



**THIRUVALLUVAR UNIVERSITY**  
**MASTER OF SCIENCE**  
**DEGREE COURSE**

**M. Sc. BIOTECHNOLOGY**

**Under CBCS Regulations & syllabus**  
**(For University Department) (With effect from 2020-2021)**

**Regulations, Syllabus and Scheme of Examination for**

**M. Sc., BIOTECHNOLOGY**

**(With effect from 2020-2021)**



**DEPARTMENT OF BIOTECHNOLOGY**

**THIRUVALLUVAR UNIVERSITY (State University) Vellore – 632 115**

**THIRUVALLUVAR UNIVERSITY**  
**SERKKADU, VELLORE- 632 115**  
**MASTER OF SCIENCE IN BIOTECHNOLOGY**  
**UNDER CBCS (effective from 2020-2021 onwards)**  
**The course of study and scheme of examination**

**1. Name of the course: M.Sc., Biotechnology**

**2. Medium of instructions: English**

**3. Choice Based Credit System(CBCS)**

Choice based credit system is a flexible system of learning.  
'Credit' defines the quantum of contents / syllabi prescribed for a course and determine the number of hours of instruction required.

The CBCS has unique features such as enhanced learning opportunities, ability to match students scholastic need and aspirations, inter institution transferability of students, part completion of an academic program in the institution of enrollment and part completion in specialized and recognized institution, improvement in educational quality and excellence, flexibility for working students to complete programme over an extended time and standardization and comparability of educational programmes across the country.

**4. Eligibility criteria**

A candidate with bachelor degree in any life science in the discipline of Biology/ Biochemistry/Botany/ Biotechnology /Bio-Informatics/Chemistry with Biology ancillary/ environment biotechnology/genetics/ Microbiology/ Zoology/ Agriculture/ B.E./ Genetic Engineering /B.Tech.(Bio-tech)/B.V.Sc./M.B.B.S/B.D.S or examination of some other university accepted by the syndicate or equivalent thereto shall be permitted for admission into the course.

**5. Course details**

Duration of course : **04 semesters (2 semesters/year)**

Total number of papers : **20**

Total number of lab. Courses : **6**

Project : **4<sup>th</sup> semester only**

Total marks for M.Sc. Degree

Theory papers : **2000 marks**

Lab courses : **600 marks**

Project : **100 marks**

**MOOC** : **100 Marks**

**USRR** : **100 Marks**

Total : **2900 marks / 94 credits**

## 6. Preamble of the syllabus

Master of Science (M.Sc.) in Biotechnology, the curricula and course content were designed to meet the standards of UGC-CSIR (NET) and (SLET) examinations. The choice based credit system of learning develop a strong base in the core subject and specialize in the disciplines of his / her liking and abilities and develop in-depth understanding of various aspects of Biotechnology. The students develop experimental skills, to design and implementation of novel synthetic methods, and to develop the aptitude for academic and professional skills, by acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological process and rationale towards computer. The project introduced in the curriculum will motivate the students to pursue research and towards entrepreneurial skill development.

### Instruction to the Students

The students admitted to M.Sc. Biotechnology course are to adhere to the following rules:

1. A minimum of 75% attendance for lecture / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers/ seminar/ industrial visits/ training course as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be given to those student who are absent for the tests.
3. FEE STRUCTURE  
As per the Thiruvalluvar University norms

## 8. PATTERN OF EXAMINATION

Evaluation of students

1. The odd-semester and even –semester examinations will be of 100 marks each.
2. A Student should obtain 50% marks in all the examinations (both theory and Laboratory Course).

## 9. SCHEME OF EXAMINATION

The semester examination will be conducted at the end of each semester (both theory and lab course examination), for odd semesters in the month of November / December; for even semester in April/May. All theory examinations are conducted for three hours irrespective of total marks. However, duration of laboratory course examinations is for 4 hours only.

**Theory paper** will be of 75 marks each for university examination and 25 marks for internal evaluation.

### Question paper settings

Question papers will be set in the view of the entire syllabus by giving equal weight for each unit of syllabus.

### Pattern of question paper (theory):

*(Part A & B –two questions from each unit & part C- one from each unit)*

	<b>Part A</b>	
10 questions x 02 Marks– No Choice (Answer in about 50 words)		(10x2=20 Marks)
	<b>Part B</b>	
5 questions (either or type) x 05marks (Answer in about 200 words)		(5x5=25 Marks)

## Part C

3 out of 05 questions x 10 marks  
(Answer in about 500 words)

(3 x 10 = 30 Marks)

**Total = 75 marks**

### INTERNAL ASSESSMENT

S.No.	For Theory - PG courses	Distribution of Marks	
		Assignments	Tests
1	Assignment-1 (First 2 Units of the Syllabus)	10	-
2	Test-1 (First 2 Units of the Syllabus for 1 Hour duration)	-	50
3	Assignment-2 (3 <sup>rd</sup> & 4 <sup>th</sup> Units of the Syllabus)	10	
4	Test-2 (First 4 Units of the Syllabus for 2 Hours duration)	-	50
5	Seminar ( Entire Syllabus)	10	-
6	Test-3 (Entire Syllabus for 3 Hours duration)	-	100
	<b>TOTAL MARKS</b>	30	200
	<b>Marks to be converted to</b>	5	20
	<b>Total Maximum Marks for CIA</b>	25	

**Lab. Course examination (practical) will be of 75 marks each for university examinations and 25 marks for internal assessment.**

Distribution of marks for lab. Course (practical) examination

#### **University examinations experiment: 75 Marks**

Experiment & Result : 55 marks  
Lab. Course viva-voce : 10 marks  
Record : 10 marks  
**Total : 75 marks**

#### **Lab. Course internal assessment: 25 Marks**

Performance : 15 marks  
Record : 10 marks  
**Total : 25 marks**

#### **Passing minimum in lab. Course (practical) examinations: 50% marks**

Project dissertation : 100 marks  
Dissertation : 75 marks  
Viva-voce : 25 marks  
**Total : 100 marks**

## **Distribution of marks for dissertation / project**

Project will be evaluated by the concerned by the project guide along with departmental project committee. Assessment will be done by the committee every month. Evaluation will be on the basis of monthly progress of project work, progress report, referencing, oral results and documentations.

<b>Project</b>	<b>: 100 marks</b>
Dissertation format	: 25marks
Scope of the research problem:	10marks
Methodology	: 10marks
Analysis	: 15 marks
Results and findings	: 15marks
<b>Total</b>	<b>: 75marks</b>

### **Viva-voce examinations : 25 marks**

Presentation	: 10 marks
Subject knowledge	: 10 marks
Interaction	: 05 marks
<b>Total</b>	<b>: 25 marks</b>

## **Question paper settings**

Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

### **Standard of passing**

A candidate should get not less than 50 % in the university examinations, compulsorily, in all papers, including lab, course. Also, the candidate who secures not less than 50% marks in the university examinations (UE) and internal assessment (IA) examinations put together in any theory paper/ practical shall be declared to have successfully passed the examinations.

Internal marks will not change. Students cannot repeat internal assessment. If a student misses internal assessment examinations, he / she will have score passing minimum in the external examinations only.

### **Illustration**

Theory –internal assessment	: 12 marks
University examinations	: 38 marks

**OR**

Internal Assessment	: 0 marks
University examinations	: 50 marks

There shall be revaluation of answer script of end semester examinations, but not of internal assessment papers.

Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

### **Open Elective Courses (Non-major/ Multidisciplinary)**

“Open Elective Courses not related to the core courses of the programme concerned, offered in the programme”.

### **USRR (UNIVERSITY SOCIAL RESPONSIBILITY REPORT)**

The aim of the University Social Responsibility Report is to help the students to connect with the society in the respective discipline. Following are the important features of the USRR

**1. Aim:** The USRR must aim at relating the subject of study with the society in so far as the application and the usefulness of the study are concerned

**2. Topic selection:** The topic for the USRR must be chosen by the student in the second semester in the month of February; the process for the same shall begin on 1st February and shall end on the last working day of the month of February. Students are free to select the topic for the USRR in consultation with the Experts and Faculty Members of their choice, both from within and outside the University

**3. Period and duration:** The USRR shall be undertaken for a duration of 15 days in the summer vacation that falls immediately at the end of the second semester of the program and the same should be accounted for the Third Semester of the program

**4. USRR:** The USSR (University Social Responsibility Report) must be prepared by every student of the program written in 50 to 75 pages. The report shall be written based on the standard research methodology.

#### **5. Review and evaluation schedule:**

*a. Reviewing the Field work:* First week of July

*b. Report Review:* Second week of August

*c. Report submission:* First week of September

*d. Report Evaluation:* Third week of September

**6. Faculty Composition:** The following members may be nominated for confirming the topic and for evaluating the USRR:

a. Professor and Head of the concerned Department

b. One Faculty member with related field of specialization from the concerned Department

c. One senior faculty member from the Department of Sociology from other Institution

**THIRUVALLUVAR UNIVERSITY**

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Name of the course: **M.Sc., Biotechnology**

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‘Credit’ defines the quantum of contents / syllabi prescribed for a course and determine the number of hours of instruction required.

Choice based credit system (CBCS) has unique features such as enhanced learning opportunities, ability to match students scholastic need and aspirations, inter institution transferability of students, part completion of an academic program in the institution of enrollment and part completion in specialized and recognized institution, improvement in educational quality and excellence, flexibility for working students to complete programme over an extended time and standardization and comparability of educational programmes across the country

**Eligibility criteria**

A candidate with bachelor degree in any life science in the discipline of Biology/ Biochemistry/Botany/ Biotechnology /Bio-Informatics/Chemistry with Biology ancillary/ environment biotechnology/genetics/ microbiology/ zoology/ agriculture/ B.E./ genetic engineering /B.Tech.(Bio-tech)/ B.V.Sc. /M.B.B.S/B.D.S or examination of some other university accepted by the syndicate or equivalent thereto shall be permitted for admission into the course.

**Duration of the Course:**

The duration of the course shall consist of 4 semesters in two academic years.

**Examination Pattern:**

**Time allotted: Theory – 03Hrs. & Practical – 04 hrs**

**Marks allotted for university examination:**

	<b>External marks</b>	<b>Internals marks</b>	<b>Total marks</b>
<b>Theory</b>	75	25	100
<b>Practical</b>	75	25	100

**Marks distribution for internals:**

	<b>Test</b>	<b>seminars</b>	<b>Assignment</b>	<b>Total marks</b>
<b>Theory</b>	15	05	05	25

	<b>Test</b>	<b>Record</b>	<b>Total marks</b>
<b>Practical</b>	10	15	25

**Pattern of question paper (theory):**

*(Part A & B –two questions from each unit & part C- one from each unit)*

**Part A**

10 questions x 02 Marks–No Choice

(10x2=20 Marks)

*(Answer in about 50 words)*

**Part B**

5questions (either or type) x05 marks

8

(5x5=25 Marks)



*(Answer in about 200 words)*

**Part C**

3 out of 05 questions x 10 marks  
*(Answer in about 500 words)*

(3 x 10 = 30 Marks)

**Total = 75 marks**

**THIRUVALLUVAR UNIVERSITY**

(With effect from 2020 – 2021)

**The course of study and the scheme of Examination – Department of Biotechnology**

	<i>Study Components</i>		<i>ins. hrs / week</i>	<i>Cre dit</i>	<i>Title of the Paper</i>	<i>Maximum Marks</i>		
	<i>Course Title</i>					<i>CIA</i>	<i>Uni. Exam</i>	<i>Total</i>
<b>SEMESTER I</b>								
Core	Paper -1		5	4	Biochemistry	25	75	100
Core	Paper -2		5	4	Cell and Molecular Biology	25	75	100
Core	Paper -3		4	4	Microbiology	25	75	100
Internal Elective for same major students (Choose any one)								
Core Elective	Elective – I		4	3	A. Medical Laboratory Technology B. Virology C. Basic Analytical Methods	25	75	100
Practical -I			5	3	Lab in Biochemistry & Cell And Molecular Biology	25	75	100
Practical -II			5	3	Lab in Microbiology	25	75	100
Value Added course	VAC-1		2	2	A. Mushroom Cultivation and Apiculture B. Vermiculture Technology C. Validation of Medicinal Plants	25	75	100
			<b>30</b>	<b>23</b>				
<b>SEMESTER II</b>								
Core	Paper - 4		4	4	Immunology	25	75	100
Core	Paper - 5		4	4	Genetic Engineering	25	75	100
Core	Paper - 6		4	4	Developmental and Stem cell Biology	25	75	100
Core	Paper - 7		4	4	Bioinformatics	25	75	100
Internal Elective for same major students (Choose any one)								
Core Elective	Elective -II		2	2	A. Enzyme Technology B. Dairy Technology C. Pharmaceutical Technology	25	75	100
Practical -III			4	3	Lab in Immunology	25	75	100
Practical -IV			4	3	Lab in Genetic Engineering	25	75	100
External Elective for other major students (Inter/multi-disciplinary papers) (Choose any one)								
Open Elective	Open Elective -I		2	2	A. Medical Laboratory Technology B. Food and Nutrition C. Biodiversity	25	75	100
Compulsory Paper	Paper -8		2	2	Human Rights	25	75	100
			<b>30</b>	<b>27</b>				

