food and enzymes from microorganisms - Single cell protein - amylase and protease.

### **UNIT V (14 Hours)**

Dairy Microbiology - Micro flora of milk - sources of contamination - Milk borne diseases–intoxication- Milk preservation methods. Fermented dairy products – butter milk, cream, yoghurt, kafir, kumiss, acidophilus milk and cheese production and its types. Food hygiene and control - food sanitation in food manufacture and in the retail trade. Food control agencies and its regulations.

### **Text Books**

1. Vijaya Ramesh K (2007). **Food Microbiology**. 1<sup>st</sup> Edition, MJP Publishers, Chennai.
2. Sivasankar B (2002). **Food Processing and Preservation**. PHI Learning P.Ltd., New Delhi
3. Rao MK (2007). **Food and Dairy Microbiology**, Mangalam Publishers and Distributors.
4. Banwart GJ (2004). **Basic Food Microbiology**. 2<sup>nd</sup> Edition, CBS Publishers and Distributors, New Delhi

### **Reference Books**

1. Adams MR and Moss MO (2015). **Food Microbiology**, 4<sup>nd</sup> Edition, Royal Society of Chemistry.
2. Frazier WC and Westhoff DC (2013). **Food Microbiology**, 5<sup>th</sup> edition, McGraw Hill Education, New Delhi.
3. May JM, Loessner MJ and Golden DA (2006). **Modern Food Microbiology**, 7<sup>th</sup> edition, Springer Science and Business Media, USA
4. Garbutt J (1997). **Essentials of Food Microbiology**. 2<sup>nd</sup> Edition. Arnold, London.

## **PRACTICAL-II**

### **1. Processing of clinical specimen, Isolation, Identification and Antibigram of unknown Bacterial pathogens in specimens.**

- (a) *Staphylococcus* spp.,
- (b) *Streptococcus* spp.,
- (c) *Bacillus* spp.,
- (d) *Escherichia* spp.,
- (e) *Klebsiella* spp.,
- (f) *Proteus* spp.,
- (g) *Salmonella* spp.,
- (h) *Shigella* spp.,
- (i) *Pseudomonas* spp.,
- (j) *Vibrio* spp.,

### **2. Isolation and Identification of Fungal Specimens**

- Direct Microscopy – KOH and Lacto phenol preparations.

### **3. Isolation and Identification of Yeast - Germ tube, Gram Staining and Negative staining**

- (a) *Candida* spp.
- (b) *Cryptococcus* spp.

### **4. Cultivation and identification of fungal pathogens from clinical specimens.**

- (a) Dermatophytes
- (b) *Aspergillus* spp.

### **5. Cultivation of viruses**

- (a) Egg inoculation methods (all routes)
- (b) Animal tissue culture (demonstration)

### **6. Serological tests: Serodiagnosis of various viral diseases.**

- ELISA – HBV and HIV.
- Complement fixation test.
- Haemagglutination and Haemagglutination Inhibition Test.

### **7. Wet Mount examination of stool for parasites.**

### **8. Estimation of worm burden in stool.**

- Flootation technique
- Sedimentation technique

### **9. Microbiological analysis of food products.**

- Direct microscopic count of organisms in milk (Breed's count).
- Detection of Bacteria in milk by standard plate count method (SPC).

#### **10. Quality control testing in milk.**

- Methylene blue test
- Resazurin test
- Litmus milk test.
- Detection of bacteria in milk by standard plate count.

#### **11. Isolation of *Lactobacilli* and *Streptococci* from curd.**

#### **12. Examination of Microbial load in Spoiled foods.**

#### **13. Isolation of lipolytic organisms from butter.**

#### **Reference Manuals**

1. Dubey RC and Maheshwari DK (2012). **Practical Microbiology**. 3rd Edition. S. Chand & Company Ltd., New Delhi.
2. Aneja KR (2010). **Experiments in Microbiology, Plant pathology and Biotechnology**. 4<sup>th</sup> Edition, New age International publishers, Chennai.
3. Sundaraj T and Aswathy S (2002). **Microbiology Laboratory Manual**. 1<sup>st</sup> Edition. Chennai.
4. Baron EJ and Tenover FC (1995). **Diagnostic Microbiology**. Blackwell Scientific Systems. UK.
5. Collee, J.C., J.P. Duguid, A.C. Fraser and B.P. Marimon (1996). **Mackie and McCartney, Practical Medical Microbiology**. 14<sup>th</sup> Edition, Churchill Livingstone, London.
6. Cowan and Steel (1995). **Manual for Identification of Medical Bacteria**. 4<sup>th</sup> Edition, Cambridge University Press, London.

**SEMESTER –II**  
**14P2AMBE01**  
**Credit - 4**

**ELECTIVE-I**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **MICROBIAL NANOTECHNOLOGY**

### **Objectives:**

- To study the significance of microorganism in nanotechnology.
- To become familiar with spectroscopy and microscopy.
- To understand nanoparticle biosynthesis.
- To gain knowledge about the role of nanotechnology in drug development.
- To gain knowledge about environmental applications of nanotechnology.

The contents of this syllabus would enlighten the students to understand the basic concepts of nanotechnology, microbial synthesis of nanoparticles and application nanotools to relevant medical and environmental problems.

### **UNIT I**

**(12 Hours)**

Definition – Evolution of Nanoscience – Need of Nanotechnology – Hurdles for Nanotechnology development – Significance of microbes in nanotechnology - Factors affecting the manufacturing process of nanomaterials – Applications of nanotechnology.

### **UNIT II**

**(12 Hours)**

Spectroscopy and Microscopy – Infra-red spectroscopy, Raman spectroscopy, Ultra-violet visible spectroscopy. Atomic force microscope – Scanning electron microscope – Transmission electron microscope – Scanning tunneling microscope – Magnetic resonance force microscopy – Confocal microscopy.

### **UNIT III**

**(12 Hours)**

Bio-nanotechnology: Role of microbes in nanoparticles synthesis – Silver, gold, cadmium, iron - factors affecting nanoparticle synthesis, mechanisms of reductase enzyme – methods to study the nanoparticles.

### **UNIT IV**

**(12 Hours)**

Nanotechnology for drug development and medical applications- drug solubilization and drug delivery - Diagnosis using nanomaterials - Nanotherapy for cancer treatment – Interior artery expansions – Replacing joints with better stuff - Radioactive tubercule cages in nuclear medicine.

### **UNIT V**

**(12 Hours)**

Cleaner environment with Nanotechnology - Cleaning the air with Nanotechnology – Nanotechnology for water treatment - nanocarbon ball as deodorizer in fermentation process - Possible harm from nanomaterials - Nanoscience in India and foreign countries - Looking at ethics and society.

### **Text Books**

1. Varghese T and Balakrishna KM (2012). **Nanotechnology: An introduction to Synthesis, Properties, and Applications of Nanomaterials.** Atlantic Publishers and Distributors (P) Ltd.
2. Karkare M (2008). **Nanotechnology Fundamentals and Applications.** IK International Publishing House (P) Ltd.
3. Chattopadhyay KK and Banerjee AN (2009). **Introduction to Nanoscience and Nanotechnology.** Prentice Hall India Learning Private Ltd.
4. Shanmugam S (2016). **Nanotechnology.** MJP Publishers, Chennai.

### **Reference Books**

1. Pradeep T (2012). **A Text Book of Nanoscience and Nanotechnology.** McGraw Hill Education.
2. Niemeyer CM and Mirkin CA (2012). **Nanobiotechnology.** Wiley India Pvt Ltd.
3. Shah MA and Ahmad T (2010). **Principles of Nanoscience and Nanotechnology.** Narosa Publishing House.
4. Foster LE (2007). **Nanotechnology: Science, Innovations and Opportunity.** Pearson Education India.

**SEMESTER –III**  
**14P3AMB08**  
**Credit - 4**

**CORE-X**  
**Total Number of Hours: 60**  
**5Hours/ Week**

## **SOIL AND ENVIRONMENTAL MICROBIOLOGY**

### **Objectives:**

- To study the soil properties and significance of soil microorganisms.
- To gain knowledge about biogeochemical cycles and biofertilizers.
- To understand plant pathology.
- To gain knowledge about microbiology of air and water.
- To gain knowledge about sewage treatment and pollution.

This course would enlighten the students to understand soil properties, biogeochemical cycles, plant diseases, biofertilizers, air sanitation, water purification, sewage treatment and pollution.

### **UNIT I**

**(12 Hours)**

Introduction to soil microbiology – Properties of soil- Structure, texture & formation. Types and significance of soil microbes – Bacteria, Fungi, Actinomycetes, Microalgae, Protozoa, Nematodes and Viruses. Factors affecting microbial population.

### **UNIT II**

**(12 Hours)**

Biogeochemical - carbon cycle - role of microbes in carbon cycle - trophic relationships - mobilization and immobilisation of carbon with rhizosphere. Nitrogen cycle - mechanism of biological nitrogen fixation – ammonification - nitrification - denitrification and microorganisms involved in such processes. Phosphorous cycle - Sulphur cycle. Biofertilizer – Rhizobium, Azotobacter and Cyanobacteria – mass multiplication, Field study and its applications.

### **UNIT III**

**(12 Hours)**

Microbial interaction between microbes – neutralism, commensalism, synergism, mutualism, ammensalism, competition, parasitism and predation. Interaction of microbes with plants – Rhizosphere, Phyllosphere, Mycorrhizae. Plant Pathology - Symptoms & disease cycle. Bacterial diseases - Citrus canker. Fungal disease - Wilt of Cotton, Tikka leaf spot of groundnut. Viral diseases – TMV & control measures.

### **UNIT IV**

**(12 Hours)**

Conventional and molecular methods of studying microbial diversity – Microbiology of air & water – Enumeration of bacteria from air – Air sampling devices – Air sanitation. Potability of water quality – indicator organisms – water purification – waterborne diseases and their control measures. Positive and negative roles of microbes in environment.

### **UNIT V**

**(12 Hours)**

Microbiology of Sewage - chemical and biochemical characters of sewage – BOD, COD - Sewage treatment and disposal of wastes - Heavy metal pollution – Thermal pollution – Noise pollution – radioactive elements pollution and its control measures.



### **Text Books**

1. Subba Rao NS (2004). **Soil Microbiology**. 4th Edition, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi
2. Rangaswami G and Bagyaraj DJ (2002). **Agricultural Microbiology**. 2nd Edition, PHI Learning (P) Ltd., New Delhi.
3. Joseph C Daniel (1999). **Environmental aspects of Microbiology**. 1<sup>st</sup> Edition, Bright Sun Publications, Chennai.
4. Vijaya Ramesh K (2004). **Environmental Microbiology**. 1<sup>st</sup> Edition, MJP publishers. Chennai.

### **Reference Books**

1. Robert, L Tate (1995). **Soil Microbiology**. 1<sup>st</sup> Edition, John Wiley and Sons, Inc. New York.
2. Rangaswami G and Mahadevan A (2002). **Disease of Crop Plants in India**. 4<sup>th</sup> Edition, PHI Learning (P) Ltd., New Delhi.
3. Mithell R (1974). **Introduction to Environmental Microbiology**. Prantice Hall. Inc., Englewood Cliffs, New Jersey.
4. Elas JDV, Jansson JK and Trevors JT (2006). **Modern Soil Microbiology**. CRC Press, Boca Raton.