Study Components		ins. hrs / week	Credit	Title of the Paper	Maximum Marks		
Course Title					CIA	Uni. Exam	Total
<b>SEMESTER III</b>							
Core	Paper -9	4	4	Plant Biotechnology	25	75	100
Core	Paper - 10	4	4	Animal Biotechnology	25	75	100
Core	Paper - 11	4	4	Microbial Biotechnology	25	75	100
Core	Paper -12	5	4	Environmental Biotechnology	25	75	100
Internal Elective for same major students (Choose any one)							
Core Elective	Elective -III	3	3	A. Genomics and Proteomics B. Food and Nutrition C. Herbal Biotechnology	25	75	100
External Elective for other major students (Inter/multi-disciplinary papers) (Choose any one)							
Open Elective	Open Elective - II	2	2	A. Environmental Sciences B. Medical Microbiology C. Agricultural Biotechnology	25	75	100
Practical -V		4	3	Lab in Plant Biotechnology and Animal Biotechnology	25	75	100
Practical - VI		4	3	Lab in Microbial Biotechnology and Environmental Biotechnology	25	75	100
<b>MOOC Courses</b>			2				100
<b>USRR</b>			2				100
		<b>30</b>	<b>31</b>				
<b>SEMESTER IV</b>					<b>CIA</b>	<b>Uni. Exam</b>	<b>Total</b>
Core	Paper -13	5	4	Research Methodology	25	75	100
Core Elective	Elective -IV	4	3	A. Nano Biotechnology B. Genetics C. System Biology	25	75	100
<b>Core</b>	<b>Project Compulsory</b>	<b>21</b>	<b>5</b>	Project with <i>viva voce</i>	100 (75 Project +25 viva)		100
		<b>30</b>	<b>12</b>				
		<b>120</b>	<b>94</b>		<b>725</b>	<b>2175</b>	<b>2900</b>

## SEMESTER I

### PAPER 1: BIOCHEMISTRY

**Objectives:** To enable the students to understand the basic concepts in biochemistry and biomolecules and also to learn the various metabolic cycles and also to analyze the significance of biochemical findings

#### UNIT I

**Basic Concepts:** Units of measurements of solutes in solution, e.g. Normality, Molality, molarity, hyper and hypotonic solution pH, pK, acids, bases, ionic bonds, covalent bonds and secondary bonds (hydrogen bonds and Vander Waal's bonds).

#### UNIT II

**Biomolecules :** Definitions, nomenclature, classification, structure, chemistry and properties of carbohydrates, amino acids, proteins (hemoglobin, myoglobin and plasma proteins), lipids and Nucleic acids.

#### UNIT III

**Metabolism:** Metabolism of Carbohydrates –EMP, TCA, HMP. Amino Acids, Lipids and Nucleic Acids-Their Biosynthesis; Mechanism Of Oxidative Phosphorylation and Its Inhibitors, Photophosphorylation.

#### UNIT IV

**Enzymology:** Enzymes: general aspects (classifications and structure), allosteric mechanism, regulatory and active sites, activation energy, iso-enzymes, enzyme kinetics (MM, LB plot, Km) and hormones.

#### UNIT V

**Clinical biochemistry:** Blood sugar level-factors controlling blood sugar level – hypo, hyperglycemia, diabetes mellitus, types – GTT, Metabolism of bilirubin- jaundice-types differential diagnosis and liver function tests. Renal functional test and gastric function test.

#### Reference

1. Biochemistry, 7<sup>th</sup> Edition, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer 2012. W.H. Freeman & company, New York
2. Molecular Bio methods handbook, 2<sup>nd</sup> edition R. Rapley & J.M Walker, 2008, Humana press.
3. Principles of Biochemistry, 5<sup>th</sup> Edition AL. Lehninger, D.L. Nelson and M.M Cox., 2008. Worth publishers, New York.
4. Biochemistry 4<sup>th</sup> Edition, G. Zubay, 1998. Mc Millan publishing Co. New York.
5. Harper's Biochemistry, 29<sup>th</sup> Edition - Robert K. Murray, Daryl K. Grammer, 2012 McGraw Hill, Lange Medical Books
6. Understanding enzymes - 5<sup>th</sup> edition Trevor Palmer, Prentice Hall/Ellias Horwood 1995
7. Text Book Medical Biochemistry M.N. Chatterjee 8<sup>th</sup> edition Jaypee brothers Medical publishers 2013

8. Biochemistry – 4<sup>th</sup> edition Donald Voet and Judith G. Voet ,VP Publishers 2011 steitz and A.M.Weiner ,The Benjamin /CUMMINGS publ.Co.,Inc.,California,2013
9. Genes VI(9<sup>th</sup> Ed).Benjamin Lewin, oxford universitypress,uk.,2007
10. Molecular biology of cell (5<sup>th</sup> edition)  
brucealberts,alexanderjohnson,Julianlewis,martinraff,keithRoberts,peterwalter ,garland sciencepublications.2008
11. Molecular Biology (5<sup>th</sup> edition).weaver .R.F,McGraw Hillpublications,2011.  
Cell and molecular biology : concepts and experiments (5<sup>th</sup> edition ).geraldkarp,wiley publications,2013

## PAPER 2: CELL AND MOLECULAR BIOLOGY

**Objectives:** Understanding the structural and functional aspects of the cell provides the students with a strong foundations in molecular mechanism underlying cellular functions.

### UNIT I

**Cell Biology:** Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane - Membrane Model, active and passive, transport channels and pumps., Structure & Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes.

### UNIT II

**Cell division:** Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure, Genome Organization. **DNA replication** : Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models DNA damage, Mutations, DNA repair and recombination.

### UNIT III

**Transcription:** Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post-transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability.

**Translation-** Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post-translational modifications of proteins and localization.

### UNIT IV

**Gene regulation: Prokaryotic gene regulation-** Operon concept ; Lac operon and tryptophan operon. **Eukaryotic gene regulation:** Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins.

Biochemistry and applications of ribozyme technologies. Transposable genetic elements. CRISPR CAS gene editing.

### UNIT V

**Epigenetics :** Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics.

**Cancer Biology:** Viral and cellular oncogenes; Tumor suppressor genes - Structure, function and mechanism of action of pRB and p53, p21, BRACA1. Oncogenes as transcriptional activators.

## References:

1. Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994.
2. Molecular and cellular Biology, Stephen L. Wolfe, Wadsworth Publishing Company, 1993.
3. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1998.
5. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991.
6. Molecular Biology of the Gene (4th Edition), J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner, The Benjamin/Cummings Publ. Co., Inc., California, 1987.
7. Genes VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K., 1998
8. Molecular biology of cell – Albert Bruce et al., 1994 3rd Ed
9. Molecular Biology-Weaver. R. F. 3rd ed. Mc Graw Hill publication, 2005
10. Cell and Molecular Biology: Concepts and Experiments 5th Ed, Gerald Karp. Wiley publications, 2013.
11. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002

## **PAPER 3: MICROBIOLOGY**

**Objective:** To develop skill of students in microbiology and understanding the current concepts in microbiology. At the end of this course, the students would have learnt about principles of microbiology, including bacteria ,fungi , algae and virus and their role in different environment and its applications. To develop highly qualified professional manpower with the basic requirement lies on the microbiology quality based coaching , R&D and training in industry oriented techniques (quality controller in pharmaceuticals & Food and Dairy products etc).

### **UNIT- I**

History of Microbiology - Classification of microorganism – Kingdom - Protista, Prokaryotic and eukaryotic microorganisms, Five kingdom concept of classification, Archae bacteria, Eubacteria and eukaryotes. Microscope - Light field, Dark field, Fluorescent and Electron microscope, Prokaryotic and Eukaryotic cell structure. Staining techniques - Simple and Differential staining.

### **UNIT II**

Nutritional classification of bacteria, Isolation, cultivation, enumeration and preservation of microbes; Culture media and its types - Pure culture technique - Growth curve; Axenic culture, Synchronous culture, Continuous culture; Effect of physical and chemical factors on microbial growth.

### **UNIT- III**

Sterilization and Disinfection: Moist heat, Dry heat, Radiation, Filtration, Phenols, Halogens, Phenol coefficient method. Antibiotics - Inhibitors of Nucleic acid, protein and cell wall synthesis. Chemotherapeutic agents - Anti microbial susceptibility test.

### **UNIT IV**

Microbial diversity- methods to assess microbial diversity, Culture dependent and culture independent methods. Molecular analysis of bacterial community; Denaturing Gradient Gel Electrophoresis (DGGE), Terminal Restriction Fragment Length (TRFL) Polymorphism (T-RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA).

### **UNIT- V**

Microbial community in natural habitats – air, water, soil, food and milk. Food and milk borne diseases, Extremophiles- habitant & Classification, Halophiles, Thermophiles, Alkaliphiles, Acidophiles, Biotechnological applications of Extremophiles.



## References:

1. General Microbiology .Tortora, funke and case.11<sup>th</sup> edition pearson Higher education,USA,2012.
2. Microbiology .L.M. Prescott, J.P.harley and D.A.klein 7/e,McGraw – Hill ,Boston,2007.
3. Microbial functional genomics. J.ZHOU, d.k.Thomson, Y.Xu,J.m.Tiedje,J.Wiley,2004
4. Microbial ecology-fundamentals and application.Atlas.R.M and Bartha. M. Benjamin-Cummings, Menlo park, California,2003.
5. Biology of Microorganisms. Madigan .M.T,martinko.J.M,Parker,J,Brock,10<sup>th</sup> edition, prentice hallpublishers,2003.
6. Fundamentals of Microbiology ,Alcarno I. E, 6<sup>th</sup> Ed, Benjamin –Cummings publishing Company ,Inc2001.
7. Microbiology ecology- fundamentals and applications .R. M. Atlas andR.Bartha,2000
8. Fundamentals principles of bacteriology .A.J. sale Tata McGraw – Hill Publishing company limited, Newdelhi,1999
9. Medical microbiology D.Greenwood , R.Slack and J.Peutherer.ELST with Churchill Livingstone, Hongkong,1997.
10. Molecular biology and biotechnology .Robert A. Meyers, Wiley India pvtLtd,1995.
11. Microbiology .M.J.Pelzer Jr,E.C.S chan and N.R. Kreig.McGraw Hill,Inc, NewYork,1993
12. The Microbial world Stainer.R. Y,Ingraham. J.L, Wheelis.M.L and Painter.P.R. new Jercy, Prentice-hall,1986

## **CORE ELECTIVE 1 (A) MEDICAL LABORATORY TECHNOLOGY**

Objectives: to enable the students to learn about the General laboratory and instrumentation. Know the significance of biological samples examination & to understand the various types of infection and clinical symptoms caused by microorganisms.

### **UNIT I**

General Laboratory and instrumentation: Code of conduct for laboratory personnel-safety measures in the laboratory-chemical/Reagents, labeling, storage and usage .First aid in laboratory accidents-Precautions and first aid equipments. Sterilization , preparation of reagents .General approach to quality control, quality control of quantitative data.

### **UNIT II**

Clinical pathology: Urine analysis: Collection, composition, preservation, gross examination, chemical examination. Significance of sugar in urine, ketone bodies, bile pigment, hematuria, uric acid, microscopic examination of the urinary sediment: stool Examination-specimen collection, pH, Interfering substance. Test for occult blood, fecal fat, microscopic examination of stool specimen.

### **UNIT III**

Clinical Hematology: Collection of blood-Anticoagulant, preservation ,Estimation of Hb, PCV,WBC (TC & DC),RBC, platelets, ESR. Clotting time, bleeding time-normal value, clinical interpretation .Serology-VDRL,CRP,RA, HIV,HBs Ag.

### **UNIT IV**

Histology: Basic concepts of different mammalian tissues and their histological structure. Different human organs and their gross and histological structure and functions. Receiving of biopsy specimens at laboratory (Clinical notes/fixatives). Fixation of tissue –different fixatives and their mode of action .Methods of decalcification. Use of microtomes, selection and maintenance of knives, technique of section cutting &mounting on slides. Staining of tissue sections, preparation of different stains, staining methods for Haematoxylin& Eosin.

### **UNIT V**

Blood banking: blood group(ABO & Rh)-methods of grouping & reverse grouping .Basic blood banking procedures- collection of blood, anticoagulants used, cross matching ,different screening ;tests including Coomb's Test for incomplete antibodiespreparation of different blood components for use and how to serve a requisition. preparation of red cell suspension. Blood transfusion & hazards. Detect the time when to discard blood in blood bank, computerized record.

References:

1. Medical Laboratory Technology-6<sup>th</sup> edition L. Mukherjee. vol. I, II, III. 2010 Tata Mcgraw-Hill publishing company limited.
2. Hand book medical laboratory technology 2<sup>nd</sup> edition-V.H. Talib CBS publishers & 2008.
3. Clinical laboratory practices in CMC procedure, CMC, Vellore.
4. Text book of Medical lab technology, 1<sup>st</sup> Edition-Ranmniksood, jaypee 2006.
5. Laboratory manual in biochemistry-Jayaraman New Age International Pvt Ltd publishers 2011.

## **ELECTIVE 1: (B) VIROLOGY**

Objectives: To understand the biology of viruses, pathogenesis, clinical features, epidemiology and prophylaxis of dreadful viral infections in susceptible hosts.