**SEMESTER –III**  
**14P3AMB09**  
**Credit - 4**

**CORE-XI**  
**Total Number of Hours: 60**  
**5 Hours/ Week**

## **GENETIC ENGINEERING AND GENE TECHNOLOGY**

### **Objectives:**

- To study nucleic acid isolation techniques.
- To gain knowledge about analysis of genomes.
- To understand gene cloning.
- To gain knowledge about genomics.
- To gain knowledge about proteomics.

The contents of this syllabus would enlighten the students to understand nucleic acid isolation techniques, restriction enzymes, gene transfer methods, gene cloning, PCR, genome sequencing methods and proteomics.

### **UNIT-I**

**(12 Hours)**

**Nucleic Acids Isolation** - Genomic DNA isolation from bacteria - RNA isolation method by Guanidium isothicyanate method - mRNA purification – Purification, Concentration and Quantification of Nucleic acids – Plasmid DNA isolation - Phage DNA isolation –Electrophoresis of DNA – Pulse Field Gel Electrophoresis (PFGE), SDS-PAGE, Nucleic Acid Staining.

### **UNIT-II**

**(12 Hours)**

**Analysis of Genomes** - Restriction enzymes – nomenclature, classification and types, DNA modifying enzymes. Introduction of DNA into living cells - Methods of gene transfer – Radio labeling of Nucleic acids – Autoradiography – Molecular probes – Blotting and Hybridization Techniques – DNA fingerprinting methods.

### **UNIT-III**

**(12 Hours)**

**Gene cloning** - Prokaryotic and Eukaryotic hosts. Construction of prototype vector (PBR 322), different types of cloning vectors (PUC series, phage vectors, cosmid, M13). Expression and Promotor probe vectors. Artificial chromosomes. Cloning strategies, Synthesis and cloning of cDNA in vectors. Genomic and cDNA library construction & application. Genetic selection and screening methods.

## UNIT-IV

(12 Hours)

**Genomics** – Principle, Components and factors affecting optimization of PCR. Enzymes used in PCR and their properties – Types of PCR – Applications of PCR - DNA Sequencing – Maxam Gilbert method, Sanger's Dideoxy method, pyrosequencing - Molecular beacons, Site directed mutagenesis. Genome sequencing methods – map based approach and shotgun approach - Ordering the genome sequence, Genetic maps and Physical maps, STS content.

## UNIT-V

(12 Hours)

**Proteomics** - Edman degradation method, N-terminal sequencing method and sequencing using mass spectrometry. Peptide synthesis method - Yeast one-hybrid screening, Yeast two-hybrid screening, Phage Display.

### Text Books

1. Jogdand SN (2005). **Gene Biotechnology**. Himalaya Publishing House, Mumbai.
2. Satyanarayana (2005). **Biotechnology**. 1<sup>st</sup> edition, Books and Allied (P) Ltd., Kolkata.
3. Mitra (2005). **Genetic Engineering**. Macmillan India Ltd., Chennai.

### Reference Books

1. Bernad R Glick (2010). **Molecular Biotechnology - Principles and Applications of Recombinant DNA**. 4<sup>th</sup> Edition, ASM Press, Washington, D.C.
2. Brown TA (2010). **Gene Cloning and DNA Analysis: An Introduction**. 6th Edition, Wiley-Blackwell Publishers.
3. Primrose SB and Twyman RM (2006). **Principles of Gene Manipulation and Genomics** (2006) 7<sup>th</sup> Edition, Black Well Publishing, Oxford.

## **MICROBIAL TECHNOLOGY**

### **Objectives:**

- To study the history of fermentation and screening techniques.
- To gain knowledge about fermentation processes.
- To gain knowledge about construction of bioreactor.
- To understand downstream processing.
- To gain knowledge about production of vaccines and bioprocess economics.

The contents of this course will help students to understand screening techniques, strain improvement, fermentation processes, construction of fermentor, industrial production of beverages, antimicrobials, organic acids, enzymes and vaccines and bioprocess economics.

### **UNIT I (12 Hours)**

Introduction to fermentation technology: History of fermentation- Isolation and screening of industrially important microbes. Primary & Secondary detection & assay of fermentation products. Improvement of the strains for increased yield and other desirable characteristics.

### **UNIT II (12 Hours)**

Principles to fermentation processes- Fermentation types and culture - Submerged, solid state – Batch and continuous culture. Media formulation. Sterilization. Batch and continuous sterilization systems, Sterilization of air. Fibrous filters - aseptic inoculation methods- valve systems and sampling methods.

### **UNIT III (12 Hours)**

Fermentor- Bioreactor design, parts and their functions. Types of reactors - CSTR, Tower, Jet loop, Airlift, Bubble column, Packed bed - basic concepts for selection of a reactor-asepsis and containment requirements- body construction and temperature control- aeration and agitation systems.

### **UNIT IV (12 Hours)**

Downstream processing – recovery and purification of the industrial products- Industrial production of Wine, Beer and Ethanol. Organic acids- Citric acid and Lactic acid- Antibiotics- Penicillin and streptomycin- Vitamin B<sup>12</sup> – Enzymes -  $\alpha$  amylase and alkaline protease.

## UNIT V

(12 Hours)

Microbial production of Vaccines – BCG and Typhoid vaccine, Toxoid- Tetanus and Diphtheria. Antiseptics, Disinfectants and their standardization, Biotransformation-steroid and non-steroid compounds. Bioprocess economics –Bio-product regulation- General fermentation economics.

### Text Books

1. Patel AH (2005). **Industrial Microbiology**. Mac Millan India Ltd., Chennai.
2. Satyanarayana (2005). **Biotechnology**. 1<sup>st</sup> Edition, Books and Allied (P) Ltd., Kolkata.
3. Sivakumar PK, Joe MM and Sukesh K (2010). **An Introduction to Industrial Microbiology**. 1st Edition, S.Chand & Company Ltd, New Delhi.
4. Agrawal AK and Pradeep Parihar (2006). **Industrial Microbiology**. Student edition, Jodhpur

### Reference Books

1. Stanbury PF, Whitaker A and Hall SJ (1997). **Principles of Fermentation Technology**. 2<sup>nd</sup> Edition, Pergmon Press.
2. Cassida JR (2005). **Industrial Microbiology**. New Age International (P) Ltd., New Delhi.
3. Reed G (2004). **Presscott and Dunn's Industrial Microbiology**. 4<sup>th</sup> Edition. CBS Publishers and Distributors.
4. Pepler H J and Perlman D (1979). **Microbial Technology: Microbial Processes**. Vol 1. Academic Press, London.

**SEMESTER - III**  
**14P3AMB11**  
**Credit - 4**

**CORE-XIII**  
**Total Number of Hours: 60**  
**5 Hours/ Week**

## **ADVANCES IN MICROBIOLOGY**

### **Objectives:**

- To understand quorum sensing.
- To gain knowledge about biofuel production.
- To become familiar with microbial mining.
- To gain knowledge about sustainable agriculture.
- To understand biotechnological potential of algae.

The contents of this paper provides understanding on quorum sensing, biofilms, biofuel production, organic farming, biopesticides, bioinsecticide, bioherbicide, biofertilizers and biotechnological applications of microalgae.

### **UNIT I (12 Hours)**

**Quorum sensing** - Life cycle of *Dyctiostellium discoïdum*, Molecular mechanism of quorum sensing in slime moulds, Life cycle of myxobacteria, Molecular mechanism of quorum sensing in myxobacteria. Quorum sensing in Gram positive and Gram negative bacteria, Biofilms, their organization, signals involved in their formation and dispersal, applications of study on biofilms in pathogenic and non-pathogenic environments.

### **UNIT II (12 Hours)**

**Microbial fuel** – Definition – types, Fundamental concepts in understanding biofuel/bioenergy production - microbial production – biodiesel –advantages. Biodiesel production from oil seeds, waste oils and algae - Environmental impacts of biofuel production.

### **UNIT III (12 Hours)**

**Microbial mining** -Microbial leaching of ores- process, microorganisms involved and metal recovery with special reference to copper and iron, Biotransformation of heavy metals and xenobiotics, Petroleum biodegradation; reductive and aerobic dechlorination. A brief account of biodegradable plastics and super bug.

### **UNIT IV (12 Hours)**

**Sustainable agriculture** - Concepts of sustainable agriculture. Traditional agricultural practice and organic farming- Rhizosphere, Rhizoplane, phyllosphere. Rhizobium, Azospirillum, Azotobacter, phosphobacteria, Frankia, AMF and BGA. Biopesticide, Bioinsecticides, Bioherbicides and its application to the agriculture - Microbial endophytes.

### **UNIT V (12 Hours)**

Algal technology - Definition, Concepts -History, biotechnological potentials of microalgae – food – feed – Colourant - fuel and pharmaceutically variable compounds. Production of microbial biofertilizers – Mass cultivation of cyanobacteria (*Spirullina*), *Azolla* and other N<sub>2</sub> fixers.

### **Text Books**

1. Purohit SS (2005). **Biotechnology: Fundamentals and Applications**. 3<sup>rd</sup> Edition Agrobios (India).
2. Sathyanarayana U (2005). **Biotechnology**. 1<sup>st</sup> Edition, Books and Allied (P) Ltd., Kolkata.
3. Dubey RC (2006). **A Text Book of Biotechnology**. 4<sup>th</sup> Edition. S.Chand & Company (P) Ltd., New Delhi.
4. Jogdand SN (2010). **Environmental Biotechnology**. Himalaya Publishing House, New Delhi.

### **Reference Books**

1. Bernad R Glick (2010). **Molecular Biotechnology - Principles and Applications of Recombinant DNA**. 4<sup>th</sup> Edition, ASM Press, Washington, D.C.
2. Maheswari DK and Dubey RC (2008). **Potential Microorganisms for Sustainable Agriculture**. I K International Publishing House Pvt. Ltd.
3. Sahoo D and Kaushik BD (2012). **Algal Biotechnology and Environment**. 1<sup>st</sup> Edition, I K International Publishing House Pvt. Ltd.
4. Thatoi HN and Mishra BB (2011). **Microbial Biotechnology: Methods and Applications**. 1<sup>st</sup> Edition, Alpha Science International Ltd.

**PRACTICAL – III**

**Soil & Agricultural Microbiology**

1. Enumeration of microbial population from soil - Bacteria, Fungi, Actinomycetes
2. Localization of VAM
3. Isolation of antibiotic producer from soil sample.
4. Isolation of amylase producer from soil sample.
5. Pigment extraction from Cyanobacteria - Microalgae
6. Isolation of free living nitrogen fixing bacteria from soil – Azotobacter
7. Isolation of symbiotic Nitrogen fixing bacteria from root nodule – Rhizobium
8. Enumeration of microorganisms from phyllosphere
9. Examination of plant diseases

**Bacterial Disease**

Blight of rice  
Citrus canker,  
Red rot of sugarcane

**Fungal Disease**

Wilt & Blast of rice  
Brown rot of potato  
Tikka leaf spot of ground nut

**Environmental Microbiology**

10. Bacterial examination of water (qualitative)
11. Standard plate count (quantitative test)
12. Membrane filter technique
13. Enumeration of microorganism from air  
Settle plate technique  
Air sampling techniques
14. Estimation of dissolved oxygen
15. Estimation of BOD and COD
16. Ethanol production from molasses and sugars.
17. Bio-gas production from cow-dung slurry-demonstration.