### **UNIT I**

General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries-icosahedral , polyhedral and helical, structural proteins-matrix proteins and lipoproteins, viral genomic organization and replication-types of nucleic acids, protein nucleic acid interactions and genome packaging, Virus related structures-viroids and prions. Cultivation of viruses: Inovo, In vivo ,Ex vivo/In vitro. Cytopathic effect-pock forming unit.

### **UNIT II**

Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies),electron microscopy ,Immuno diagnosis ,hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probeassay.

### **UNIT III**

Bacterio phages and plant viruses: Bacterio phage: Morphology, genome organization, classification-Lifecycle-Lytic and Lysogenic Cycle, Head and tail phages-T4 phage- phage-Filamentous Bacteriophages-174-M13,phage therapy for control of bacterial poultry diseases. Viral Disease in Plants: Histological, physiological and cytological changes in infected plants, Behavior of viruses in plants, Methods for detection of plant viruses, Transmission of plant viruses through vectors-insects, nematodes and fungi.

### **UNIT IV**

Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses-pox virus ,Herpes Virus ,Adenovirus, Hepatitis Virus. RNA Viruses- Picorna Virus, Orthomyxo Virus, Rabies Virus, HIV. Oncogenic viruses; Virus induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses, Retrovirus mediated oncogenesis.

### **UNIT V**

Viral vaccines and anti-viral drugs: Viral vaccine, conventional vaccines-killed and attenuated, Modern vaccines-DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immunomodulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons,

designing and screening for antivirals, mechanisms of action, antiretrovirals-mechanism of action and drugresistance.

**References:**

1. Flint S.J., V.R.Racaniollo ,L.W.Enquist, V.R.Rancaniello,A.M.Skalka ,(2003),principle of virology:Molecular Biology , pathogenesis, and control of animal Viruses, American society Microbiology, Chapters3-13
2. Topley &Wilson's.(1990) Principles of Bacteriology, Virology and ImmunityVIII Edition Vol. Iv Virology, Edward Arnold,London.
3. Haaheim L.R., J.R. Pattison and R.J. Whitley, (2002),A practical Guide to Clinical virology ,end Ed. Edited by, John Wiley & Sons,Ltd.
4. International Congress on Taxonomy of Viruses;<http://WWW.ncbi.nlm.nih.gov/ICTV>
5. Knipe David M.,PeterM.Howley, Diane E.Griffin,Rober t A.Lamb,Malcolm A. Martin,BernardRoizman, Stephen E .Straus,(2007),Field's Virology, 5<sup>th</sup> Ed. Lippincott Williams&Wilkins
6. Cann Alan j, (2000),DNA virus Replication, Oxford Universitypress
7. Plotkin Stanley A.,WalterA.Orenstein, (2003), Vaccines Elsevier HealthSciences
8. Tyring. Stephen K.(2004),Antiviral Agents, vaccines, and Immunotherapies,Marcesl Dekker
9. TimburyMC.(1994)Medical Virology X Edition. ChurchillLivingston.

## **ELECTIVE 1: (C)BASIC ANALYTICAL METHODS**

Objective: To provide knowledge of various analytical techniques in biological research

### **UNIT I**

Electrochemical techniques- basic principles- The pH electrode- Ion-selective gas-sensing and oxygen electrodes- Elementary details of biosensors. Beer – Lambert law, light absorption and its transmittance. Basic principles & brief outline of instrumentation of UV-Visible Spectroscopy: Infrared Spectroscopy, NMR. Mass spectrometry. Spectrofluorimetry, Flame photometry, Atomic absorption spectrophotometry– Principles, instrumentation and applications

### **UNIT II**

Introduction & classification of chromatography. Theory, instrumentation & applications of Column chromatography, TLC, Paper chromatography, GC, HPTLC and HPLC - detection methods and systems qualitative and quantitative aspects applications.

### **UNIT III**

Centrifugation- basic principles-instrumentation-centrifugation units, Nature of particles-centrifugation methods and accessories - sedimentation velocity-sedimentation equilibrium-cell fractionation method. Differential, density gradient, isopycnic and equilibrium centrifugation. Preparative and analytical ultracentrifugation techniques. Isoelectric focusing- blotting methods-western- southern and northern- application- methods in life sciences and biotechnology.

### **UNIT IV**

General principles. Factors affecting the migration rate – sample, electric field, buffer and supporting medium. Tiselius moving boundary electrophoresis. PAGE. SDS– PAGE. Immunoelectrophoresis. Cellulose acetate membrane electrophoresis. Agarose gel electrophoresis.

### **UNIT V**

Radioisotopic techniques: Introduction to radioisotopes, Detection, Measurement and uses of radioisotopes, Counting efficiency and autoradiography, Biotechnological applications Microscopy: Principles of microscopy, Fluorescent, Transmission and Scanning electron microscopy, Confocal microscopy, Microtomy and analysis and measurement of images.

### **References**

1. Principles and Techniques of Practical Biochemistry (Paperback) by Keith Wilson (Editor), John Walker (Editor), John M. Walker (Author) “ Fifth Edition 2000
2. Introductory Practical Biochemistry (Hardcover).by S. K. Sawhney; Randhir Singh (Editor) 2005
3. Principles of Physical Biochemistry (2nd Edition) by Kensal E van Holde, Curtis Johnson, and Pui Shing Ho (Hardcover – April 16, 2005)
4. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by David M. Freifelder (Paperback – Aug 15, 1982)
5. Instrumental Methods of Chemical Analysis by G R Chatwal and S K Anand (Hardcover – Jun 1980).

## **Practical 1 : Lab In Biochemistry And Cell & Molecular Biology Lab in biochemistry**

1. Determination of Chl.a, Chl.b& total Chl. By Arnonmethod.
2. Estimation of Carbohydrates
3. Estimation of salivary amylase activity in relation to,substrate/pH/Temperature
4. Estimation of blood glucose & urea
5. Estimation of LDH.
6. Estimation of total serum proteins
7. Estimation of creatinine in urine.
8. Paper / thin layer chromatography

## **Lab in Cell and Molecular biology**

9. Isolation of Genomic DNA from E.coli
10. Isolation of plasmid DNA from E.coli
12. Elution & quantification of DNA from agarose gel.
13. Preparation of competent cells and transformation
14. PCR
15. Isolation of Total RNA from bacteria
16. Synthesis of cDNA by Reverse transcription polymerase chain reaction

## Reference

1. Introduction to Practical Biochemistry, E.F Plummer Mu, Plummer Tata McGraw-Hill Education,1998.
2. Molecular cloning: a laboratory manual,4<sup>th</sup> ed. J.Sambrook, Fritsch and T.Maniatis.cold spring harbor laboratory press ,New York,2012
3. Essential cell biology : a practical approach volume 1: cell structure. John Davey, J.Michaellord. Oxford university press, USA,2003
4. Principles and techniques of biochemistry and molecular biology (7<sup>th</sup> ed).Keith Wilson (editor),John walker (editor),Cambridge university press,2010.

## Practical II Microbiology

1. Sterilization techniques
2. Preparation of culture media (Selective and Enriched media)
3. Staining techniques- Simple, Differential, Negative staining and Motility studies
4. Determination of Bacterial growth curve
5. Enumeration of bacteria from environmental samples- soil, water, air and milk.
6. Pure culture techniques - Streak, pour plate and spread plate.
7. Biochemical tests for identification of bacteria (IMViC, TSI, Catalase, Oxidase)
8. Antimicrobial assay, phenol coefficient, agar plate sensitivity method.
9. Water quality analysis - MPN method.
10. Milk quality analysis – MBRT method

### References:

1. Microbiology- A Laboratory manual P. Gunasekaran . New age publications, New delhi, 1995.
2. Molecular cloning- A Laboratory manual. Sambrook, J , Fritsch. E.F, and T. Maniatis, 2<sup>nd</sup> Edition. Cold spring Harbor Laboratory press, New York, 1989.
3. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5<sup>th</sup> Edition, the McGraw-Hill companies, 2002.
4. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley, 2002.
5. Laboratory Manual of Experimental Microbiology ,R.M. Atlas, A.E. Brown and L.C. Parks, 1995. Mosby, St. Louis, 2002.
6. Laboratory manual in General Microbiology, N. Kannan, Panima publishers.
7. Bergey's Manual of Determinative Bacteriology. Ninth Edition J.G. Holt, N.R. Krieg., Lippincott Williams, Wilkin publishers, 2000.



## VALUE ADDED COURSES

### (A) MUSHROOM CULTIVATION AND APICULTURE

**Objectives:** To exploit possibilities and assist in building up a mushroom cultivation and apiculture industry that will make a significant contribution to the general economy.

#### **Unit I:**

History and classification of Mushrooms: Edible and Poisonous Mushroom.

#### **Unit II:**

Incubation; spawn run and colonization; ventilation and humidity management; Readings: Posted instructor handouts.

#### **Unit III:**

Culture maintenance; spawn preparation; spawning techniques; environmental conditions for spawn run; fruiting initiation; harvest.

#### **Unit IV:**

Introduction to Apiculture - scope, importance and History of bee keeping: Definition, Bee keeping in worldwide, In India. Traditional bee keeping, Modern beekeeping, Urban or backyard beekeeping.

#### **Unit V:**

Honey - its properties and application in various fields and Types of value added honey products.

#### **References:**

- 1.Laidlaw, H.H., 1997. Contemporary queen rearing. Published by Dadant and Sons. R. A. Morse, Rearing queen honey bees. Wicwas press, NY.
- 2.Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
- 3.Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S.
- 4.Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Books.
- 5.Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & Tomorrows Printers &Publishers, New Delhi.
- 6.Pandey B P 1996. A textbook of fungi.Chand and Company N Delhi.

## **(B) VERMICULTURE TECHNOLOGY**

**Objectives :** Students will be able to compost in a limited space and describe the decomposing process

### **Unit-I**

Introduction to vermiculture. definition, meaning, history, economic important, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore

### **Unit-II**

The matter and humus cycle (product, qualities). Ground population, transformation process in organic matter

### **Unit-III**

Nutritional Composition of Vermicompost for plants, comparison with other fertilizers

### **Unit-IV**

Preparation vermibeds, maintenance of vermicompost & climatic conditions.

### **Unit -V**

Harvesting, packaging, transport and storage of Vermicompost and separation

### **References :**

Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi 2.

Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.

3. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London. 4.

Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney. 5. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils)

## C) VALIDATION OF MEDICINAL PLANTS

### Objectives:

- The course aims to introduce the students to the identification and validation of medicinal plant and to understand the cultivation and propagation techniques.
- To understand the importance of medicinal plants in human health care.

### Unit I Introduction to medicinal plants

Introduction to Medicinally important Plants and its parts: Fruits, Leaves, Stem and its modifications (underground and aerial), Roots.

### Unit II Identification of medicinal plants

Plant identification – Elementary knowledge of Binomial nomenclature – Outline of Bentham and Hooker classification – Herbarium techniques.

### Unit III Validation of medicinal plants

Macroscopic characteristics, Microscopic characteristics, Chemical tests, Chromatography techniques (TLC, HPLC, HPTLC, gas chromatography).

### Unit IV Cultivation of medicinal plants

Cultivation - Cultivation techniques, Factors affecting cultivation; Propagation - Different methods of propagation; Management and maintenance of medicinal plants.

### Unit V Importance of medicinal plants

Importance of medicinal plants - role in human health care, Role in prevention of human diseases. Traditional knowledge and utility of Indian medicinal plants.

### References:

1. A Class Book of Botany. A.C. Dutta. Oxford University Press.
2. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
3. Hartmann, H.T & Kester, D.E (1989). Plant Propagation – Principles and Practices. Prentice Hall of India

4. Awadesh N, Ghoemi A and Sharma R, Indigenous Health Care and Ethnomedicine, Sarup and Sons.
5. Medicinal Plants Cultivation: A Scientific Approach by S.S. Purohit, (2004).

## SEMESTER II

### PAPER 4: IMMUNOLOGY

**Objective:** to provide the students insights into the various aspects of immunology such as classical immunology, clinical immunology, immunotherapy and diagnostic immunology.

#### UNIT I

Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Humoral and cellular- Mediated Immunoresponses. Components of immunity, Innate and Adaptive immunity, Cells and Tissues of the immune system: Cells involved in the Immune response: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. The lymphoid organs: Bone marrow, Spleen, lymph nodes, MALT. Haematopoiesis and differentiation, lymphocyte trafficking.

#### UNIT II

Antigens and Immunogenicity. Nature of Antigens and antibodies. Theories of Antibody formation. Antibody structure, structural basis of Antibody diversity; Immunoglobulin as Antigen, Properties of immunoglobulin and subtypes.

#### UNIT III

Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA. B-cell generation, activation and differentiation. Antibody production, Regulation and Diversity.

#### UNIT IV

Cytokines: structure of Cytokines; function of Cytokines. Complement and its role in Immune Responses. Complement fixation. Structure and function of MHC class I and II molecules - antigen recognition and presentation, HLA typing, Cellular Immunity, Immune tolerance and suppression, Hypersensitivity Reactions, Types of Hypersensitivity, Autoimmunity.

#### UNIT V

Hybridoma secreting monoclonal antibodies-Recombinant antibody molecules. Catalytic Antibodies. Vaccine technology including DNA vaccines. Immunological techniques for identification of infectious diseases : immune-electrophoresis, western blot, flowcytometry and immune-fluorescence microscopy including *in situ* localization techniques such as FISH and GISH.