## **Genetic Engineering**

18. Thin Layer Chromatography of amino acids
19. Column Chromatography of plant pigments
20. Immobilization of Microorganisms
21. Estimation of RNA by Orcinol methods
22. Estimation of DNA by Diphenyl amine method (Burton's method)
23. Isolation of genomic DNA from bacterial cells and quantification by UV spectrophotometer
24. Isolation of plasmid DNA from bacterial cells and separation by agarose gel electrophoresis.
25. Melting point determination of bacterial DNA.
26. Single and Double Restriction enzyme digestion of plasmid DNA.
27. Determination of Molecular weight of proteins by SDS PAGE.
28. Bacterial transformation and blue white selection assay.
29. NCBI Blast search algorithm (Demonstration)
30. Western blotting (Demonstration)

## **Reference Manuals**

1. Dubey RC and Maheshwari DK (2012). **Practical Microbiology**. 3rd Edition. S. Chand & Company Ltd., New Delhi.
2. Aneja KR (2010). **Experiments in Microbiology, Plant pathology and Biotechnology**. 4<sup>th</sup> Edition, New age International publishers, Chennai.
3. Chaitanya KV (2013). **Cell and Molecular Biology: A Lab Manual**. Prentice Hall India Learning Pvt Ltd.
4. Vennison SJ (2010). **Laboratory Manual for Genetic Engineering**. 1<sup>st</sup> Edition, Prentice Hall India Learning Pvt Ltd.
5. Palanivelu P (2009). **Analytical Biochemistry and Separation Techniques**. 4<sup>th</sup> Edition. Twenty First Century Publications.

## **PLANT AND ANIMAL CELL CULTURE TECHNIQUES**

### **Subject Description:**

This course aims to introduce the principles and applications of plant tissue culture, animal tissue as well as the biology of cultured plant cells. Later through the course, Students will be exposed to some molecular techniques using plant systems. The designed experiments will illustrate the principles and ideas discussed in the plant biotechnology, animal biotechnology.

### **Objectives**

This course was designed to acquaint the students to:

- Work under aseptic conditions to cultivate different plant species and/or parts in vitro. Learn how to subculture and follow the growth pattern of the cultures.
- Practice scientific thinking in analyzing the experiments, keeping records, and presenting results.
- Practice and learn some techniques in plant biochemistry, molecular biology, animal biotechnology.

### **UNIT-I**

**(08 hours)**

**Introduction to plant tissue culture:** Structure and organisation of plant cell. PTC Laboratory – Design and layout. Sterilization techniques. Media preparation (MS medium), growth regulators - auxin, cytokinin and other hormones.

### **UNIT-II**

**(10 hours)**

**Tissue culture techniques:** Callus culture - initiation and maintenance of callus. Principles of Micropropagation: Direct and indirect morphogenesis, somatic embryogenesis. Synthetic seed production. Protoplast isolation & somaclonal variations.

### **UNIT-III**

**(10 hours)**

**Gene transfer methods in plants:** Agrobacterium mediated transformation (Ti plasmid & Ri plasmid). Particle bombardment, Electroporation. Selectable marker, promoter and reporter genes used in plant transgenesis-Herbicide resistance, pesticide resistance and disease resistance.

### **UNIT-IV**

**(10 hours)**

**Introduction to animal cell culture:** Animal cell; Laboratory Equipments and materials for animal cell culture, Balanced salt solutions and Complete medium; Constituents of animal cell culture media and role of serum and serum free media and their applications. Primary and established cell line cultures.

## UNIT-V

(10 hours)

**Applications of animal cell culture:** Biology and characterization of the cultured cells, Measurement of viability and cytotoxicity, Basic techniques of mammalian cell culture *in vitro*; primary culture, maintenance of cell culture; cell separation. Cryopreservation of gametes and embryos. Embryonic stem cell culture. Tissue engineering.

### References

1. Smith RH (2013). **Plant tissue culture: Techniques and Experiments** 2<sup>nd</sup> Edition, Academic Press.
2. Bhowjwani S S and Razdan MK (2004). **Plant Tissue Culture: Theory and Practice**. Studies in Plant Science, 5. Elsevier, New York.
3. Chawla HS (2002). **Introduction to Plant Biotechnology**. 2<sup>nd</sup> Edition, Science Publishers.
4. Glick BR and Thompson JE (1993). **Methods in Plant Molecular Biology and Biotechnology**. CRC Press, Taylor and Francis
5. Ranga MM (2007). **Animal Biotechnology**. 3<sup>rd</sup> Edition. Agrobios (India), Jodhpur.
6. Mather JP and David Barnes (1998). **Methods in Cell biology: Animal Cell Culture Methods**. volume 57. Academic Press.
7. Sathyanarayana U (2005). **Biotechnology**. 1<sup>st</sup> Edition, Books and Allied (P) Ltd., Kolkata.
8. Dubey RC (2006). **A Text Book of Biotechnology**. 4<sup>th</sup> Edition. S.Chand & Company (P) Ltd., New Delhi.

## EDC FOR OTHER DEPARTMENTS

**SEMESTER –IV**  
**18P4AMBED01**  
**Credit - 4**

**EDC**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

### MEDICAL LABORATORY TECHNOLOGY

#### UNIT I

**(12 hours)**

The Laboratory- Introduction - Basic laboratory principles and procedures – Types- standardized clinical laboratory set up - Lab accidents, Laboratory safety – Universal work precautions (UWP) - Preparation and cleaning of glasswares. Sterilization- Principles and Methods. Quality control in sterilization. Testing of Disinfectants.

#### UNIT II

**(12 hours)**

Culture media – preparation and types – Inoculation methods - anaerobic cultivation methods. Preservation of cultures - Stains and staining techniques- Identification of Bacteria – Biochemical tests - Antibiotic sensitivity test.

#### UNIT III

**(12 hours)**

Immunohaematology - Introduction – Blood - Composition - Component preparation – Anticoagulants - Complete Blood count (CBC) – ABO and Rh blood group systems - Blood grouping and Rh typing – Compatibility testing, Transfusion reactions, Haemolytic Disease of the Newborn.

#### UNIT IV

**(12 hours)**

Collection and examination of clinical specimens - Urine, Blood, Faeces and CSF. Concentration techniques in stool. Examination of blood smears for malaria. Laboratory methods of diagnosing fungal Infection – Microscopy - KOH and LCB mount - Cultivation methods and staining.

#### UNIT V

**(12 hours)**

Antigen - Antibody reaction – General principles and their application - Diagnosis of infectious diseases, Precipitation, Agglutination, Immunofluorescence, Immunoelectrophoresis, RIA, ELISA, HAT, Immune blot technique - Western blot.

### **Text Books**

1. Mukerjee KL and Ghosh S (2010). **Medical Laboratory Technology: Procedure Manual for Routine Diagnostic Tests**. Volume 1. 2<sup>nd</sup> Edition. Tata McGraw Hill Education Pvt Ltd., New Delhi.
2. Chakraborty P (2015). **A Text Book of Microbiology**. 2<sup>nd</sup> Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
3. Sood R (2006). **Textbook of Medical Laboratory Technology**, Jaypee Brothers Publishers, New Delhi.
4. Dubey RC and Maheswari DK (2013). **A Text Book of Microbiology**. 3<sup>rd</sup> Edition. S.Chand Publishing, New Delhi.

### **Reference Books**

1. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**. 9<sup>th</sup> Edition, Orient Blackswan Private Limited.
2. Godkar PB and Godkar DP (2008). **Text Book of Medical Laboratory Technology**. 2<sup>nd</sup> Edition, Bhalani Publishing House, New Delhi.
3. Cheesbrough M (2006). **District Laboratory Practice in Tropical Countries**, Part 1 & 2. 2<sup>nd</sup> Edition, Cambridge University Press, Cambridge.
4. Bhatia Rand Ichhpujani RL (2004). **Essentials of Medical Microbiology**. 3<sup>rd</sup> Edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.

**SEMESTER –III**  
**14P3HR01**  
**Credit - 1**

**HUMAN RIGHTS**  
**Total Number of Hours: 25**  
**1 Hour/ Week**

## **HUMAN RIGHTS**

### **UNIT I**

**Introduction to Human Rights:** Human Rights, Introduction, Definition, Historical Background, The UN and its Charter, International Bill of Human Rights, Perspectives on Human Rights and Human Duties, Individual and Human Rights, State Responsibility in International Law, Indian Perspectives on Human Rights, UN Perceptions, Emerging Dimensions in Human Rights, Future Trends for the Third Millennium.

### **UNIT II**

**Principles and Theories of Human Rights:** Evolution of the Concepts, Theories and Principles, Internationalisation of Human Rights, Theoretical Foundations of Human Rights, Modern Theories of International Human Rights.

### **UNIT III**

**Child and Human Rights:** The Rights of Children; Child Survival; Soft and Hard Rights; Nutrition Rights; Protecting the Right to Life; Human Rights and Female Foeticide, The Foetus Rights as Human Rights; Abortion through the Ages; Sex Determination and Ultrasonography; Foeticide, Infanticide and Child Murder; Crime Against Children; Abuses of Children Rights, Sexual Exploitation and Child Labour; Human Rights Violations of Street Children; Parenting and Child Health; Child Prostitution; Child Rape; Bonded Labour; Child Labour; Forced Labour; Illegitimate Child; Delinquent Child.

### **UNIT IV**

**Women and Human Rights:** The Status of Women in India; Offences, Violence and Crime Against Women; Women Prisoners; Sexual Harassment at Work Places; Rape Victims; Dowry Deaths; Strategies to Safeguard the Rights and Dignity of Women; Human Rights of Women - International Standards and the Indian Law; The Beijing Declaration and Action Plan.

### **UNIT V**

**Organizations Related to Human Rights:** Human Rights Organisations - Structure and Functions, Role of UN and Its Specialized Agencies for the Protection of Human Rights, General Assembly, Security Council, ECOSOC, and UN Commission on Human Rights, The United Nations and National Human Rights Institutions, Regional Commissions on Human Rights.

**SEMESTER –IV**  
**14P4AMB12**  
**Credit 5**

**CORE-XV**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **BIOINFORMATICS AND BIOSTATISTICS**

### **Objectives:**

- To gain knowledge about research methodology.
- To understand biostatistics.
- To gain knowledge about computer applications in biology.
- To gain knowledge about sequence analysis.
- To understand predicting protein structure and function.

The contents of this paper provides understanding on preparation of thesis, biostatistics, computer applications in biology, sequence analysis, phylogenetic alignment and determination of protein structure.

### **UNIT I**

**(12 hours)**

Research Methodology – Introduction and Strategies - Research process, Research design and experimentation – Observational studies – Cross-sectional, Case control and Cohort studies -Ethical Issues in Research - International guidelines - Ethical principles, Preparation of Research report, thesis and review articles.

### **UNIT II**

**(12 hours)**

Biostatistics - Principles and importance - Collection of data – Sampling methods -Data entry and data analysis using computer software. Hypothesis testing – small and large sample tests – t,  $\chi^2$ , Z and F test – Anova – one way and two way analysis with simple problems.

### **UNIT III**

**(12 hours)**

Biology in the Computer age - Computational approaches to Biological questions. Basics of computers - Servers, Workstations, Operating systems, Unix, Linux. World Wide Web. Search engines, finding scientific articles - Pub med - Public Biological Databases.

### **UNIT IV**

**(12 hours)**

Sequence analysis – Sequencing genomes – sequence assembly – pairwise sequence comparison - genome on the web – annotating and analysing genome sequences. Genbank – sequence queries against biological databases – BLAST and FASTA– multifunctional tools for sequence analysis. Multiple sequence alignments, Phylogenetic alignment – profiles and motifs

### **UNIT V**

**(12 hours)**

Protein Data Bank, Swiss-prot - biochemical pathway databases -Predicting Protein structure and function from sequence – Determination of structure – feature detection – secondary structure prediction – predicting 3 D structure - protein modeling.