## References

1. Immunology (7<sup>th</sup> ed) J.Kuby ,W.H freeman and company , newYork.2013
2. Basic immunology updates ed: functions and disorders of immune system (3<sup>rd</sup> ed). abulk.abbas, Andrew H.HLictman ,saunders publishers , newYork,2010
3. Immunology: an introduction (4<sup>th</sup> ) I.R Tizard, saunders college publishers, newYork.
4. Essential immunology (11<sup>th</sup> ed).peterdelves,seamusmartin,dennjis burton, Ivan Roitt, Wiley – Blackwell publication, Singapore,2006
5. Immunology (Lippincotts illustrated reviews series) thaodoan, roger melvold, susanviselli, Carl Waltenbaugh, Lippincott Williams & Wilkins publications2012
6. Fundamental immunology (7<sup>th</sup> ed) William e Paul, Lippincott Williams & Wilkins publications,2012
7. Essentials of clinical immunology (6<sup>th</sup> ed) Helen chapel ,Manselhaeney, Siraj misbah, Neil snowden, Wiley-Blackwell publications,2014
8. Monoclonal antibodies principles and practice(3<sup>rd</sup> ed) W.Goodings, academic press,2010
9. Monoclonal antibodies :P methods and protocols (2<sup>nd</sup> ed) .Vincentossipo, Nicolas fisher, Humana press,2014
10. Essentials of clinical immunology (6<sup>th</sup> ed).Helen chapel, Manselhaeney, ,Siraj misbah, Neil Snowden, Wiley- Blackwell publications,2014 J.Kuby, 2003, Immunology 5<sup>th</sup> edition, W.H. Freeman and Company, Newyork..
11. C.V.Rao. 2002, An Introduction to Immunology, Narosa Publishing House,Chennai.
12. I.R.Tizard, 1995, Immunology: An Introduction , 4th edition , Saunders College Publishers, NewYork.
13. I.Roitt, 1994, Essential Immunology, Blackwell Science,Singapore.
14. A. Bul and K.Abbas, 1994, Cellular and Molecularimmunology
15. Current Protocols in Immunology 3 Volumes, Wiley Publications1994.
16. Monoclonal Antibodies: Principles and Practice, J. W. Goding, 1983. AcademicPress
17. Hybridoma Technology in the Biosciences and medicine, T.A. Springer, 1985. Plenum PressNY.
18. Vaccines, New Approaches to immunization, F.Brown, R.M.Chanock, KA Lerner, 1986. Cold springHarborolab.
19. Topley and Wilson principles of bacteriology, Virology and immunology, G. Wilson, A.Miles, M.T.Paker, 1984. Arnold,Heineman.
20. Basic and Clinical Immunology, D.P. Stities and J.D.Stobo.

## PAPER 5: GENETIC ENGINEERING

### Objectives:

To impart sound knowledge about core strategies of implementation and transmission of genetic material at molecular and cellular levels and also about the techniques to alter the genes to construct genetically modified organisms with biotechnologically desirable characters.

### UNIT I

Tools of Genetic Engineering: Enzymes - endo & exo nucleases, Restriction endonucleases - types, nomenclature, recognition sequences and mechanism of action; Isochizomers, Isocaudomers - star activity, Methylation and modification. Ligases – types (NAD and ATP dependent), mechanism of action. Role of Kinases, phosphatases, polynucleotide phosphorylase, polynucleotide kinases, terminal transferase, Alkaline phosphatase, Reverse transcriptase - Taq polymerase.

### UNIT II

Cloning vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and Marker genes-lac Z. Construction of pBR 322, pBR325, pBR327, pUC8, pUC 18 & 19 vectors and Expression vectors, Bacteriophage vectors, Lambda phage, Insertion vectors, Replacement vectors, Cosmids, Phagemids, Mini chromosomes, BAC's, YAC's, Shuttle vectors, Ti plasmids, Vectors for animals-SV40 and Bovine papilloma virus.

### UNIT III

Gene cloning strategies and transformation techniques: Chimeric DNA, Cloning strategies-ligation, Transformation and selection, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, genomic DNA libraries, Short gun method, Partial digestion, End modification, Cloning from mRNA- Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. cDNA library. Advanced cloning strategies-synthesis and Cloning of cDNA, PCR amplified DNA.

Transformation techniques: Preparation of competent cells, Physical methods - Electroporation, Microinjection, Gene gun, chemical methods - PEG, DEAE, CaCl<sub>2</sub>, calcium phosphate precipitation method, liposome mediated method

### UNIT IV

Selection, screening and analysis of recombinants: Genetic selection - Insertional inactivation, Antibiotic Resistant genes, lac Z genes, Blue white screening,  $\alpha$  - Complementation, colony hybridization, Immunological screening, Plaque hybridization, Blotting techniques, DNA sequencing - chemical and enzymatic methods, PCR and its variants, Preparation of radiolabelled and non - radiolabelled probes and its applications.

### UNIT V

Applications of rDNA technology: Production of vaccines – Hepatitis B, Edible Vaccine, Hormones – Somatotropin, Humulin, Blood clotting factor VIII, Interferons, Diagnostics of inherited disorders and infectious diseases, Gene therapy, ADA- Cystic fibrosis.

References:

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3rd Ed.) Universitypress.UK. 2008
  2. 2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK.1996.
  3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
  4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim, Germany Reprinted by Panima Publishing Corporation, New Delhi. 2003
  5. Benjamin Lewis, Genes VIII (3rd Ed.) Oxford University & CellPress, NY.2004
  6. Robert Williamson. Genetic Engineering (1st Ed.) Academic Press. 1981. USA
  7. Rodriguez. R.L (Author), Denhardt D.T. Vectors: A Survey of Molecular Cloning Vectors and Their Uses (1st Ed.) Butterworth-Heinemann publisher. UK. 1987
  8. Ansel F.M., Brent R., Kingston R.E., Moore D.D. et al. Short protocols in molecular biology (4th Ed), Wiley publishers. India. 1999.
  9. Sambrook J et al. Molecular cloning Volumes I, II and III. Cold Spring Harbor laboratory Press, New York, USA. (1989, 2000)
  10. Terence A Brown. Genomes, (2nd Ed.) BioScientific Publishers. UK. 2002
  11. Anthony JF Griffiths, William M Gelbart, Jeffrey H Miller, and Richard C Lewontin Modern Genetic Analysis (1st Ed.) W. H. Freeman Publishers. NY. 1999
- S. B. Primrose, Richard M. Twyman. Principles of gene manipulation and genomics (7th Ed.) John Wiley & Sons publishers. 2006



## **PAPER 6 : Developmental Biology and Stem cell Biology**

### **Objectives:**

To understand the recent advances and its applications to modern biotechnology.

#### Unit – I Introduction to Developmental Biology

Cells and morphogens gradients. Ultrastructure of sperm, egg, pollen and ovule. Production of gametes in animal and plant (Spermatogenesis, Oogenesis). Cell surface molecules in sperm - egg recognition in animals; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers in animals.

#### Unit – II Developmental Concepts

Morphogenesis and organogenesis in animals (Drosophila and Chick). Cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting. Role of epigenetics in development. Cellular differentiation and Differential activation. Role of cell death in development. Teratogenesis - Ageing, transgenics.

#### UNIT III Introduction to stem cell biology

Introduction to concepts in stem cell biology (renewal and potency) introduction to stem cells, Germ line stem cells and germ line derived pluripotent cell, Epigenetics, nuclear transfer and cloning, introduction to cell, tissues and organ. Introduction to embryonic and adult stem cell.

#### UNIT IV Basic and Types of Stem cell

Stem cell basic: Reprogramming and induced pluripotent cells (iPS cells), chromatin and stem cells, telomeres and stem cells, stem cell differentiation and characterization : CD antigens and its role in stem cell differentiation. Neuronal stem cell, mesenchymal stem cell, cardiac stem cells, hematopoietic stem cells

#### UNIT V Technique and Application

Techniques used for stem cell isolation, enumeration and Ex-VIVO expansion, techniques used for stem cell characterization. Therapeutic applications of stem cell: fundamentals of regenerative medicine, autologous and allogenic stem cell transplantation, HLA typing, Stem cell banking – cryopreservation techniques, national guideline by ICMR, recent advances in stem cell biology.

#### Recommended Books

1. Essentials of stem cell biology 2009, (second ed) Robert Lanza, John Gearhart, Brigid Hogan, Douglass Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut.
2. Ann a. Kiessling, human embryonic stem cells: an introduction to the science and therapeutic potential, Jones and Bartlett, 2003

3. Peter J ,Quesenberry, stem cell biology and gene therapy, 1st ed, willyless,1998
4. Developmental biology, (2018), 11th edition by Michael J. F. Barresi, Scott F. Gilbert.
5. Human Embryology & Developmental Biology (2019), 6th edition by Bruce M. Carlson
6. Principles of Development (2019), 6th edition by Cheryll Tickle; Lewis Wolpert; Alfonso Martinez Arias.
7. Freshney RI. 2016. Culture of animal cells: A manual of basic technique and Specialized Applications. 7th Edn. Wiley- Blackwell.. United States of America.
8. Singh, B., Mal, G., Gautam, S.K., Mukesh, M.2019 Advances in animal biotechnology 1st Edn Springer International Publishing. Switzerland

## PAPER 7: BIOINFORMATICS

**Objective:** to provide information an understanding of the major computational problems in the field of molecular biology and to gain knowledge on molecular databases, comparative genomics, pattern search, classification of sequence and structure, alignment of sequence, rapid similarity searching, phylogenies, automated pattern learning, representing and searching protein structure, gene expression profiling, clustering expressed genes, discovering transcription factor bindings sites, discovering common functions of co-expressed genes, metabolic pathways, signal transduction pathways.

### UNIT I

Biological data bases: gen bank: sequence data/ types ; - protein data bases – ESTs STSs – GSSs – HTGS; NCBI- PubMed- Entrez –BLAST – OMIM; Types Of Accession Numbers- Locus Link, Unigene, Entrez, EBI and Expasy.

### UNIT II

Sequence alignment: alignment algorithms – global and local – significance ; BLAST search steps –BLAST algorithm –BLAST search strategies ; advanced BLAST-alignment tools.

### UNIT III

Gene expression analysis tools: the mRNA-c DNA-libraries ; microarrays: experimental design – probe – hybridization – image analysis – data analysis- biological confirmation – microarray database.

### UNIT IV

Proteomic analysis tools: protein domains and motifs – bio informatic tools for high throughput protein analysis – protein structure – homology and functional genomics.

### UNIT V

Pathway bioinformatics : protein – carbohydrate metabolism – biochemical cycles – interconnection of pathways – metabolic regulation – translating biochemical networks into linear algebra –KEGG: theory and practice. computational methods : nucleic acid and protein sequence databases; determining methods for sequence analysis, web based tools for sequence searches, motif analysis and presentation.

### Reference :

1. Bioinformatics and functional genomics ( 2<sup>nd</sup>ed). Jonathan Pevsner, Wiley Blackwell publications 2009
2. Introduction to bioinformatics (4<sup>th</sup> ed). Arthur M .lesk ,oxford university press(UK), 2013
3. Bioinformatics for biologists. Pavalpevzner, ron Shamir, Cambridge university press. 2011.
4. practical bioinformatics (1<sup>st</sup> ed). Michael Agostino ,Garland science publication, 2012
5. Exploring informatics (2<sup>st</sup> ed) .Caroline St.clair, Jonathan E. Visick , Jones & Barlett learning, 2013.

6. Bioinformatics : sequence and genome analysis(2<sup>nd</sup> ) David mount, cold spring harbor laboratory press2013.
7. Bioinformatics and molecular evolution .PaulG.Higgs, Teresa K.Attwood, Wiley – Blackwellpublication,
- 8.instant notes in bioinformatics (2<sup>nd</sup> ed).Charlie Hodgman, Andrew French, David West head, Taylor &francis,2009.
9. next-generations DNA sequencing informatics. Stuart M. Brown, cold spring harbor laboratorypress,2013
10. from genes to genomes: concepts and applications of Dddna TECHNOLOGY (3<sup>rd</sup> Ed).JeremyW.Dale, Malcom von Schantz, Nicholas plant, Wiley publications,2011

## **ELECTIVE II : (A) ENZYME TECHNOLOGY**

**Objective:** To provide knowledge of various enzymes and enzyme technology applied in the industries.

### **UNIT I**

Introduction to enzymes: History of enzymes, nomenclature and classification of enzymes. Structural features of Enzymes: Chemical nature of Enzymes: amino acids, protein structure: Primary, secondary, tertiary and quaternary structure. Specificity of Enzymes: Types of specificity, the Koshland "induced fit" hypothesis, strain or transition-state stabilization hypothesis.

### **UNIT II**

Enzyme Catalysis and Kinetics: Factors affecting the rate of chemical reactions, kinetics of uncatalyzed chemical reactions, kinetics of enzyme-catalyzed reaction, methods for investigating the kinetics of enzyme-catalyzed reaction, nature of enzyme catalysis, inhibition of enzyme activity.

### **UNIT III**

Extraction and purification of microbial enzymes : Importance of enzyme purification, different sources of enzymes. Extracellular and intracellular enzymes. Physical and Chemical methods used for cell disintegration. Enzyme fractionation by precipitation (using Temperature, salt, solvent pH, etc.), liquid-liquid extraction, ionic exchange, gel chromatography, affinity chromatography and other special purification methods, Enzyme crystallization techniques. Criteria of purity of enzymes. Pitfalls in working with pure enzymes.

### **UNIT IV**

Enzyme inhibition and Co-factors: Irreversible, reversible, competitive, non-competitive and un-competitive inhibition with suitable examples and their kinetic studies. Allosteric inhibition, types of allosteric inhibition and their significance in metabolic regulation & their kinetic study. Vitamins and their co-enzymes: Structure and functions with suitable examples, Metalloenzymes and Metal ions as co-factors and enzyme activators.

### **UNIT V**

Immobilization of microbial enzymes and Enzyme Engineering: Methods viz. adsorption, covalent bonding, entrapment & membrane confinement and their analytical, therapeutic & industrial applications. Properties of immobilized enzymes. Enzyme Engineering- Chemical modification and site-directed mutagenesis to study the structure-function relationship of industrially important enzymes.

### **UNIT VI**

Applications of microbial enzymes: Microbial enzymes in textile, leather, wood industries and detergents. Enzymes in clinical diagnostics. Enzyme sensors for clinical processes and

environmental analyses. Enzymes as therapeutic agents.

**Reference:**

1. Enzymes by palmer(2001): Horwood publishingseries.
2. Fundamentals of Enzymology by price and Stevens (2002): Oxford UniversityPress.
3. Enzyme Technology by Helmut Uling (1998): JohnWiley.
4. Introduction to proteins Structure by Branden and Tooze (1998): GarlandPublishing Group.
5. Methods in Enzymology. Volume 22-Enzyme purification and related techniques. Edited by William B. Jakoby. Academic press, NewYork.
6. Allosteric Enzymes-Kinetic Behaviour. 1982. By B.I .Kurganov ,John Wiley and Sons. Inc., NewYork.
7. Biotechnology . Volume 7 A- Enzymes in Biotechnology. 1983 Edited by H.J.Rehm and G.Reed. Verlag Chemie.
8. Enzymes as Drugs Edited by John S. Holcenberg and Joseph Roberts, John Wiley& sons NewYork.
9. Methods of Enzymatic analysis by Hans Ulrich, Bergmeyer, AcademicPress.
10. Methods in Enzymology by W.A.Wood, AcdemicPress.
11. Advances in Enzmology by Alton Meister, IntersciencePublishers.
12. Topics in Enzyme and Fermentation Biotechnology by L.N. Wiseman ,John Wileyand sons.

## **ELECTIVE II : (B) DAIRY TECHNOLOGY**

**Objective:** to impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.

### **Unit I**

Common microbes in milk and their significance. Sources of microbial contamination of raw milk influencing quality of milk during production, collection, transformation and storage. Clean milk production and antimicrobial systems in raw milk. Microbial changes in raw milk during long storage. Microbiological grading of raw milk.

### **UNIT II**

**Microbiological processing techniques:** bacteriophage, thermization, pasteurization, sterilization, boiling, UHT, non thermal processes and membrane filtration of milk. Role of psychrophilic, mesophilic, thermophilic and thermotolerant bacteria in spoilage of processed milks and prevention. Microbiological standards (BIS/PFA) of heat treated fluid milks.

### **UNIT III**

Microbiological quality of dairy products; fat rich (cream and butter), frozen (ice cream), concentrated (evaporated and condensed milk), dried milks (roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution. Probiotics and prebiotics (GRAS), cloning - sanitation, control of microorganisms in dairy processing.

### **UNIT IV**

Microbiology quality of traditional dairy products; heat desiccated (khoa, burfi, peda, kheer), acid coagulated (paneer, chhana, rasgulla), fermented (lassi, srikhand) and frozen (kulfi). Sources of microbial contaminants and their role in spoilage. Importance of personnel and environmental hygiene on quality of traditional milk products. Microbiological standards for indigenous dairy foods.

### **UNIT V**

Milk-borne diseases – viral and bacterial, zoonotic infections, pathogens associated with fluid milks, dairy products and their public health significance. Sources of pathogens and their prevention. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies. Regulatory control of dairy products, testing of milk and milk products, treatment of dairy wastes.

## References:

1. Adams MR and Moss MO.(1995).food microbiology, the royal society ofchemistry, Cambridge.
2. Andrews AT, Varley J(1994) biochemistry of milk products. Royal society ofchemistry.
3. BanwartGJ(1989),basic food microbiology, Chapman & hall, new York.
4. Frazier WC and Westhoff DC.(1988) food microbiology, TATA McGraw hill publishing company Ltd. NewDelhi.
5. Hobbs BC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold(a division of Hodder and Stoughton),London.
6. May JM. (1987) modern food microbiology, CBS publishers and distributors, NewDelhi.
7. Robinson RK. 1990.the microbiology of milk. Elsevier applied Science.London
8. Edward Harth ,J.T.Steele. Applied dairy microbiology .1998. Marcel DeckerInc.
9. Modi, HA (2009) dairy microbiology pointer publishers, India. Marth, E.H and steel J. L(2001) applied Dairy microbiology, 2<sup>nd</sup> Edition, Marcel Dekker, Inc.270 MadisonAvenue, new York, New York10016.



## ELECTIVE II : (C) PHARMACEUTICAL TECHNOLOGY

**Objectives:** To impart knowledge on the importance of drug during life span. To enlighten on the biotechnological modifications in drugs. To find mechanism of action of drugs used in therapy.

### UNIT I

Drug- structural feature and pharmacology activity, pro drug concept. Absorption – first – pass effect .distributor , metabolism- phase I, II reactions, action of cyto chrome p450 & elimination of drug receptor- localization, type and subtypes, models and their drug- receptor interaction, against & antagonist .

### UNIT II

Adverse response to drugs, drug tolerance, drug intolerance ,Idio SYNERACY (pharmacogenesis), drug allergy. Tachyphylaxis, drug abuse, vaccination against infection , factor that modifies the effect of drug. Assay of drug potency – bioassay and immunoassay.

### UNIT III

**Biotechnology and pharmacy:** genetically engineered protein and peptide agents. novel drug delivery systems – non conventional routes of administration. Anti AIDS drug development, oncogenes target for drugs, multi- drugsresistance.

### UNIT IV

**Mechanism of action of drugs used in therapy of :**respiratory system-cough, bronchial-asthma, pulmonary tuberculosis .GIT – digestents , appetite suppressants. hypolipidemia agents,, vomiting, constipation and peptic ulcer. antimicrobial drugs- sulfonamide s,trimethoprim, cotrimoxazole, penicillin and macrolides . aminoglycosides, cephalosporin and bacterial resistance .Insulin and oral diabetic drugs, anti fertility and ovulation inducing drugs.

### UNIT V

**Drugs of plant origin:** drug dependence and abuse- management of self poisoning cancer. Chemotherapy- cytotoxic drug. immuno suppressive drug therapy. New biological targets for drug development. Novel drug screeningstrategies.

### Reference:

1. The pharmacology Vol I and Vol II– Goodman and Gillman, Mc Graw Hill professional;12 ed (2010)
2. Basic pharmacology – Foxter cox bulter worth's1980.
3. Pharmacology and pharmaco therapeutics – R.S.Satoskar. S.D.Bhandhhakar&S.S.Anilapure popular PrakasharBombay.
4. Principles of medical chemistry – William O. Foge. B.I. Waverks Pvt Ltd, NewDelhi.

5. Oxford text books of clinical pharmacology and drug therapy. D.G.Burger's Medical chemistry & drugdiscovery.
6. Principles and practice – Manfred. E. Wolf John Wiley andsons.

### **PRACTICAL III: LAB IN IMMUNOLOGY**

1. Blood grouping
2. Lymphocyte subset identification and enumeration.
3. Radial immuno-diffusion test.
4. Ouchterlony double diffusion
5. Immuno electrophoresis
6. Rocket Immuno electrophoresis
7. Latex Agglutination
8. Quantitative Precipitation assay
9. Complement fixation test
10. ELISA
11. Western Blotting
12. Antigen-antibody reaction (precipitation and agglutination reaction tests).

#### **References:**

1. Practical Immunology. Franck C. Hay, Olwyn M.R. Westwood. Wiley-Blackwell publications, 2010.
2. Immunoassays: A Practical Approach. James P. Gosling (editor). Oxford University Press, USA, 2010.
3. Lab manual in biochemistry, immunology and biotechnology. Arti Nigam Archana Ayyagari. McGraw-Hill Education, 2008.
4. Practical immunology. Rabindra Narain, DDM & Wisdom Publications, 2012

## **PRACTICAL IV**

### **LAB IN GENETIC ENGINEERING AND BIOINFORMATICS**

#### **GENETIC ENGINEERING**

1. Isolation of genomic DNA from the given sample and its molecular weight determination
2. Isolation of RNA from the given sample and its molecular weight determination
3. Isolation of plasmid DNA from the given sample
4. Restriction digestion of Lambda phage DNA
5. Ligation of DNA and analysis by electrophoresis
6. DNA amplification by PCR and RAPD
7. Preparation of competent cells and transformation by CaCl<sub>2</sub> method and Selection of transformed colony by X-Gal method
8. Determination of molecular weight of proteins by SDS PAGE

#### **BIOINFORMATICS**

1. Restriction mapping
2. PCR Primer Designing
3. ORF finding
4. Homology search
5. Multiple sequence alignment

## **OPEN ELECTIVE (A) : MEDICAL LABORATORY TECHNOLOGY**

**Objectives:** to enable the students to learn about the General laboratory and instrumentation. Know the significance of biological samples examination & to understand the various types of infection and clinical symptoms caused by microorganisms.

### **UNIT I**

General Laboratory and instrumentation: Code of conduct for laboratory personnel-safety measures in the laboratory-chemical/Reagents, labeling, storage and usage .First aid in laboratory accidents-Precautions and first aid equipments.

### **UNIT II**

Clinical pathology: Urine analysis: Collection, composition, preservation, gross examination, chemical examination. Significance of sugar in urine, ketone bodies, bile pigment, hematuria, uric acid, microscopic examination of the urinary sediment: stool Examination-specimen collection.

### **UNIT III**

Clinical Hematology: Collection of blood-Anticoagulant, preservation ,Estimation of Hb, PCV,WBC (TC & DC),RBC, platelets, ESR. Clotting time, bleeding time-normal value, clinical interpretation .Serology-VDRL,CRP,RA, HIV,HBs Ag.

### **UNIT IV**

Histology: Basic concepts of different mammalian tissues and their histological structure. Different human organs and their gross and histological structure and functions. Receiving of biopsy specimens at laboratory (Clinical notes/fixatives). Fixation of tissue –different fixatives and their mode of action .Methods of decalcification.

### **UNIT V**

Blood banking: blood group(ABO & Rh)-methods of grouping & reverse grouping .Basic blood banking procedures- collection of blood, anticoagulants used, cross matching ,different screening ;tests including

### **References:**

1. Medical Laboratory Technology-6<sup>th</sup> edition L.Mukherjee.vol.I,II,III.2010Tata Mcgraw-Hill publishing company limited.
2. Hand book medical laboratory technology 2<sup>nd</sup> edition-V.H.Talib CBS publishers& 2008.

3. Clinical laboratory practices in CMC procedure, CMC,Vellore.
4. Text book of Medical lab technology, 1<sup>st</sup> Edition-Ranmniksood.jaypee2006.
5. Laboratory manual in biochemistry-Jayaraman New Age International Pvt  
Ltd publishers2011.

## **OPEN ELECTIVE (B ): FOOD & NUTRITION**

Objectives: To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

### **UNIT I**

Nutrition and Dietary System: Definition of food nutrition, basic food groups, physiological role and nutritional significance of carbohydrates, protein, lipids, vitamins and minerals .protein malnutrition (Kwashiorkar) and under nutrition (marasmus) and their preventive, curatives measures.

### **UNIT II**

Fat soluble vitamins: Vitamin A, Vitamin D,E&k. Water soluble vitamins: Vitamin c, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12,Vitamin B6.

### **UNIT III**

Nutritive and calorific Value of food: Unit of energy measurements of food stuffs by Bomb calorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Nutritive value of protein, essential amino acid. composition of balanced diet for infants, pregnancy and lactating women, old age.

### **UNIT IV**

Food adulteration & food poisoning: sources of floods, types ,advantages and disadvantages, constituents of foods, carbohydrate ,protein, fats, oils, colors, flavours, natural toxicants. Sources ,causes and remedies for acidity, gastritis, indigestion and constipation

### **UNIT V**

Food preservation and processing: food spoilage, causes of food spoilage ,types of food spoilage, food preservations, food processing – different types, sterilizations & pasteurization

#### **References:**

1. Seema yadav: - Food Chemistry, anmol publishing (P) Ltd, NewDelhi
2. Car H.Synder: -the extraordinary chemistry for ordinary things, John Wiley & sonsinc, NewYork,1992.
- 3.B.Sivasankar – food processing and preservation – PHI learni9ng (P) LTD , New Delhi – 11001.

## **OPEN ELECTIVE (C) : BIODIVERSITY**

Objectives: To enable students to gain a deeper understanding about the every living things including plants, bacteria, animals and humans .and enormous variety of life on Earth.

### **Unit 1:**

Ecosystem concept Introduction and overview of ecosystem ecology - History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies,.

### **Unit 2:**

Biodiversity and its origin, Global and local trends , Mega biodiversity countries, hot spots and heritage sites, types of diversity, levels of biodiversity (genetic, species, ecological diversities), value of biodiversity.

### **Unit 3:**

History, guiding principles, conservation challenges and models of conservation biology. IUCN Red list categories and criteria, habitat management and establishment of wildlife corridors and protected areas, bio-indicators. Biosphere reserves, in situ and ex situ conservations (sanctuaries, national parks, zoological parks, botanical gardens, oceanorium).

### **Unit IV**

Environmental Pollution- Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment Protection Act: Air, water, forest and wild life acts, issues involved in enforcement of environmental legislation.

### **Unit V**

Water conservation, Rain water harvesting & watershed management, and environmental ethics. Climate change, global warming, acid, rain, ozone layer depletion. Environmental protection act, population explosion. Disaster management.

### **References**

1. Alcock J 2013 Animal Behavior: An Evolutionary Approach, 10th edition (Sinauer Associates,Inc.)
2. Bolhuis J J and L Giraldeau (eds) 2005 The behaviour of animals (BlackwellPub.)
3. Breed and Moore 2011 Animal Behavior, 1st Edition (Academic Press) 4. Burnse D (ed.) 2001 Animal: the definitive visual guide to worlds' wildlife (Cambridge UniversityPress)
4. Collen B, Pettorelli N, Baillie J E M and Durant S M (Eds) 2013 Biodiversity Monitoring and Conservation: Bridging the Gap Between Global Commitment and Local Action(WileyBlackwell)
5. GL. Karia and R.A. Christian, West Water Treatment, Concepts and Design Approach,



- Prentice Hall of India,2005.
6. Benny Joseph, Environmental Studies, Tata McGrawHill,2005

**PAPER 8: COMPUSORY – HUMAN RIGHTS**

## SEMESTER III

### PAPER 9: PLANT BIOTECHNOLOGY

**Objective:** This paper has been designed to give the students comprehensive knowledge about the applications of plant Molecular biotechnology for increasing agricultural production, environment improvement, human, nutrition and health. Help students to get a career in both industry/R & D.

**UNIT – I Genome organization in Plants:** Nucleus, Chloroplast and Mitochondria, Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, Microsatellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Strand Conformational Polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection.

**UNIT – II Plant Cell and Tissue Culture:** Tissue culture media (composition and preparation), Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis; transfer and establishment of whole plants in soil; greenhouse technology. Embryo culture and embryo rescue. Artificial seeds. Protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants. Cryopreservation and DNA banking for germplasm conservation.

#### **UNIT – III Concepts in Plant Genetic Engineering :**

Plant vectors :Co-integrate, binary vectors and viral vectors, 35S and other promoters, Terminators, selectable Antibiotic resistance marker and reporter genes GUS gene, Lux gene and GFP protein. Transgene stability and gene silencing.

#### **UNIT-IV Methods of gene transfer in plants**

Transient and stable gene transformation:Agrobacterium mediated gene transfer, Ti&Ri plasmid, the process of T DNA transfer and integration. Physical method of gene transfer, Particle bombardment, electroporation, microinjection, chemical mediated transformation, silicon carbide mediated and floral dip method. Transplastomics: Chloroplast transformation: advantages, vectors, success with tobacco and potato. Strategies for marker freetransformation.

#### **UNIT-V**

Application of transgenesis in crop improvement: Insect resistance, disease resistance, virus resistance, herbicide resistance, and resistance to biotic & abiotic stress. Transgenesis for male sterility and terminator seed. Transgenesis for quality improvement: Protein, lipids, carbohydrates, vitamins & mineral nutrients. Molecular pharming: Exploitation of Biotechnological techniques for plant therapeutic compounds - production of recombinant

proteins in plants. Expression of antibodies in plants for immunotherapy. Expression of recombinant antibody fragments in plants.

### References:

1. Slater A, NW Scott, MR Fowler. Plant bio technology, Oxford University Press,2003
2. Hans Walter Heldt. Plant Biotechnology & Molecular Biology, Oxford University Press, 1997
3. Nigel W. Scott, Mark R. Fowler,Adrian Slater. Plant Biotechnology: The genetic manipulation of plants 2nd Edition 2nd Edition, Oxford University Press,2008
4. J. Hammond, P. McGarvey,V. Yusibov. Plant Biotechnology: New Products and Applications 1st ed. Springer1999.
5. Bob Buchanan,Wilhelm Gruissem, Russell Jones. Biochemistry & Molecular Biology of Plants. I.k. International Pvt. Ltd,2007.
6. Robert J. Henry. Practical Applications of Plant Molecular Biology. Routledge Chapman & Hall,1997.
7. Introduction to Plant Biotechnology by H.S. Chawla, 2002. Oxford and IBH P Publishing Co.Pvt. Ltd. NewDelhi.
8. Plant molecular genetics by Monica. A. Hughes.1999. Pearson Education limited, England.
9. An introduction to genetic engineering in plants, Mantel S.H, Mathews J.A. Mickee R.A.1985. Blackwell Scientific Publishers.London.
10. Scott and Mark R. Fowler, 2003, Oxford University press, UK. 11. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press,UK.
11. In Vitro culture of higher plants by R.L.M. Pierik, 1987. MartinusNijhoffPublisher, Dordrecht.
12. Gonzales.1994.Oxford University Press. Oxford. 4. Plant Molecular Biology by Donald Grierson and S.V. Convey.1984. Blackie andSon.
13. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon andR.A.

## **PAPER 10: ANIMAL BIOTECHNOLOGY**

**Objective:** To provide an overview and current developments in different areas of animal Biotechnology and its application.

### **UNIT I**

Culture of mammalian cells, Tissues and Organs, Primary Culture, Secondary Culture, Continuous cell lines, Suspension cultures, Cryopreservation and transport of Animal germplasm ( Embryo, Semen and ovum).

### **UNIT II**

Cell cultures media and Growth parameters of animal cell culture, Role of serum and essential supplements to medium and their applications. Cell Synchronization, Cell cloning Methods and Micromanipulation.

### **UNIT III**

Gene transfer to Animal cell, Animal Germ cell and development, Valuable genes for Animal biotechnology, Transgenic Animals (story of Dolly) and gene knockout, Somatic cell cloning and Hybridization, Transfection and Transformation of cells, Production of transgenic animals – mice, sheep and fish. Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry, transgenic insects as bioreactor.

### **UNIT IV**

Commercial scale production of animal cells, application of animal cell culture for in vitro, testing of drugs, testing the toxicity of environmental pollutants in cell culture, application of cell cultures technology in production of pharmaceutical proteins, human and animal viral vaccines.

### **UNIT V**

Stem cell culture, embryonic stem cells and their applications. Cytotoxicity, Apoptosis, Tissue engineering. Diagnostic antigens and other pharmaceutical agents.

References:

1. Culture of Animal cells, 2006, 3<sup>rd</sup> Edition, R. Ian Freshney . A John Wiley & Sons, Inc., publications.
2. Animal Cell Culture – Practical Approach, R.W. Masters, Oxford. Animal Cell Culture Techniques. Ed. Martin Clynes, Springer.
3. Biotechnology by Kashav. T (Wiley Eastern Ltd).
4. Animal Cell Biotechnology; Methods and protocols, Nigel Jenkins, Humana Press.
5. Biotechnology of Animal Tissue. P.R. Yadav & Rajiv Tyagi, 2006. Discovery

publishing House. NewDelhi.

6. From Genes to Clones Introduction to Gene Technology – Winnacker, E.L.1987., Panima Educational Book Agency, NewDelhi.
7. Gene VII – Benjamin Lewin, 2000. Oxford University Press,UK.
8. Principles of Gene Manipulation and Genomics – Primrose, S.B. and Twyman, R.M. 2006. 7<sup>th</sup> Edition. Blackwell PublishingCompany.
9. Recombinant DNA Second Edition – James D. Watson, Micheal Gilman, MarkZoller, 2001. W.H. Freeman and Company, NewYork.
10. Biotechnology, Satyanarayanan .U, (2008), Books and Allied (p)Ltd.

## **PAPER 11: MICROBIAL BIOTECHNOLOGY**

**Objective:** To understand the various processes involved in Microbial Technology uses in industries for the production of Primary and secondary metabolites that will be useful for the benefit of human beings.

### **UNIT I**

Scope and importance of bioprocess engineering technology, Development and strain improvement of industrially important microorganisms. Bioreactors: Typical structure of advanced bioreactor and their working mechanism; Design features - Heat transfer and Mass transfer; Specialized bioreactors- design and their functions; Airlift bioreactor, Tubular bioreactors, Membrane bioreactors, Tower bioreactors, Fluidized bed reactor, Packed bed reactors and Photo bioreactors.

### **UNIT II**

Fermentation technology: Natural and synthetic media; Strategies for media formulation, sources of carbon, nitrogen, vitamins and minerals. Role of buffers, precursors, inhibitors, inducers and antifoam agents. Types of fermentation process-submerged fermentation, surface or solid state fermentation, batch fermentation, continuous fermentation, kinetics of fermentation process, bioprocess control, monitoring of variables-temperature, agitation, pH and pressure.

### **UNIT III**

Downstream processing: cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization-biosensors-construction and applications

### **UNIT IV**

Immobilization and Biotransformation: Methods of immobilization - adsorption, crosslinking, ionic bonding, entrapment, encapsulation; Advantages and industrial applications of Immobilization of enzymes and whole cells. Biotransformation of antibiotics, steroids and their applications.

### **UNIT V**

Production of Industrially important products: Alcohol- Ethanol, glycerol, butanol, Acetone; Organic acids- citric, acetic, and gluconic acid; Amino acids- lysine, glutamic acid; Antibiotics- penicillin, streptomycin, tetracycline; Vitamins- riboflavin; Enzymes- amylase, protease; biodegradable plastic- polyhydroxyalkanoates (butyrate, propionate).

### **References:**

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall,Engelwood Cliffs,1991.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2ndEdition, Prentice Hall, Engelwood Cliffs,2002.
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology,Pergamon press, Oxford,1997.
4. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology,(2nd Ed). Taylor & Francis Ltd, UK, 2007.

5. Colin Ratledge and Bjorn Kristiansen, Basic Biotechnology (2ndEd.).Cambridge University Press.2002.
6. Prescott, Sc and Dunn, C. Industrial Microbiology, McGraw Hill, New York.1984
7. Michael, L. Shulers and FikretKargi. Bioprocess Engineering: Basic concepts(2nd Ed.) Prientice Hall Publishers.2001
8. Paulins, M. D. Bioprocess Engineering Principles. John WileyPublishers.



## PAPER 12: ENVIRONMENTAL BIOTECHNOLOGY

**Objective:** To acquire a basic comprehension of the environment in its totality and of its problems and to provide an understanding of the environmental and biological challenges facing society through the integration of biology with legal, regulatory and social issues.

### UNIT-I

**Environmental pollution:** Basic concepts and global issues-Global warming & Acid rain. Pollution measurements- air and water. Biosensor in environmental monitoring. Bioremediation of environmental pollutants in soil and water- oils, heavy metals and detergents. Biofouling and Biosensors.

### UNIT-II

**Waste treatment:** Waste water treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries. Solid wastes: Types and characteristics. Solid waste disposal- land filling, incineration. Biogas from solid waste. Composting and vermicomposting. Monitoring parameters for composting.

### UNIT-III

**Bioremediation:** Introduction of Bioremediation advantages and applications; Types of bioremediation. Microbial remediation of phenolics-sewage nutrients (phosphate and nittare). Impact of bioremediation in petroleum industry, paper industry, marine oil pollutants and chemical industry. Phytoremediation advantages and applications (agriculture).

### UNIT-IV

**Biocorrosion and microbial mediated recovery:** Microbial corrosion and its control (petroleum industry and cooling tower system). Bio metallurgy- Bioleaching- application, biotechnology approaches for heavy metal elimination from effluents. Bio-mediated recovery of metals (gold and platinum). Recovery of petroleum-MEOR- Biosurfactant.

### UNIT-V

**Biodegradation:** Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioenergy.

### References

1. Murugesan AG and Rajakumari C. (2005). Environmental Science and Biotechnology: theory and Techniques.
2. Sharma PD. (1994). Environmental Biology, Rastogi Publications.
3. Eugenia J. Olguin. (2000). Environmental Biotechnology and cleaner Bioprocesses, Taylor and Francis.
4. Beech IB and Gaylarde CC (1999). Recent advance in the study of biocorrosion- an overview. *Rev Microbial* **30**, 177- 190.

5. Booth GH (1971). Microbiological corrosion, M and B monographs CE11, Mills and Boon, London.
6. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
7. Jogdand SN. (2008). Environmental Biotechnology, 4th Edition, Himalaya Publishing House Pvt. Ltd.

## **CORE ELECTIVE III (A) : GENOMICS & PROTEOMICS**

**OBJECTIVE:** To enable us to explore many different components of living systems and the advent of proteomics will made it possible to identify a broad spectrum of proteins in living systems. This elective subject will help to understand basic principles and applications in genomics and proteomics.

### **UNIT I :**

Organization of genes across living systems, interrupted genes, overlapping genes, alternative genes , (RNA editing and RNA Splicing ) etc. identification and characterization of insert DNA fragments, gene content and C value paradox – gene cluster and genefamilies  
.restriction mapping, chromosome walking and chromosomal localization of genes. RFLP and other uses of cloned sequences, cloning of microbial genes.

### **UNIT II**

Methods of preparing genomic DNA, DNA sequence analysis methods, Sanger Di deoxy method, next generation sequencing, SNP – single nucleotide polymorphism, expressed sequenced Tags(ESTs),Gene disease association, site directed mutagenesis and molecular chimeras , gungal genome and genomics.PCR based Analysis, DNA Fingerprinting.

### **UNIT III**

Scope of proteomics, protein separation techniques – ion exchange chromatography, size – exclusion and affinity chromatography techniques, size – exclusion and affinity chromatography techniques , protein analysis (includes measurement of concentration , amino acid composition, N-terminal sequencing ); SDS-PAGE , two dimensional gel electrophoresis and imageanalysis.

### **UNIT IV**

Introduction to mass spectrometry; strategies for protein identification ; protein sequencing ; protein modifications and proteomics ; applications of proteome analysis to drug; protein – protein interaction (Two hybrid interaction screening ), analysis and sequencing individual spots by mass spectrometry (Maldi toff) and protein microarrays .

### **UNIT V**

Meta genomics – construction, vector design and screening o f meta genomic libraries-biotechnological applications of meta genomics.

## Reference

1. Microbial Genomes. Fraser, ClarieM:read ,timothy D:Nelson , Karen E,Ed. Humana press 2004.
2. mobile DNAII.Craig Nancy, Craigie ,Robert:Gellert, Martin: Lambowitz. Alan M. ASM Press2002.
3. Genomes 2<sup>nd</sup> ed. Brown.T.A Wiley- Liss, Oxford2002.
4. Laboratory Manual winter school on Meta genomics .P.Gunasekaran, MKU Press, Madurai,2009.
5. Laboratory manual : Winter school on Microbial genome typing . P.Gunasekaran, MKU press, Madurai, 2008.
6. Biotechnology of antibiotics, Stroh, William R, 2<sup>nd</sup> ed. Marcel Dekker Inc. 1997.
7. Gnesenomics, proteomics & vaccines. Gudiograndi.John Wiley&sons, New York.2004
9. Ge, Benjamin Lewin, Jones and Bartletts Publishers, 2008. 9.Molecular genetics MYOBACTERIA. W.R. Jacobs, ASM press2000.

## **CORE ELECTIVE III (B) : FOOD & NUTRITION**

Objectives: To enable students to gain a deeper understanding about principles of nutrition and also to develop competence to carry out investigation in nutrition

### **UNIT I**

Nutrition and Dietary System: Definition of food nutrition, basic food groups, physiological role and nutritional significance of carbohydrates, protein, lipids, vitamins and minerals .protein malnutrition (Kwashiorkar) and under nutrition (marasmus) and their preventive, curatives measures.

### **UNIT II**

Nutrients: Macro minerals: Calcium ,phosphorus Magnesium, sodium, potassium chloride. Micro minerals :Iron, zinc, copper, selenium, chromium, iodine, manganese, molybdenum and fluoride. Ultra traceminerals :Arsenic, Boron, Nickel, silicon, vanadium & cobalt: Digestion & absorption, Functions, Toxicity, interaction with other nutrients. Fat soluble vitamins: Vitamin A, Vitamin D,E&k. Water soluble vitamins: Vitamin c, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12,Vitamin B6.

### **UNIT III**

Nutritive and calorific Value of food: Unit of energy measurements of food stuffs by Bomb calorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Nutritive value of protein, essential amino acid. composition of balanced diet for infants, pregnancy and lactating women, old age.

### **UNIT IV**

Food adulteration & food poisoning: sources of floods, types ,advantages and disadvantages, constituents of foods, carbohydrate ,protein, fats, oils, colors, flavours, natural toxicants. Sources ,causes and remedies for acidity, gastritis, indigestion and constipation

### **UNIT V**

Food preservation and processing: food spoilage, causes of food spoilage ,types of food spoilage, food preservations, food processing – different types, sterilizations & pasteurization

#### **References:**

3.Seema yadav: - Food Chemistry, anmol publishing (P) Ltd, NewDelhi

4.Car H.Synder: -the extraordinary chemistry for ordinary things, John Wiley & sonsinc, NewYork,1992.

3.B.Sivasankar – food processing and preservation – PHI learni9ng (P) LTD , New Delhi – 11001.

## CORE ELECTIVE III (C) : Herbal Biotechnology

### *Objectives*

- \*To give the details of plant derived value added compounds and its functions
- \* To provide knowledge on biotech based production of Herbal medicines

### **UNIT I Introduction to Herbal Medicine**

Study of on history and scope of herbals - Introduction to Indian system of medicine – Herbal drugs and its important- Herbal Cosmetic and Cosmeceuticals - Formulation Development of herbal preparations - Herbal Drug discovery and Novel drug delivery systems.

### **UNIT II Herbal Drugs and Phytochemistry**

Important medicinal herbs in treating diseases- Phytochemistry of medicinal plants- alkaloids- flavones- flavanoids and xanthenes -furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - sterols and steroid like compounds - tannins and terpenes.

### **UNIT III Herbal Biotechnology**

Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation. Herbal gardening and maintenance- Standardization of cultivation protocols of selected medicinal plants; *in vitro* production of secondary metabolites. Polyhouse Technology- Important diseases of medicinal plants and their management.

### **UNIT IV Selection Methods**

Methods Involved in secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scale up - Enhancement of product formation by elicitation- Immunodiagnostics and molecular diagnostics in selection of elite plant species.

### **UNIT IV Separation Techniques and Analysis**

Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).

## **UNIT V Pharmaceutics and IPR**

Pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins. - Intellectual Property Rights - Regulatory Affair herbal pharmaceuticals - Entrepreneurship Management.

## **REFERENCES**

1. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
2. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University, Press, 1996.
3. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press. 2009.
4. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
6. Bidlack, W.R., Omaye, S.T., Meskin, M.S. and Topham, D.K.W., "Phytochemicals as Bioactive Agents", 1st Edition, CRC Press, 2000.
7. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth. Edn. 1, Printed in the USA by Malloy Lithographing Inc.

## OPEN ELECTIVE II (A) : ENVIRONMENTAL SCIENCES

### Objectives:

- To introduce students to the basics of Environment.
- To make students understand the distribution of life and life forms on earth.
- To make students aware of the basic structure and functions of ecosystem.
- To make students understand the distribution and cycling of energy and matter in the Environment.

### **Unit-I: Fundamentals of Environmental Sciences**

Definition, Principles and Scope of Environmental Science - Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere - Meteorological parameters Environmental education and awareness. Environmental ethics.

### **Unit-II: Environmental Biology**

Origin of life and speciation - Ecosystem Structure and functions - food chains and food webs. Basis of Ecosystem classification -biotransformation - water and air borne microbes - Bioremediation, Bioindicators, Biofertilizers, Biofuels and Biosensors.

### **Unit-III: Environmental Geosciences**

Origin of earth - Climates of India- weathering reactions, erosion, transportation and deposition of sediments -Soil forming minerals and process - Identification and characterization of clay minerals - Groundwater quality - Pollution of groundwater resources - mitigation of their impacts.

### **Unit-IV: Energy and Environment**

Sun as source of energy; solar radiation and its spectral characteristics - characteristics and energy content of coal, petroleum and natural gas. Energy use pattern in India and the world, emissions of CO<sub>2</sub> in and global warming.

### **Unit-V:Environmental Pollution and Control**

Air, Noise, Water, Soil, Thermal, Marine, Radioactive Pollution. Solid and Hazardous Waste Management - Electrical energy generation - e-waste - Fly ash - Plastic waste - Environmental Management System Standards - IPCC, UNEP, IGBP. Global Environmental Issues – Biodiversity loss, Climate change, Ozone layer depletion. Sea level rise.

### RECOMMENDED READINGS



1. Botkin, Daniel B. (2011). Environmental Science: Earth as a living Planet, John Wiley and Sons, New Delhi.
2. Chapman. J. L. and Reiss, M.J. (2005). Ecology, Principles ad Applictions, Cambridge University Press, London.
3. Dash, M.C. (1994).Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.
4. Gunther, O. (1998) Environmental Information Systems. Berlin, New York, Springer.
5. Miller G. Taylor and Scot Spoolman. (2011). Essentials of Ecology, Books/ Cole Learning, U.S.A.
6. Odum, E.P. (1971). Fundamentals of Ecology, W.B. Saunder Company, Philadelphia
7. Sharma P. D. (1996). Environmental Biology, Rastogi Publications, Meerut.
8. Verma P.S. and V.K. Agarwal. (1985). Principles of Ecology. S. Chand and Company (Pub.), New Delhi.
9. Strahler, A. V. and Strahler, A.A (1973). Environmental Geoscience, Wiley International.
10. PrimackR.B. 2014. *Essentials of Conservation Biology*, Oxford University Press, USA.

## OPEN ELECTIVE II (B): MEDICAL MICROBIOLOGY

### Objectives

\*To enable the students to understand the basics of Medical Microbiology

### UNIT I: Collections and transport of specimens

Collections and transport of specimens. Primary Media for isolation and their quality control. Antibiotic sensitivity testing procedure.

### UNIT II Host Parasite Relationship

Normal microbial flora of human body, Virulence factors of bacteria causing infection, Microbial Infections, Host Parasite Relationships.

### UNIT III Bacterial pathogens and associated diseases part I

Classification, Morphology, cultural & Biochemical characteristics, pathogenicity, Lab diagnosis & Prophylaxis and treatment of disease caused by *Staphylococci*, *Streptococci*, *Neisseriae*, *Mycobacteria*, *Corynebacteria*, *Bacillus*, *Clostridium*.

### UNIT IV: Bacterial pathogens and associated diseases part II

*E. coli*, *Salmonella*, *Shigella*, *Vibrio*, *Pseudomonas*, *Spirochaetes*, *Rickettsiae*. Gram Negative anaerobes.

### UNIT V: Nosocomial and Zoonotic diseases

Hospital acquired infection –infection control committee, Zoonotic diseases- Anthrax, Plague.

### REFERENCES

1. David Greenwood, Richard C.B, Slack, John Forest peuthere “Medical Microbiology” 14<sup>th</sup>Edn. ELBS with Churchill Livingstone.
2. Ananthanarayanan R and JayaramPanicker, C.K. Textbook of microbiology-Orient Longman
3. Colle JC, Duguid JP, Fraser AC, Marimon (Bp) 1996. Mackie and McCartney Practical Medical Microbiology 14<sup>th</sup>Edn. Churchill Livingstone.

4. Baron L.J, Peterson L.R and Finegod S.M (1994) Bailey and Scott Diagnostic Microbiology, 9<sup>th</sup>Edn. Mosby Publications.
5. Cowan and Steel (1995) Manual for identificatioin of Medical Bacteria. 4<sup>th</sup> EDN, Cambridge University Press London.

## OPEN ELECTIVE II (C): AGRICULTURAL BIOTECHNOLOGY

### *Objectives*

- To make the students learn the fundamental principles of biotechnology, various developments and their applications and scope in agricultural Biotechnology.
- To provide knowledge in biotechnological innovations pertaining to issues in agriculture.

### **UNIT I Scope of Biotechnology**

History, scope and importance of biotechnology in Agriculture – Application of biotechnology in Agriculture.

### **UNIT II Mendelian Genetics**

Mendelian genetics, allosomes, linkage and extra chromosomal inheritance-Introduction to genetics - Earlier concepts of inheritance – cell and cell organelles- Cell division, Mendel's laws.

### **UNIT III rDNA Technology**

Nucleic acid structure and its function-Modes of DNA replication- Genetic code - Central dogma of life – Transcription – Translation- Recombinant DNA technology - DNA modifying enzymes –Cloning Vectors –Plasmids-cosmids-phagemids-Shuttlevectors-BAC-YAC-HAC-applications.

### **UNIT IV Gene Transfer**

Gene transfer methods – *Agrobacterium* - mediated gene transfer, direct gene transfer, gene silencing – Principles of QTL and Marker Assisted Selection (MAS) –Achievements - Transgenic plants – Achievements – Current trends.

### **UNIT V Hybridization and Sequencing**

Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCR based cloning, positional cloning- Nucleic acid hybridization and immunochemical detection- DNA sequencing.

### **REFERENCES**

1. Brown CM, Campbell I and Priest FG. 2005. Introduction to Biotechnology. Panima Publications.
2. Bhojwani and Dantu, 2013. Plant tissue culture: An introductory text, Springer, New Delhi.
3. Singh, B.D., Fundamentals of genetics 2014, Kalyani Publishers, New Delhi.
4. Gardner, E.J. & Snustad, D.P. 1991. Principles of Genetics. John Wiley & Sons, USA.
5. Chawla, H.S. 2008. Introduction to Plant Biotechnology, 3rd Ed. Oxford IBH, India.

6. Dale, J.W. and Von Schantz, M. 2002. From Genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons, New York, USA.
7. Snustad, D.P. & Simmons, M.J. 2006. Genetics. 4th Ed. John Wiley & Sons, USA.
8. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.

## **PRACTICAL V: LAB IN PLANT BIOTECHNOLOGY & ANIMAL BIOTECHNOLOGY**

### **Plant Biotechnology**

1. Introduction to plant tissue culture-induction of callus and suspension cultures.
2. Isolation and purify the protoplasts and check its viability.
3. Induction of somatic embryogenesis and analysis of different stages.
4. Extract the genomic DNA from plants by CTAB
5. Culture and selection of *Agrobacterium* on Agar medium
6. *Agrobacterium* mediated gene transformation
7. Use of Agroinfiltration for Transient Expression in Plant
8. Gus assay
9. Analysis of WT/ Transgenic plant by PCR
10. Isolation of Total RNA from leaves
11. Gene gun method of transformation
12. Synthetic seed preparation

### **Lab in Animal Biotechnology**

1. Development of primary cell lines/maintenance of established cell lines.
2. Cell counting and cell viability.
3. Trypsinization of monolayer and subculturing.
4. Gene transfer by transfection
5. Preparation of metaphase chromosomes from cultured cells.
6. Isolation of DNA and demonstration of apoptosis of DNA laddering
7. MTT assay for cell viability and growth

## References

1. Practical Applications of Plant Molecular Biology. Robert J. Henry .Routledge Chapman & Hall,2008.
2. Molecular Plant Biology: A practical approach (Vol. I and II). Gilmartin andBowler. Oxford University press, UK,2002.
3. Plant Cell Culture: Essential Methods. Michael R. Davey, Paul Anthony.Wiley, 2010.
4. Plant Tissue Culture, Third Edition:Techniques and Experiments . Roberta H. Smith. Academic Press,2012.
5. Plant cell culture Protocols (Methods in Molecular Biology, 3<sup>rd</sup> Ed). Victor M. Loyola-Vargas, Neftali Ochoa-Alejo. Humana Press,2012.
6. Plant Cell, Tissue and Organ Culture: Fudamental Methods (Springer Lab Manuals). Oluf L. Gamborg (Editor), Gregory Phillips (Editor), Springer,2013.

## **PRACTICAL VI: LAB IN MICROBIAL TECHNOLOGY & ENVIRONMENTAL BIOTECHNOLOGY**

### **Microbial Technology**

1. Study of fermentor-Demonstration.
2. Production and isolation of antibiotics (Penicillin and Streptomycin)
3. Production and analysis of Single cell protein (Spirulina and yeast)
4. Production of yoghurt and estimation of lactic acid.
5. Estimation of percentage of alcohol of given sample
6. Production and assay of  $\alpha$ -amylase from *Aspergillus niger* by solid substrate fermentation.
7. Immobilization of given enzyme/whole cells
8. Estimation of amount of citric acid in the given sample.

### **References:**

### **Environmental Biotechnology**

1. Water Analysis: Measurement of Total Solids, Total – dissolved solids, Total-suspended solids, dissolved oxygen, total hardness, chloride, turbidity, nitrite, nitrate, fluoride and total nitrogen.
2. Estimation of COD, BOD of industrial effluents.
3. Potability test of water (MPN technique).
4. Degradation of phenols. Colorimetric assay
5. Estimation of MIC and Heavy metal tolerance of chromium resistant bacteria
6. Screening of Biosurfactant activity-Oil Displacement test-Drop collapse test
7. Isolation of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans* from metal sulphides, rock and acid mine water.
8. Microbial degradation, decolorization and adsorption of organic dyes by free and immobilized cells
9. Studies on halophiles from sea water (pigmentation and salt tolerance)



## **MOOC- MASSIVE OPEN ONLINE COURSES**

## **USRR (UNIVERSITY SOCIAL RESPONSIBILITY REPORT)**

The aim of the Field Study is to help students connect with the society in the respective discipline. Following are the important features of the Field Study and the USRR:

**1. Aim:** The Field Study must aim at relating the subject of study with the society in so far as the application and the usefulness of the study are concerned

**2. Topic selection:** The topic for the Field Study must be chosen by the student in the second semester in the month of February; the process for the same shall begin on 1st February and shall end on the last working day of the month of February. Students are free to select the topic for the Field Study in consultation with the Experts and Faculty Members of their choice, both from within and outside the University

**3. Period and duration:** The Field Study shall be undertaken for a duration of 15 days in the summer vacation that falls immediately at the end of the second semester of the program and the same should be accounted for the Third Semester of the program

**4. USRR:** The USSR (University Social Responsibility Report) must be prepared by every student of the program written in 50 to 75 pages. The report shall be written based on the standard research methodology.

### **5. Review and evaluation schedule:**

*a. Reviewing the Field work:* First week of July

*b. Report Review:* Second week of August

*c. Report submission:* First week of September

*d. Report Evaluation:* Third week of September

**6. Faculty Composition:** The following members may be nominated for confirming the topic and for evaluating the USRR:

a. Professor and Head of the concerned Department

b. One Faculty member with related field of specialization from the concerned Department

c. One senior faculty member from the Department of Sociology from other Institution

## SEMESTER IV

### PAPER 13 : RESEARCH METHODOLOGY

**Objectives:** To enable the students to understand the importance's of research, familiarize on writing the project report, learn about the various applications of statistics in the research.

**Unit-I - Objectives and types of research:** Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

**Unit-II - Research Formulation** – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs- patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

**Unit-III - Research design and methods** – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, experimentation. Determining experimental and sample designs. Research techniques- microscopy, HPLC, HPTLC, GC-MS, FTIR, SEM/TEM, NMR and AAS.

**Unit-IV - Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

**Unit-V - Reporting and ethics** – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports. Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

## References

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2. Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International.418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing.270p.
5. Wadehra, B.L. 2000. *Law relating to patents, trademarks, copyright designs and geographical indications*. Universal LawPublishing.
6. Satarkar, S.V., 2000. *Intellectual property rights and Copy right*. EssEssPublication

## CORE ELCTIVE IV (A) .NANO BIOTECHNOLOGY

**Objective:** This discipline helps to indicate the merger of biological research with various fields of nanotechnology. This technical approach to biology allows scientists to imagine and create systems that can be used for biological research. The most important objectives that are frequently found in nano biology involve applying nano tools to relevant medical/biological problems and refining these applications.

### UNIT I

Introduction to nanotechnology: characteristic scale for quantum phenomena, nano particles, nano-clusters ,nano composite ,nao tubes, nano wires emergence of bio nanotechnology. characterization of nano particles- UV-Vis spectroscopy, electron Microscopy- HRTEM,SEM,AFM,EDS,XRD.

### UNIT II

Microbial nanotechnology – microbial synthesis of nano drugs-metal nano particles and drug delivery vehicles- Nanoshells – Tectodentrimers Nano particle drug systems – diagnostic applications of nanotechnology.

### UNIT III

Preparation of nano biomaterials – polymeric scaffolds collagen, elastins: Mucopolysaccharides, Proteoglycans ,cellulose and derivates; dextrans ; alginates; Pectins; Chitin. Nanoparticles – types, functions-Silver, Gold and Titanium. Physical and chemical properties of nanoparticles.

### UNIT IV

Nanoscale applications in biology and medicine: nanotechnology fro biology and medicine – micr and nano-fluides- scanning probe microscopy in biology and medicine- self –assembly of biological molecules .drug delivery – protein mediated and nanoparticle mediated. Hybrid conjugates of gold nano particles –DNA oligomers - use of DNA molecules in nanomechanics and computing . Nano particles as carrier for genetic material .Genetically modified organisms (GMO) and applications.

### UNIT V

Implications of nanotechnology : health and safety implications from nano particles: health issues- environmental issues- need for regulation – societal implications : possible military applications–potential benefits and risk for developing countries – intellectual property issues – criticism of Nanotechnology – studies on the implications ofNanotechnology.

### References:

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- 1.Parthasarathy, B.K(2007). Introduction to Nano technology ,Ishapublication.
- 2.Elisabeth Papazoglou and Aravind Parthasarathy (2007).Bio nanotechnology. Morgan & Claypoolpublishers.
- 3.Bernd Rehm (2006). Microbial bio nanotechnology: biological self-assembly

systems and biopolymer – based nanostructures. Horizon scientificpress.

4. David E. Reisner ,Joseph D. Bronzino (2008). Bio nanotechnology : global prospects. CRC Press.

5. Ehud Gazit(2006). Plenty of room for biology at the bottom: An introduction to bio nanotechnology. Imperial college press.

6. Hari Singh Nalwles , “ Nano structured materials and nanotechnology “,2002academic press

7. M.H.Fulekar,2010” Nanotechnology importance and applications .”I.K. International publishing housePvt.

8. Nanotechnology : Global strategies, Industry Trends and applications 2005John Wiley & sonsLtd.

## CORE ELECTIVE IV (B): GENETICS

Objective: To provide lucid knowledge in Principles of Genetics, overall view about genetic makeup of organisms and to pave a path for the students to take up genetic engineering research.

### Unit I

History of Genetics: Definition and scope of Genetics- Pre-mendelian genetic concepts. Basis of Mendelian Inheritance and Mendelian genetics. Simple Problems Relating to Inheritance. Structure of gene-Interaction of Gene-Commentary factors, Supplementary factors, Inhibitory and lethal Factors-Atavism. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes

### Unit- II

Blood Groups and their Inheritance in Human – Linkage and Crossing Over:- Drosophila – Morgans' Experiments – Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms – Cytological Evidence for Crossing Over, Mapping of Chromosomes – Interference and Coincidence.

### Unit-III

Sex Linkage in Drosophila and Man, Sex influenced and Sex Limited Genes – Non-Disjunction and Gynandromorphs – Cytoplasmic Inheritance – Maternal Effect on Limnaea (Shell Coiling), Male Sterility (Rode's Experiment). CO<sub>2</sub> sensitivity in Drosophila, Kappa particles in Paramecium, Milk factor Mice.

### Unit-IV

Nature and Function of Genetic Material – Genetic code – Why the genetic code is comma less, non ambiguous, degenerate triplet code. Fine Structure of the Gene – Cistron, Recon, Muton – Gene Regulation – Operon Concept – Lac Operon – Positive and Negative Regulation. Mutation – Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations – Numerical and Structural Examples from Human.

### Unit-V

Genetic engineering – Objectives, tools, gene cloning, and gene isolation. Transgenic plants and animals, Animal Breeding – Heterosis, Inbreeding, Out Breeding, Out Crossing, Hybrid Vigour. Population Genetics- Hardy Weinberg Law – Gene Frequency, Factors Affecting Gene Frequency, Eugenics, Euphenics and Ethenics, Bioethics.

### References:

1. Gunther, S. Stent, 1986. Molecular Genetics. Macmillan Publishing Co Inc. 773pp.
2. Goodenough, V., 1978. Genetics, 2<sup>nd</sup> ed., New York Holt, Rinehart and Winston, 894 pp.
3. Hart, D.L. and D. Freifelder, 1988. Basic Genetics, John & Barlet Publishers, 505 pp.
4. Gardner, 1972. Principles of Genetics, Wiley Eastern Pvt. Ltd. 590pp.
5. Watson, J.D. and W.A. Benjamin, 1976. Molecular Biology of the Gene, 3<sup>rd</sup>., Benjamin Co. Inc., New York, 739pp.<sup>79</sup>
6. Winchester, 1967. Genetics, Oxford IBH Publications, 504pp.
7. Stickberger, 1968. Genetics, Macmillan Publications, New York, 914pp.
8. Verma, P.S. and V.K. Agarwal, 1995. Genetics, 8<sup>th</sup> edition, S. Chand & Co., New Delhi – 110 055, 580pp.

## **CORE ELECTIVE IV (C): SYSTEM BIOLOGY**

**Objectives:** To gain basic knowledge of systems biology and understand some of the larger questions and issues with systems biology and large-scale data collection and analysis

### **Unit I:**

Molecular databases: accessibility, compatibility, comprehensive database, portability, quality, and navigability. Systems Biology: Definition, Hypothesis-driven research in systems biology, Wet experiments-Dry experiments: predictions and simulations. Reductionist and Integrative approach.

### **Unit II**

Interpreting expression data using Gene Ontology; Evolution of modularity and transcriptional networks, Riboswitches, metabolite sensing, and translational control; Microarrays-types and applications, Importance of non-coding sequence.

### **Unit III**

Protein-carbohydrate metabolism; Biochemical cycles; Interconnection of pathways-metabolic regulation; Translating biochemical networks into linear algebra; KEGG: theory and practice.

### **Unit IV**

Genomics, Proteomics, Metabolomics, Transcriptomics, Interactomics, Phenomics, Localizomics; Gene networks - Integration of Networks. Combination of omics approaches: data integration, modeling;

### **Unit V**

Synthetic biology, Artificial Intelligence (AI): Methodology, tools, and its application in agriculture, drug discovery, and biomedicine.

### **References**

1. Kitano, Systems Biology: A Brief Overview. Science, 2002, 295: 1662-1664.
2. Ideker et al. A new approach to decoding life: Systems Biology. Annual Review on Genomics and Human Genetics 2001, 2: 343-372.
3. Ideker et al. Integrated Genomic and Proteomic Analyses of a Systematically Perturbed Metabolic Network. Science, 2001, 292: 929-934.
4. Ge et al. Integrating „omic“ information: a bridge between genomics and systems biology. Trends in Genetics, 2003, 19, 10: 551-560.
5. Chong et al. Wholistic Biology, Science, 2003, 295:1661.

**PROJECT / DISSERTATION WITH VIVA-VOCE**