### **Text Books**

1. Arora PN and Malhon PK (1996). **Biostatistics**. Himalaya Publishing House, Mumbai.
2. Mahajan BK (2011). **Biostatistics**, 7<sup>th</sup> Edition. Jaypee Brothers, New Delhi.
3. Harish S (2007). **Fundamentals of Bioinformatics**. IK International Publishing House, New Delhi.
4. Cynthia Gibas and Per Jambeck (2001). **Developing Bioinformatics Computer Skills**. Published by O'Reilly Media.

### **Reference Books**

1. Higgins D and Willie Taylor W (2002). **Bioinformatics: Sequence, structure and databanks**. Oxford University Press
2. Baxevanis AD and Ouellette BEF (2001) **Bioinformatics: A practical guide to the analysis of genes and proteins**, Wiley Inter science – New York
3. Rashidi HH and Buehler LK (2002). **Bioinformatics Basics: Applications in Biological Science and Medicine**, CRC Press, London
4. Ewens WJ and Grant G (2005). **Statistical Methods in Bioinformatics: An Introduction** (Statistics for Biology & Health), Springer



**SEMESTER –IV**  
**14P4AMBE02**  
**Credit - 4**

**ELECTIVE- II**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **ENTREPRENEURSHIP IN MICROBIOLOGY**

### **Objective:**

- To gain knowledge about entrepreneur and entrepreneurship.
- To know about entrepreneurship development programme.
- To gain knowledge about skills for entrepreneurs and finance management.
- To gain knowledge about project and e commerce.
- To understand the production of microbiological products.

The contents of this paper provides understanding on entrepreneurship in economic development, funding agencies for entrepreneurs, entrepreneur skills, marketing strategy, finance management, project formulation, e commerce and production of microbial products.

### **UNIT I (12 hours)**

Entrepreneur- Evolution and Concept, Definition, Characteristics, Function, Types, Entrepreneurship: Definitions - concept, growth in India, Factors affecting Entrepreneurial growth, Entrepreneurial motivation, Entrepreneurial competencies– Role of Entrepreneurship in Economic Development- Women entrepreneurs.

### **UNIT II (12 hours)**

Entrepreneurship Development programmes- Need, Objectives, Phases of EDP, Evaluation. Institutional Finance and Support to Bio entrepreneurs - Government initiatives- DST, CSIR, ICMR, BCIL, DBT-BIRAC, BIG scheme, BISS, SIBRI, BIPP, NSTEDB, CRS, TePP, ISBA, ABLE. Nationalized banks – other financial institutions.

### **UNIT III (12 hours)**

Skills for entrepreneurs – Communication skills, problem solving skills; Opportunity recognition, product planning and development process. Market and Marketing strategy – Market research, Marketing methods, Negotiation skills, SWOT analysis, Finance management- Basics- Marketing – Pricing and distribution, promotion and market goal setting.

### **UNIT IV (12 hours)**

Project – Meaning, idea generation - Sources of new ideas – Methods of Generating creative ideas - Project identification and Selection - Project report- significance, contents of project report, – Project formulation – Network analysis - project appraisal- concept and methods, e-commerce.

## UNIT V

(12 hours)

Production of microbiological products. Food-SCP (Algae - Spirulina, Yeast, Mushroom). Biofertilizer – (Cyanobacteria, *Rhizobium*, *Azospirillum*, *Azotobacter*, *Frankia*, VAM). Bioinsecticide (*Bacillus thuriangiensis*). Fuel – ethanol. Pharmaceuticals – antigens, interferons, vaccines, insulin, hormones, gene therapy methods. Hybridomas and monoclonal antibodies.

### Text Books

1. Khanka SS (2006). **Entrepreneurial Development**. S Chand Publishing, New Delhi.
2. Naidu NVR and Krishnarao T (2008). **Management and Entrepreneurship**. I.K. International Pvt. Ltd, New Delhi.
3. Venkataraman GS (1972). **Algal Biofertilizers and Rice Cultivation**. Today and Tomorrow's Printers and Publishers, New Delhi.
4. Gordon E and Natarajan K. **Entrepreneurship Development**. 5<sup>th</sup> Edition. Himalaya Publishing House, New Delhi.

### Reference Books

1. Hisrich RD, Peters MP and Shepherd DA (2005). **Entrepreneurship**. 6<sup>th</sup> Edition, Mc Graw Hill Irwin.
2. Bhatnagar B and Budhiraja A (2011). **Entrepreneurship Development and Small Business Management**. Vayu Education of India, New Delhi.
3. Gupta CB and Srinivasan NP (2014). **Entrepreneurial Development in India**. Sultan Chand & Sons, New Delhi.
4. Tilak, KVBR (1990). **Bacterial Biofertilizers**. IARI Publications, New Delhi.

**SEMESTER - IV**  
**14P4AMBE03**  
**Credit - 4**

**ELECTIVE- III**  
**Total Number of Hours: 60**  
**6 Hours/ Week**

## **BIOMEDICAL ENGINEERING**

### **Objective:**

- To gain knowledge about basics of biomedical engineering.
- To know about electronic instrumentation.
- To gain knowledge about diagnostic and therapeutic equipments.
- To gain knowledge about implant materials.
- To know about tissue replacement and artificial organs.

The contents of this paper provides understanding on structure and function of human cell and cellular components, principle and applications of biomedical instruments, implant materials, tissue replacement and artificial organs.

### **UNIT I**

**(12 hours)**

**Basics of Biomedical Engineering** - Structure and function of human Cell & Cellular components, Blood Cell – Composition – Fluid and electrolytic balance - Blood Groups and compatibility – Estimation of RBC, WBC and platelets – Biomaterials - Definition and Classification of bio-materials, Mechanical properties, Visco-elasticity, wound healing process, body response to implants.

### **UNIT II**

**(12 hours)**

**Electronic instrumentation** - Principles and applications - Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electro Oculogram (EOG), ElectroRetinogram (ERG), Recording Electrodes- Silver-Silver Chloride, Electrodes for ECG, X-ray, CT Scan and MRI.

### **UNIT-III**

**(12 hours)**

**Diagnostic and Therapeutic Equipments** - Blood pressure monitor, Digital stethoscope, Thermometer, pulse oximeter, optical fiber optics for circulatory and respiratory system measurement. Pacemaker, External cardiovector defibrillator, Implantable cardiovector defibrillator, Deep brain stimulation, Functional electrical stimulator (FES), Hemodialysis delivery system, Mechanical ventilator.

### **UNIT- IV**

**(12 hours)**

**Implant Materials** - Metallic implant materials, stainless steels, Co-based alloys, Ti-based alloys and ceramic based implant materials, aluminum oxides, hydroxyapatite, glass, and carbon implants. Polymeric Implant Materials - polyamides, Acrylic polymers, rubbers and high strength Thermoplastics – Biopolymers - Collagen and Elastin-Materials for ophthalmology - contact lens and Intraocular lens.

### **UNIT-V**

**(12 hours)**

**Tissue Replacement & Artificial Organs** - Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft tissue replacements - sutures, surgical tapes, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, Hard tissue replacement - joint replacements, Pancreas replacement. Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants.

### **Text Books**

1. Bhatt SV (2005). **Biomaterials**. 2nd Edition, Alpha Science International, New York.
2. Baura G (2011). **Medical Device Technologies: A Systems Based Overview Using Engineering Standards**. Academic Press, New York.
3. Culjat M, Singh R and Lee H (2012). **Medical Devices: Surgical and Image-Guided Technologies**. Wiley-Blackwell, New York.

#### **Reference Books**

1. Myer Kutz (2003). **Standard Handbook of Biomedical Engineering & Design**. Mc Graw Hill, New York.
2. Enderle J, Bronzino JD, Blanchard SM (2005). **Introduction to Biomedical Engineering**. Elsevier, New York.
3. Anand SC, Kennedy JF, Miraftab M and Rajendran S (2005). **Medical Textiles and Biomaterials for Healthcare**. Woodhead Publishing Limited, New York.
4. Ratner BD, Hoffmann AS, Schoen FJ, Lemmons JE (1996). **An Introduction to Materials in Medicine**. Academic Press, London.

## ELECTIVE SUBJECTS

### ADVANCES IN LIFE SCIENCES

#### Objectives:

- To gain knowledge about molecules relevant to biology.
- To know about fundamental biological processes.
- To gain knowledge about developmental biology.
- To gain knowledge about plant system physiology.
- To know about animal system physiology.

The contents of this paper provides understanding on molecules relevant to biology, central dogma of life, cell communication, cancer biology, immune response, developmental biology and system physiology of plants and animals.

#### UNIT I

**Molecules relevant to Biology:** Structure of atoms, molecules and chemical bonds. Composition, structure & function of biomolecules. Stabilizing interactions. Conformation of proteins - Ramachandran plot, Stability of protein and nucleic acid structures. Cellular Organization: Organization of genes and chromosomes: Operon, interrupted genes, gene families, transposons. Cell division & cell cycle and regulation, control of cell cycle. Microbial Physiology: strategies of cell division, stress response.

#### UNIT II

**Fundamental Biological processes:** DNA replication, RNA synthesis and processing, Protein synthesis and processing - genetic code, protein folding. Control of gene expression, Cell Communication & Cell Signaling: cell receptors, signal transduction pathways, bacterial and plant two-component signaling systems, chemotaxis and quorum sensing. Cellular communication: general principles of cell communication - neurotransmission and its regulation. Cancer: oncogenes, cancer and the cell cycle, virus-induced cancer, interaction of cancer cells with normal cells. Immune response during infections, autoimmunity, immunodeficiency, vaccines.

#### UNIT III

**Developmental Biology:** Basic concepts of development: cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants & transgenics in analysis of development. Gametogenesis - fertilization - double fertilization in plants; zygote formation, seed formation & germination. Morphogenesis & organogenesis in animals. Morphogenesis and organogenesis in plants, Programmed cell death, aging and senescence.

#### UNIT IV

**System physiology-Plant:** Photosynthesis, Respiration & photorespiration - ATP synthesis-alternate oxidase -photorespiration. xylem & phloem; transpiration; mechanisms of loading & unloading of photoassimilates. Secondary metabolites: Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. mechanisms of resistance to biotic stress and tolerance to abiotic stress.

#### UNIT V

**System Physiology– Animal:** Blood and circulation and components. Cardiovascular System - Respiratory system neural and chemical regulation of respiration. Nervous system - central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing. Thermoregulation: Comfort zone, body temperature - physical, chemical, neural regulation, acclimatization. Stress and adaptation. Endocrinology and reproduction.

### **Text Books**

1. GuptaJB, “A Course in Electrical and Electronic measurements and Instrumentation. SK Kataria and Sons, New Delhi.
2. Cromwell L, Weibell FJ and Pfeiffer EA (2003). Biomedical Instrumentation and Measurements. 2nd Edition, PHI, New Delhi.
3. Ghai CL (2003). A Textbook of Practical Physiology.5th Edition. Jaypee Medical Publishers, New Delhi.

### **Reference Books**

1. Guyton AC (1996). Textbook of Medical Physiology – Prism Book (p) Ltd.
2. Bergel DH (1972). Cardiovascular Fluid Dynamics. Vol. I, Academic press, London.
3. Park JB (1984). Biomaterials - Science and Engineering, Plenum Press.
4. Webster JG (1998). Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York.
5. Khandpur RS (2004). Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional.