



# MAHENDRA ARTS & SCIENCE COLLEGE (Autonomous)

Affiliated to Periyar University, Salem.

Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956

Kalippatti - 637 501, Namakkal (Dt), Tamil Nadu.

## DEPARTMENT OF BIOTECHNOLOGY

Number of Courses Focusing on Employability/ Entrepreneurship/ Skill Development

Programme: M.Sc. Biotechnology

S.No.	Year	Total No. of Courses	Employability (1)	Entrepreneurship (2)	Skill development (3)	Total No. of Courses (1+2+3)
1.	2020-2021	36	4	1	14	19
2.	2019-2020	35	3	1	14	18
3.	2018-2019	35	2	3	10	15
4.	2017-2018	35	2	3	10	15
5.	2016-2017	22	1	3	7	11

Head of the Department

**HEAD OF THE DEPARTMENT**

Department of Biotechnology,  
Mahendra Arts & Science College (Autonomous),  
Kalippatti (Po) - 637 501, Tiruchengode (Tk),  
Namakkal (Dt), Tamil Nadu, India.

Principal

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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations - 2019)

#### Programme : M.Sc. Biotechnology

S.No.	Course Name	Course Code	Employability	Entrepreneurship	Skill development
1.	Microbiology	M19PBT04			✓
2.	Biophysics & Bioinstrumentation	M19PBTE01			✓
3.	Soil Science	M19PBTE02			✓
4.	Human Physiology	M19PBTE03	✓		
5.	Horticulture	M19PBTE04		✓	
6.	Genetic Engineering and rDNA Technology	M19PBT05			✓
7.	Immunology and Immuno-technology	M19PBT06			✓
8.	Bioprocess Technology	M19PBT07			✓
9.	Cancer Biology	M19PBTE05			✓
10.	Enzyme and Enzyme Technology	M19PBTE06			✓
11.	Clinical Biochemistry	M19PBTE07			✓
12.	Aquaculture	M19PBTE08		✓	
13.	Agro biotechnology	M19EBT01		✓	
14.	Health care and environmental biotechnology	M19EBT02			✓
15.	Environmental Biotechnology and Nanotechnology	M19PBT10			✓
16.	Marine Biotechnology	M19PBTE10			✓
17.	Stem cell Biology and Tissue Engineering	M19PBTE11			✓

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S.No.	Course Name	Course Code	Employability	Entrepreneurship	Skill development
18.	Apiculture	M19PBTE12	✓		
19.	Research methodology and Research Proposal Development	M19PBT12			✓

  
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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations - 2019)

#### Programme : M.Sc. Biotechnology

S.No.	Name of the Course	Course Code	Employability/ Entrepreneurship/ Skill development	Year of introduction (during the last five years)
1.	Microbiology	M19PBT04	Skill development	2019-2020
2.	Biophysics & Bioinstrumentation	M19PBTE01	Skill development	2019-2020
3.	Soil Science	M19PBTE02	Skill development	2019-2020
4.	Human Physiology	M19PBTE03	Employability	2019-2020
5.	Horticulture	M19PBTE04	Entrepreneurship	2019-2020
6.	Genetic Engineering and rDNA Technology	M19PBT05	Skill Development	2019-2020
7.	Immunology and Immuno-technology	M19PBT06	Skill Development	2019-2020
8.	Bioprocess Technology	M19PBT07	Skill development	2019-2020
9.	Cancer Biology	M19PBTE05	Skill Development	2019-2020
10.	Enzyme and Enzyme Technology	M19PBTE06	Skill Development	2019-2020
11.	Clinical Biochemistry	M19PBTE07	Skill Development	2019-2020
12.	Aquaculture	M19PBTE08	Entrepreneurship	2019-2020
13.	Agro biotechnology	M19EBT01	Entrepreneurship	2019-2020
14.	Health care and environmental biotechnology	M19EBT02	Skill development	2019-2020
15.	Environmental Biotechnology and Nanotechnology	M19PBT10	Skill development	2020 - 2021
16.	Marine Biotechnology	M19PBTE10	Skill development	2020 - 2021
17.	Stem cell Biology and Tissue Engineering	M19PBTE11	Skill development	2020 - 2021
18.	Apiculture	M19PBTE12	Employability	2020 - 2021

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S.No.	Name of the Course	Course Code	Employability/ Entrepreneurship/ Skill development	Year of introduction (during the last five years)
19.	Research methodology and Research Proposal Development	M19PBT12	Skill development	2020 - 2021

  
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## **MASTER OF SCIENCE**

### **SYLLABUS FOR M.Sc. BIOTECHNOLOGY**

#### **OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM**

**For the students  
admitted from the  
Academic Year 2019-2020 onwards**

  
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# **MAHENDRA ARTS & SCIENCE COLLEGE**

**(Autonomous)**

**(Affiliated to Periyar University)**

## **Department of Biotechnology**

### **REGULATIONS FOR M.Sc. BIOTECHNOLOGY DEGREE COURSE**

#### **WITH SEMESTER SYSTEM AND CBCS PATTERN**

**(Effective from the academic year 2019-2020)**

#### **I. PREAMBLE**

Biotechnology has grown, extensively in last couple of decades. This advanced 'interdisciplinary' life science branch has a tremendous networking potential with modern cutting edge technology. This has given it a separate status in fundamental research as well as in modern industrial enterprise. Global and local focus has slowly shifted to not only current "Century of Knowledge" but also on to technology development and application in life sciences. In the milieu of research and industrialization for economic development and social change, biotechnology is an ideal platform to work.

The proposed credit-based curriculum and outcome based education system will even add much more to the existing interdisciplinary nature of biotechnology and will also offer many courses to the other branches of life science. The generative power of biological data is effectively harnessed by biotechnology like no other field. The relevance and application of these studies on living organisms and their bioprocesses is extensively covered in this field with the help of technology. Education and research sectors require such interdisciplinary trained workforce to develop future generations of science leaders.

## **II. PROGRAMME OBJECTIVES**

- ❖ To help the students to build interdisciplinary approach.
- ❖ To expertise students in the field of biotechnology and industry needs and providing solutions for product/processes/technology development.
- ❖ To develop confidants among students to work as entrepreneurs and biotechnologist with strong ethics and practical skills.
- ❖ To pursue higher education and research in reputed institute at National and International level.

## **III. PROGRAMME OUTCOMES**

- 1 Post Graduates will gain knowledge of Biotechnology, Science and Technology concepts to solve problems related to field of Biotechnology.
- 2 Post Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological practices
- 3 Post Graduates will be able to undertake any responsibility as an individual and as a team in a multidisciplinary environment.
- 4 Post Graduates will have thorough knowledge in Life sciences and will also be ready to engage them in lifelong learning.

## **IV. REGULATIONS**

These regulations shall take effect from the academic year 2019-2020, i.e, for students who are to be admitted to the first year of the course during the academic year 2019-2020 and thereafter.

### **1. Eligibility for Admission**

A candidate who has passed a Bachelor degree in Science with Biotechnology / Botany / Zoology / Biology / Microbiology / Microbial Gene technology/Bioinformatics / Biochemistry /Agriculture / Marine Biology / Home Science / Farm Science / Nutrition and Dietetics / Integrated Biology / Plant Science / Animal Science / Fisheries Science / Aquaculture / Medical Lab Technology / MBBS / BDS / B. Pharm / BSMS of this University or any of the above degree of any other University accepted by syndicates as equivalent thereto, subject to such conditions as may prescribed therefore shall be permitted to appear and qualify for the M.Sc., Biotechnology Degree Examination of this University after a course of study of two academic years.



## **2. Duration of the Programme**

The candidates shall complete all the courses of the programme in 2 years from the date of admission. The programme of study shall consist of four semesters and a total period of two years with a minimum of 90 credits. The programme of study will comprise the course according to the syllabus.

## **3. Programme of Study**

The Programme of study for the PG degree Programmes of all branches shall consist of the following:

- (i) Core courses
- (ii) Electives courses
- (iii) Skill Enhancement Courses
- (iv) Extra Disciplinary Course
- (v) Project
- (vi) Enhancement Compulsory Courses.

## **4. Examinations**

The Programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subjects(s) will be permitted to appear for the same in the subsequent semester examinations.

## V. STRUCTURE OF THE PROGRAMME:

### SEMESTER: I

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE - I	Cell Biology	M19PBT01	4	-	4	25	75	100
CORE COURSE -II	Biological Chemistry	M19PBT02	4	-	4	25	75	100
CORE COURSE -III	Molecular Biology	M19PBT03	4	-	4	25	75	100
CORE COURSE - IV	Microbiology	M19PBT04	4	-	4	25	75	100
ELECTIVE COURSE	Elective-I		4	-	3	25	75	100
CORE PRACTICAL- I	Practical - I- Cell Biology and Biological Chemistry	M19PBTP01	-	5	4	40	60	100
CORE PRACTICAL- II	Practical - II- Microbiology and Molecular Biology	M19PBTP02	-	5	4	40	60	100
<b>Total</b>			<b>20</b>	<b>10</b>	<b>27</b>	<b>205</b>	<b>495</b>	<b>700</b>

### SEMESTER: II

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE - V	Genetic Engineering and rDNA Technology	M19PBT05	4	-	4	25	75	100
CORE COURSE - VI	Immunology and Immunotechnology	M19PBT06	4	-	4	25	75	100
CORE COURSE - VII	Bioprocess Technology	M19PBT07	4	-	4	25	75	100
*ELECTIVE COURSE	Elective -II		4	-	3	25	75	100
EDC			4		4	25	75	100
CORE PRACTICAL- III	Practical - III- Genetic Engineering and rDNA technology	M19PBTP03	-	4	4	40	60	100
CORE PRACTICAL- IV	Practical-IV- Immunology and Bioprocess technology	M19PBTP04	-	4	4	40	60	100
ENHANCEMENT COMPULSORY COURSE	Human Rights	M19PHR01	2	-	2	25	75	100
Comprehensive Examination-I		M19PBTC01	-	-	1	-	-	100
<b>Total</b>			<b>22</b>	<b>8</b>	<b>30</b>	<b>330</b>	<b>570</b>	<b>900</b>

\*Note: The Open Book examination to be conducted for this course

**SEMESTER: III**

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE - VIII	Plant Biotechnology	M19PBT08	4	-	4	25	75	100
CORE COURSE - IX	Animal Biotechnology	M19PBT09	4	-	4	25	75	100
CORE COURSE - X	Environmental Biotechnology and Nanotechnology	M19PBT10	4	-	4	25	75	100
CORE COURSE - XI	Proteomics and Genomics	M19PBT11	4	-	4	25	75	100
ELECTIVE COURSE	Elective-III		4	-	3	25	75	100
CORE PRACTICAL-V	Practical - V-Plant and Animal Biotechnology	M19PBTP05	-	5	4	40	60	100
CORE PRACTICAL-VI	Practical - VI-Environmental Biotechnology, Proteomics and Genomics	M19PBTP06	-	5	4	40	60	100
<b>Total</b>			<b>20</b>	<b>10</b>	<b>27</b>	<b>205</b>	<b>495</b>	<b>700</b>

**SEMESTER: IV**

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
*CORE COURSE - XII	Research methodology and Research Proposal Development	M19PBT12	4	-	4	25	75	100
CORE PROJECT	Project	M19PBTPR1	-	24	4	40	60	100
	Internship	M19PBTPIS01	-	2	2	40	60	100
Comprehensive Examination-II		M19PBTC02	-	-	1	100	-	100
<b>Total</b>			<b>4</b>	<b>26</b>	<b>11</b>	<b>205</b>	<b>195</b>	<b>400</b>
<b>Grant Total</b>			<b>66</b>	<b>54</b>	<b>95*</b>	<b>945</b>	<b>1755</b>	<b>2700</b>

\*Note: The Open Book examination to be conducted for this course

\*The students will gain extra credits for successful completion of online courses from SWAYAM / MOOC.



### Summary of Credits, Hours and Mark Distribution

Course Category	Credits				Total Credits	Total Hours	No. of Courses	Max. Marks
	I	II	III	IV				
<b>Core</b>	<b>16</b>	<b>12</b>	<b>16</b>	<b>4</b>	<b>48</b>	<b>48</b>	<b>12</b>	<b>1200</b>
<b>Core Practical</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>-</b>	<b>24</b>	<b>28</b>	<b>6</b>	<b>600</b>
<b>Elective</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>-</b>	<b>9</b>	<b>12</b>	<b>3</b>	<b>300</b>
<b>EDC</b>	<b>-</b>	<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>	<b>4</b>	<b>1</b>	<b>100</b>
<b>Project</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>4</b>	<b>4</b>	<b>24</b>	<b>1</b>	<b>100</b>
<b>Human Rights</b>	<b>-</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>100</b>
<b>Internship</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>100</b>
<b>Comprehensive Exam</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>2</b>	<b>-</b>	<b>2</b>	<b>200</b>
<b>TOTAL</b>	<b>27</b>	<b>30</b>	<b>27</b>	<b>11</b>	<b>95*</b>	<b>120</b>	<b>24</b>	<b>2700</b>

\*The students will gain extra credits for successful completion of online courses from SWAYAM / MOOC.

**ELECTIVE SUBJECTS FOR M.Sc. STUDENTS**

<b>Semester</b>	<b>ELECTIVE - I</b>	
<b>I</b>	<b>Course Title</b>	<b>Course Code</b>
	Biophysics & Bioinstrumentation	
	Soil Science	
	Human Physiology	
	Horticulture	
<b>ELECTIVE - II</b>		
<b>II</b>	<b>Course Title</b>	<b>Course Code</b>
	Cancer Biology	
	Enzyme and Enzyme Technology	
	Clinical Biochemistry	
	Aquaculture	
<b>ELECTIVE - III</b>		
<b>III</b>	<b>Course Title</b>	<b>Course Code</b>
	Biostatistics	
	Marine Biotechnology	
	Stem cell Biology and Tissue Engineering	
	Apiculture	

**EXTRA DISCIPLINARY COURSES OFFERED FOR OTHER DEPARTMENT STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
<b>II</b>	Agro Biotechnology	
	Health care and environmental biotechnology	

## VI. SCHEME OF EXAMINATION:

### 1. Question Paper Pattern for Theory Examination

Time: Three Hours

Maximum Marks: 75

**Part A: (10 × 1 = 10)**

Answer ALL Questions  
(Objective Type - Two Questions from each unit)

**Part B: (5 × 2 = 10)**

Answer ALL Questions  
(One Question from each unit)

**Part C: (5 × 5 = 25)**

Answer ALL Questions  
(One Question from each unit with internal choice)

**Part D: (3 × 10 = 30)**

Answer Any Three out of Five Questions  
(One Question from each unit)

### 2. Question Paper Pattern for Practical Examination

Time: Six Hours

Maximum Marks: 60

Major Practical	=	20 Marks
Minor Practical	=	10 Marks
Spotters (5×4=20)	=	20 Marks
Viva Voce	=	05 Marks
Record	=	05 Marks
Total	=	60 Marks

### 3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory/Practical / Project courses of PG programmes.

End Semester Examination	□EA Total	Passing Minimum for EA	CIA Total	Passing Minimum for CIA	Total Marks Allotted	Passing Minimum (ESE)
Theory	75	38	25	12	100	50
Practical	60	30	40	20	100	50
Project	60	30	40	20	100	50

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical papers of PG programmes.



## **THEORY**

### **EVALUATION OF INTERNAL ASSESSMENT**

Test	: 10 Marks
Seminar	: 05 Marks
Assignment	: 05 Marks
Attendance	: 05 Marks

-----  
Total : 25 Marks  
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The Passing minimum shall be 50% out of 25 marks (12 marks)

## **PRACTICAL**

### **EVALUATION OF INTERNAL ASSESSMENT**

Test 1	: 15 Marks
Test 2	: 15 Marks
Record	: 10 Marks

-----  
Total : 40 Marks  
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The Passing minimum shall be 50% out of 40 marks (20 Marks)

## **PROJECT**

### **EVALUATION OF INTERNAL ASSESSMENT**

Review 1	: 10 Marks
Review 2	: 10 Marks
Review 3	: 10 Marks
Pre-Viva	: 10 Marks

-----  
Total : 40 Marks  
-----

The Passing minimum shall be 50% out of 40 marks (20 marks)

### **4. Passing Minimum:**

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks in the End Semester Practical Examinations.

## **5. Submission of Record Note Books for Practical Examinations**

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations

## **7. Project**

The following guidelines to be followed for the Project with Viva-voce:

1. The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner / guide/ teacher concerned.
2. The Project Report may consist a minimum of 60 pages.
3. The candidate has to submit the Project Report 20 days before the commencement of the VI Semester Examinations.
4. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

## **VII. Note**

### **SWAYAM / MOOC – Free Online Education**

SWAYAM / MOOC is an instrument for self-actualisation providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

## SEMESTER I

<b>Core - I</b>	<b>M.Sc., Biotechnology</b>	<b>2019-2020</b>
<b>Code : M19PBT01</b>	<b>CELL BIOLOGY</b>	
<b>Credits: 4</b>		

### Objective

To provide information about cells, including their composition, function and cell-cycle checkpoints.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the fundamental principles cellular biology	K1
CO2	Understand the cell, cell cycle and Cell signaling	K2
CO3	Understand the cellular components underlying mitotic and meiotic cell division.	K2
CO4	Give the ideas about cell organelles	K3
CO5	Discuss the  Understand the development of model organisms and stem cell types, uses in tissue repair	K2



## **UNIT I**

Structure and functions of Prokaryotic and Eukaryotic cells- Cell-wall, Cell Membrane, Cell organelles - Nucleus, Mitochondria, Plastids, Endoplasmic Reticulum, Golgi complex, Lysosomes, Microtubules, Centriole, Vacuole, Cilia and Flagella.

## **UNIT II**

Chromosome structure and functions – Giant chromosomes, Lamp brush and Polytene Chromosomes, Karyotype analysis, Chromosome abnormalities.

## **UNIT III**

Cell cycle: overview of cell cycle-control system, Regulation of the Cell Cycle, Mitosis, Meiosis, Molecular control involving checkpoints in cell division cycle. Differentiation, Cellular senescence.

## **UNIT IV**

Cell signaling – types, Chemical signals and cellular receptors, G Protein-linked receptors, Protein Kinase-associated receptors, Growth factors as messengers, Cell signals and Apoptosis, Cytoskeleton: microfilaments-intermediate filaments-microtubules.

## **UNIT V**

Development of Multicellular organisms- yeast, *Caenorhabditis elegans* and *Arabidopsis thaliana*, *Drosophila melanogaster*, Stem cells, types, use of stem cells to repair damaged tissues.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Cell and Molecular Biology	P.K.Gupta	Rastogi Publishers	2002
2.	Molecular Cell Biology	Lodish et al.	WH Freeman	2004

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Cell and Molecular Biology	De Robertis	Waverly publication	2004
2.	Reproduction in Eukaryotic cells	D.M.Presco	Academic Press	1976
3.	Molecular Biology of the Cell	Alberts	Garland publication, 4 <sup>th</sup> edition	2002
4.	Developmental Biology	SF. Gillbert	Sinauor Associates Inc.	2016
5.	Cell in Development and Inheritance	EB Wilson	MacMillan, New York	1996
6.	Molecular Biology of steroid and nuclear hormone receptors	Birkhuser	LP Freeman	1998
7.	Cell and Molecular Biology	Gerald Karp	Wiley Publishing Inc	1999
8.	The world of Cell, 6 <sup>th</sup> edition	Becker, W.M <i>et.al.</i>	Pearson Education	2007

### Mapping with Programme Outcomes

<b>Cos</b>	<b>P01</b>	<b>P02</b>	<b>P03</b>	<b>P04</b>	<b>P05</b>
<b>CO1</b>	S	S	S	M	S
<b>CO2</b>	S	M	S	M	S
<b>CO3</b>	M	M	S	S	S
<b>CO4</b>	S	S	M	M	M
<b>CO5</b>	M	M	S	S	S

**S**-Strong; **M**-Medium



## SEMESTER I

<b>Core - II</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBT02</b>	<b>BIOLOGICAL CHEMISTRY</b>	
<b>Credit: 4</b>		

### Objective

To provide knowledge about biomolecules classification, synthesis, metabolism and their role in living cells.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Impart knowledge about acid, bases, buffers, pH and thermodynamic principles	K3
CO2	Make knowledge about carbohydrate and lipid classification and its metabolism	K2
CO3	Impart knowledge of amino acid, protein structure and classification	K3
CO4	Make Knowledge about secondary metabolites of living organism Understand the basic principles of nucleotide metabolism	K3
CO5	Understand the basic principles of hormones function and the impact of vitamin and minerals in human health	K4

## **UNIT I**

Principles of thermodynamics- First and second laws of Thermodynamics. Free energy – Concepts of metabolism: Types- Catabolism and anabolism with reference to pathways. pH, pK, acids, bases, buffers.

## **UNIT II**

Sugars-Classification and reactions, polysaccharides-types, structural features, methods for compositional analysis. EMP pathway, TCA cycle. Lipids-Classification, structure and functions. Beta oxidation of fatty acids cholesterol biosynthesis

## **UNIT III**

Aminoacids - Classification, chemical reactions. Proteins-Classification, hierarchy in structure, Ramachandran plot. Protein sequencing, Glyco and Lipoproteins- Structure and function.

## **UNIT IV**

Biosynthesis of purines and pyrimidines- De Novo and salvage pathway. Secondary metabolites in living systems: Alkaloids, Steroids and Flavonoids.

## **UNIT V**

Vitamins-Fat soluble and water soluble vitamins. Role of vitamins in human health. Hormones: Definition, Classification of hormones. Biological functions and disorders of pancreatic hormone (Insulin), thyroid hormone (Thyroxin), Hypothalamus and pituitary hormone (GH, TSH, GTH, ADH) Hormones and reproduction-Hormones in pharmaceuticals.

## **TEXT BOOKS:**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Fundamentals of Biochemistry	J.L. Jain	S.Chand publications	2004
2.	Essentials of Biochemistry	U.Sathyanarayanan	Books and allied (p) Ltd	2002
3.	Understanding Chemistry	CNR Rao	Universities Press, Hyderabad	1999

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Fundamentals of Biochemistry	Donald Voet, Judith G.Voet and Charlotte W Pratt	John Wiley & Sons, NY	1999
2.	Biochemistry	lubert stryer	W H freeman and co, Sanfrancisco	1994
3.	Text book of biochemistry	Thomas M devlin	A John Wiley, In.	1997
4.	Biochemical Calculations	Irwin H.Segal	John Wiley and Sons Inc	2010

**Mapping with Programme Outcomes**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	M	M	M	S
<b>CO2</b>	M	M	M	S	S
<b>CO3</b>	S	S	M	M	S
<b>CO4</b>	S	M	S	S	S
<b>CO5</b>	S	S	S	M	S

**S**-Strong; **M**-Medium.

## SEMESTER I

<b>Core - III</b>	<b>M.Sc Biotechnology</b>	<b>2019-2020</b>
<b>Code : M19PBT03</b>	<b>MOLECULAR BIOLOGY</b>	
<b>Credit : 4</b>		

### Objective

To provide detailed idea about gene organization and expression of prokaryotic and eukaryotic organisms.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	To understand the basic concept of molecular biology and mechanism of nucleotide	K2
CO2	Describes the detailed knowledge about prokaryotic and eukaryotic transcription and its regulatory mechanism	K2
CO3	Describes the detailed knowledge about prokaryotic and eukaryotic translation with the protein synthesis and localization	K3
CO4	To understand the oncogene expression and its structure and function	K3
CO5	To understand the molecular markers and its various applications.	K3

## **UNIT I**

Introduction of molecular biology, Central dogma of molecular Biology. DNA Replication - Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication.

## **UNIT II**

Transcription - Prokaryotic and Eukaryotic transcription, RNA polymerase, transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing. Modifications in RNA. 5' cap formation, 3'-end processing and Polyadenylation, Splicing, Editing, Nuclear export of mRNA.

## **UNIT III**

Translation -Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post- translational modifications of proteins. Protein Localization. Synthesis of Secretory and membrane proteins, import into nucleus, mitochondria and chloroplast.

## **UNIT IV**

Oncogenes and Tumor Suppressor Genes-Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, function and mechanisms of action of pRB and p53 tumor suppressor proteins.

## **UNIT V**

Molecular Mapping, physical mapping and map based cloning, Southern and fluorescence in situ hybridization, RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling.



**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Molecular cloning A Laboratory Manual	J.Sambrook, E.F.Rritsch and I.Maniatis	Cold Spring Laboratory Press, New York	2000
2.	Introduction to Practical Molecular Biology	P.D.Dabre	John Wiley and Son Ltd	1988
3.	Molecular Biology	Labfax, T.A.Brown J.D.Watson, N.H.Hopkins,	Bioscientific publishers ltd	1991
4.	Molecular Biology of gene	J.W.Roberts, J.A.Steitz and A.M.Weiner J.Darnell,	The Benjamin/Cummings publications C Inc.California	1987
5.	Molecular Cell Biology	H.Lodish and D.Baltimore	American Book, USA	1994
6.	Gene VII	Benjamin Lewin	Oxford University Press	
7.	Molecular Biology and Biotechnology A comprehensive reference	R.A.Meyers	VCH Publishers, Inc	1995
8.	Molecular Biology and Biotechnology	J.M.Walker and R.Rapley	Wiley	2005

<b>Core - IV</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBT04</b>	<b>MICROBIOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To understand better knowledge about history of microbiology and development, medical microbiology and genetic mutations.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand the history , development and Visualization using different microscopy study	K1
CO2	Understand the microbial growth regulation and cultivation of microbes.	K2
CO3	Understand the physiological parameters required for the microbial growth.	K3
CO4	Describes the microbial infections to the animals and human	K3
CO5	Describes the details of the microbial genetics-Mutations, transformations and viral life cycle	K3

### UNIT I

**History and development of microbiology. Microscopy-** bright field, dark field, Electron. **Sterilization, Control of microorganisms by physical and chemical methods. Bacterial taxonomy and classification** according to Bergy's manual. **Stains and staining methods-simple, differential and special staining.**

## UNIT II

Microbial Growth-mathematical expression of growth, growth curve, measurement of growth. Synchronous culture and Continuous culture. Factors affecting microbial growth. Culture media and their types. Pure Culture Techniques-Serial dilution methods - spread plate - pour plate - streak plate technique. Culture collection and preservation of microbial cultures.

## UNIT III

Nutritional requirements and types of microorganisms, uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

## UNIT IV

Host - parasite relationship, normal microflora. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action - antibacterial, antiviral, antifungal, antiparasitic agents.

## UNIT V

Mutation and Mutagenesis; UV and chemical mutagens; Types of mutation; Ames test for mutagenesis; Methods of genetic analysis - Transformation, Conjugation, Transduction, Recombination. Plasmids and Transposons. Bacterial genetic maps with reference to *E. coli* - Viruses and their genetic system - Phage life cycle, Genetic systems of yeast and Neurospora .

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1	Microbiology, 5 <sup>th</sup> Edition	Pelczar MJ , Chan ECS, and Krieg NR	Tata McGraw Hill Publishing Company	2006
2.	Microbiology 5 <sup>th</sup> Edition	Pelzer, Chan and Kreig.	McGraw-Hil.	1986
3.	Microbiology 5 <sup>th</sup> Edition	Prescott, Harley, Klein	McGraw Hill Publ	2003
4	Microbiology, 7 <sup>th</sup> Edition	Benson HJ	McGraw Hill	1999

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Microbial Physiology	S.Meenakumari	MJP Publishers	2004
2.	General Microbiology.	Powar and Daginawala.	Himalaya Publishing House	2010

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	S	M	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	S	M	M

**S-** Strong; **M**-Medium.

**SEMESTER I****Elective**

<b>Elective - I</b>	<b>M.Sc., Biotechnology</b>	<b>2019-2020</b>
<b>Code: M19PBTE01</b>	<b>BIOPHYSICS AND BIOINSTRUMENTATION</b>	
<b>Credits : 3</b>		

**Objective**

To introduce fundamental concepts of biophysics and to focus on the bioanalytical techniques.

**Course Outcomes**

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understanding various structure, types and stability of proteins and nucleic acids	K1
CO2	Understand the basic principles and maintains of spectral analysis like UV, FT-IR, MALDI-TOF.	K2
CO3	Make knowledgeable and learn about different centrifugation and electrophoresis techniques	K3
CO4	Impart knowledge about different chromatographic techniques	K4
CO5	Understand about different imaging techniques and its application	K3



## UNIT I

Scope and methods of Biophysics. Understanding various structure of proteins, globular and fibrous protein; protein stability; protein folding. The physics of nucleic acids: Forces stabilizing structures; Double helical structures, properties and forms of DNA.

## UNIT II

Colorimeter-Beer Lambert's law, UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometer, IR and Raman Spectroscopy, Spectroflurometry, Mass Spectrophotometry- Matrix assisted laser desorption ionization and surface enhanced laser desorption ionization.

## UNIT III

Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation. Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

## UNIT IV

Chromatography- Paper chromatography- Thin layer chromatography- Column chromatography- LPCC and HPLC, Affinity chromatography, Partition chromatography, Ion exchange chromatography, Gel Permeation chromatography.

## UNIT V

Basic concept and measurement of radioactivity. Radioisotope techniques – GM Counter, Liquid scintillation, fluorimetry and its types. Physical Biomedical method of Imaging techniques, Intact biological structures (X- ray, CAT-SCAN, ECG, EEG, NMR) Autoradiography, X ray crystallography.

### REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Biochemistry 2nd Edn	Voet, D. & Voet,J.G.	John Wiely & Sons	1995
2.	Bioinstrumentation	John Webster	John Wiely & Sons	2004
3.	Bioinstrumentation	Veerakumari	MJP Publishers	2006
4.	Biochemistry, 4th Edi	Zubay.G.L	WmC.Brown Publishers	1993

### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	S	M	S	M	M
<b>CO2</b>	S	M	S	S	S
<b>CO3</b>	S	S	M	M	S
<b>CO4</b>	M	M	S	S	S
<b>CO5</b>	S	S	S	M	S

**S-** Strong; **M**-Medium.

## SEMESTER I

<b>Elective - I</b>	<b>M.Sc., Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTE02</b>	<b>SOIL SCIENCE</b>	
<b>Credit: 3</b>		

### Objective

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand composition, phase system, texture, properties and mineralogical composition of soil.	K2
CO2	Knowledge and understanding of the soil structure, classification, soil aggregation, factors influencing the soil structure and plant growth	K2
CO3	Impart knowledge of factors influencing Soil consistency, Cohesion, Adhesion, Soil moisture, Forms of soil water, and water energy concept	K4
CO4	Understand the knowledge about Water flow in saturated and unsaturated soil and Soil Moisture Characteristic Curve	K3
CO5	Knowledge about soil air composition, thermal property and plant growth system.	K4

## UNIT I

Definition and composition of soil, Soil as three phase system (solid, liquid and gas), Soil texture, Influence of soil texture on soil properties, Various methods of estimation of soil texture. Classification according to various systems, Soil mineralogical composition.

## UNIT II

Clay and its classification, Soil Structure and soil aggregation, Classification of soil structure. Factors influencing soil structures and plant growth. Factors Influencing Bulk density, Particle density and Porosity.

## UNIT III

Soil consistency, Cohesion, Adhesion. Forms of consistency, Factor influencing soil consistency, Plasticity. Soil moisture, Forms of soil water. Water – energy concept, Soil moisture potential.

## UNIT IV

Water flow in saturated and unsaturated soil. Infiltration, Redistribution, Evaporation, Water balance in field. Soil Moisture Characteristic Curve. Hysteresis. Soil water movement. Saturated Flow, Unsaturated Flow.

## UNIT V

Factor Influencing Soil Air Composition. Effect of soil aeration on plant growth. Soil temperature and its importance, Thermal properties of soil. Effect of soil temperature on soil properties and on plant growth.

## TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Soil Physics	Baver, L. D., Gardner, W. H. and Gardner, W. R.	John Wiley, New York.	1972
2	Soil Physics	Oswal, M. C.	Oxford IBH, New Delhi	1994
3	Applied Soil Physics	Hanks and Ascheroff	Springer– Verlag, Berlin	1980
4	Environmental Soil Physics	Hillel, D.	Academic Press, New York	1998

5	Introduction to Soil Physics	Hillel, D	Academic Press, New York	1982
6	Application of Soil Physics.	Hillel, D.	Academic Press, New York.	1980

#### REFERENES BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Soil Physics	Khanke, H.	McGraw Hill Publishing Co., New Delhi	1968
2	Advanced Soil Physics	Kirkham, D. and Powers, W. L.	Wiley Interscience	1972
3	Soil Physics	Ghildyal, B. P., K. P. Tripathi.	Wiley Eastern Limited, New Delhi	1987

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	M	S	M	M	S
<b>CO2</b>	S	S	M	M	S
<b>CO3</b>	S	M	M	S	M
<b>CO4</b>	S	M	M	S	M
<b>CO5</b>	M	S	M	S	M

**S-** Strong; **M**-Medium.



## SEMESTER I

<b>Elective - I</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBTE03</b>	<b>HUMAN PHYSIOLOGY</b>	
<b>Credit: 3</b>		

### Objective

To provide the knowledge about structure and functions of different anatomical features relating to human physiology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand composition and functions of different blood components	K2
CO2	Make knowledgeable about role of human digestive system in digestion and absorption of food	K3
CO3	Impart knowledge of central nervous system and molecular signaling mechanism of hormones.	K4
CO4	Learn about human circulatory system	K4
CO5	Make knowledge about role of kidney in human excretory system	K3

## **UNIT I**

Blood- Composition and functions of plasma, hemopoiesis, erythrocytes including Hb, leukocytes and thrombocytes, plasma proteins and their role. Blood coagulation – mechanism and regulation, Fibrinolysis, Blood groups and Rh factor. Buffer systems of blood.

## **UNIT II**

Digestive system- Composition, functions and regulation of salivary, gastric, pancreatic, intestinal and bile secretions. carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. Role of peristalsis and large intestine indigestion.

## **UNIT III**

Nervous systems- Types of neurons and synapses and transmission of nerve impulse across them. Sensory receptors in skin and muscles. Endocrinology- effects of hormones of hypothalamus, pituitary, thyroid, adrenal gland and pancreas. Synthesis and functions of testosterone and ovarian hormones.

## **UNIT IV**

Circulatory system- Structure of heart, conduction and regulation of heart beat, heart rate and output. Mechanism of berating, regulation of respiration, transfer of blood gases and pulmonary circulation.

## **UNIT V**

Excretory system- Structure of nephron, formation of urine (glomerular filtration tubular reabsorption of glucose, water and electrolytes), role of kidneys in regulation of blood pressure. Control of body temperature.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Textbook of Medical Physiology	Arthur C. Guyton and John E. Hall	Harcourt Asia Pvt Ltd	2016
2.	Essential Medical Physiology	Leonard R. Johnson	Elsevier Academic Press	2003
3.	Endocrinology: An Integrated Approach	SS Nussey and SA Whitehead	BIOS Scientific Publishers	2001

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Principles of Anatomy and Physiology	Gerard J. Tortora and Sandra Grabowski	John Wiley and Sons	2003
2.	Human Physiology: The Mechanisms of Body Function	Arthur J. Vander, James Sherman, Dorothy S. Luciano, Eric P. Widmaier, Hershel Raff and Hershal Strang	McGraw Hill Education	2003
3.	Medical Physiology: Principles for Clinical Medicine	Rodney R. Rhoades and David R. Bell	Lippincott Williams & Wilkins	2017
4.	Principles of Human Physiology	Cindy L. Stanfield and William J. Germann	Pearson Education	2004

### Mapping with Programme Outcomes

<b>Cos</b>	<b>P01</b>	<b>P02</b>	<b>P03</b>	<b>P04</b>	<b>P05</b>
<b>CO1</b>	S	S	M	S	S
<b>CO2</b>	M	M	M	S	S
<b>CO3</b>	S	M	M	M	S
<b>CO4</b>	M	M	S	M	S
<b>CO5</b>	M	M	S	S	S

**S**- Strong; **M**-Medium

## SEMESTER-I

<b>Elective - I</b>	<b>M.Sc., Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBTE04</b>	<b>HORTICULTURE</b>	
<b>Credit: 3</b>		

### Objective

To emphasis on development of entrepreneurial potential and skills amongst the students in horticulture.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand the classification, importance and nutritional requirements of horticulture crops	K2
CO2	Knowledge about plant propagation methods, plant regulators uses.	K2
CO3	Impart knowledge of garden design, types and maintenance.	K4
CO4	Make knowledgeable and learn about floriculture and cultivation of commercial flowers and fruits.	K3
CO5	Understand basic concepts about green house, indoor gardening and its maintenance.	K4

### UNIT I

Horticulture :- Importance and scope of Horticulture, Classification of horticultural crops – fruits, vegetables crops, climate, soil, water, nutrition needs of horticultural crops,

### UNIT II

Plant propagation methods, cutting, layering, grafting, budding, stock-seion relationship. Use of plant regulators in horticulture.

### UNIT III

Garden designs, types of gardens – formal, informal and kitchen garden, units of garden, hedge, border, topiary arches and lawn maintenance.

### UNIT IV

Floriculture, cultivation of commercial flowers – rose and jasmines. Cultivation of important fruit trees – Mangoes and Banana.

### UNIT V

Green house, Indoor gardening – Bonsai – flower arrangements – nursery management and maintenance.

### TEXT BOOKS.

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Floriculture – fundamental and practices.	Lex Lauries & Victor H. Rice	McGraw Hill PublisherS	1950
2	Plant Propagation	Sandhu, M.K	Wiley Eastern Ltd.,New Delhi,	1989
3	Introduction to Horticulture	Kumar , N.	Rajalakshmi Publications	1997

### REFERENCE BOOK:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Gardening in India,	Bose, T.K. & Mukherjee, D.	Oxford & IBH Publishing Co	1972



## Mapping with Programme Outcomes

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	M	S	M
<b>CO2</b>	M	S	M	M	S
<b>CO3</b>	M	M	S	S	M
<b>CO4</b>	M	S	S	M	S
<b>CO5</b>	M	M	S	S	M

**S**- Strong; **M**-Medium.

## SEMESTER I

<b>Core Practical - I</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTP01</b>	<b>PRACTICAL - I - CELL BIOLOGY AND BIOLOGICAL CHEMISTRY</b>	
<b>Credit: 4</b>		

### Objective

To provide practical knowledge on techniques involved in cell biology and biological chemistry.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Know about microscope , cell size and its measurements and tissue sectioning using microtomy	K1
CO2	Understand mitosis and meiosis ,mounting of giant chromosomes, to prepare permanent slide using DPX and determine the sex chromatin of living cells	K2
CO3	Learn to calibrate pH meter, buffer preparation	K2
CO4	Quantitatively measure the amount of glucose, DNA, RNA, protein, starch, carbohydrate and amino acid	K4
CO5	Separate amino acid by paper and thin layer chromatography and protein purification using polyacrylamide gel electrophoresis	K4

### CELL BIOLOGY

1. Principles of Microscopy and optics
2. Measurement of Cell size by Micrometry
3. Preparation of permanent slides – DPX mount
4. Mitosis and Meiosis
5. Giant Chromosomes (Polytene-Chirnomous larvae)
6. Sex Chromatin (Barr Body)
7. Microtomy - Demo

### BIOLOGICAL CHEMISTRY

1. Preparation of Buffers
2. Calibration of PH meter
3. Verification of Beer Lambert's Law
4. Estimation of glucose (DNS method)
5. Estimation of DNA (Diphenylamine)
6. Estimation of RNA (Orcinol)
7. Estimation of Protein (Lowry's and Bradford Methods)
8. Extraction and Estimation of starch from potato/ tapioca
9. Separation of amino acids by Paper and Thin layer chromatography
10. Qualitative analysis of carbohydrate
11. Qualitative analysis of amino acids.
12. Native PAGE and SDS-PAGE

#### **TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Practical Clinical Biochemistry	Harold Varley	CBS publications	2005
2.	Cell Biology : Practical Manual	Renu Gupta, Seema Makhija, Dr. Ravi Toteja	Prestige Publishers	2018

#### **REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	An Introduction To Practical Biochemistry	David Plummer	Tata McGraw Hill Education	2006
2.	Laboratory Manual For Practical Biochemistry	Shivaraja Shankara	Jaypee Brothers Medical Publishers	2013
3.	Practical Biochemistry	Damodaran Geetha K	Jaypee Brothers Medical Publishers	2016

### Mapping with Programme Outcomes

<b>Cos</b>	<b>P01</b>	<b>P02</b>	<b>P03</b>	<b>P04</b>	<b>P05</b>
<b>C01</b>	S	S	S	S	S
<b>C02</b>	M	S	M	S	S
<b>C03</b>	M	M	M	S	S
<b>C04</b>	M	S	S	M	S
<b>C05</b>	M	M	S	S	S

**S**- Strong; **M**-Medium.

## SEMESTER I

<b>Core Practical – II</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTP02</b>	<b>PRACTICAL - II - MICROBIOLOGY AND MOLECULAR BIOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To acquire skills and competency in microbiological and molecular biological laboratory practices applicable to research or clinical methods, including accurately reporting observations and analysis.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
<b>MICROBIOLOGY</b>		
CO1	Learn sterilization techniques, media preparation, pure culture technique cultural characteristics, staining techniques and preservation of microbes	K1
CO2	Analyze biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis	K4
CO3	Perform antibiotic sensitivity test and measurement and stages of bacterial growth. Determination of potability of water by MPN method	K4
CO4	Induce Mutagenesis (UV, NTG & EMS)	K3
CO5	Isolate and detection single cell colony for antibiotic resistant bacteria , markers	K4

## **MICROBIOLOGY**

1. Safety guidelines in laboratory practices.
2. Preparation of washing solution.
3. Handling of Microscopes
4. Sterilization Techniques – Physical and chemical methods.
5. Preparation of broth and agar media
6. Maintenance of Microorganisms
7. Staining methods – Simple staining, differential staining, special staining, and LCB mount.
8. Motility of bacteria by hanging drop method.
9. Biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
10. Cultural characteristics of microorganisms on Basal medium, Selective medium, Differential medium, Enriched medium, Enrichment medium.
11. Isolation and pure culture of microorganisms from soil and water - Serial dilution methods, Plating, Streaking.
12. Growth - Growth curve, Measurement of bacterial population by turbidometry, haemocytometry and serial dilution methods.
13. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
14. Determination of potability of water by MPN method.

## **MOLECULAR BIOLOGY**

1. Single Cell Colony isolation – Checking for antibiotic resistant Markers.
2. Induced Mutagenesis (UV, NTG & EMS).
3. Isolation of antibiotic resistant Bacteria by gradient plate technique.
4. Detection of mutations by replica plate technique.
5. Study of Mutation by Ames test.

## **SPOTTERS**

1. Media – NA, EMB, MSA
2. Culture techniques– Quadrant, T streak, Pour plate, Spread plate
3. Growth curve, Antibiotic sensitivity test

4. Instruments – Autoclave, Hot air oven, Haemocytometer
5. Scientist – Louis Pasteur, Edward Jenner, Leewenhoek
6. Mutation

#### TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Microbiology: A Laboratory Manual	James G. Cappuccino, Natalie Sherman	Harlow, England : Pearson Education Limited (10 <sup>th</sup> Ed)	2014

#### REFERENCE BOOKS:-

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Laboratory Methods in Microbiology	W. F. Harrigan Margaret E. McCanc	Academic Press	1966
2.	Laboratory Cell and Molecular Biology: A Lab Manual	K.V.Chaitanya	Jaypee Brothers Medical Publishers	2013

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
MICROBIOLOGY					
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	M	M	S	S
<b>CO4</b>	M	M	S	M	S
<b>CO5</b>	S	S	M	M	M

**S-** Strong; **M**-Medium.



## SEMESTER II

<b>Core - V</b>	<b>M.Sc., Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBT05</b>	<b>GENETIC ENGINEERING AND rDNA TECHNOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To impart the versatile tools and techniques employed in genetic engineering and recombinant DNA technology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand the application of molecular enzymes	K1
CO2	Understand the concepts of vectors and its database	K2
CO3	To learn the gene cloning methods in theory and practice	K3
CO4	To learn the concepts of cloning strategy	K3
CO5	To learn genetic engineering of living organism for human benefit	K3

### UNIT I

**Manipulation of DNA- Restriction and modification enzymes:** Restriction enzymes, Ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase. **Linkers, Adaptors, Oligonucleotide primers & Homopolymer tailing.**

## UNIT II

Gene cloning vectors- Plasmids, Construction of pBR322, Bacteriophages vectors, phagemids, cosmids, Yeast vectors and Expression vectors in Prokaryotic and Eukaryotic, Ti plasmids, Vector NTI database,

## UNIT III

DNA sequencing techniques- Maxam Gilbert method, Sanger's method, Next generation sequencing, DNA Amplification- PCR and its types, RFLP, RAPD, SAGE, Sitedirected Mutagenesis, Molecular beacons, DNA hybridization and blotting techniques, Microarrays.

## UNIT IV

Cloning strategies- Gene Library construction, Screening of gene library, Expression strategies for heterologous genes- expression in bacteria, yeast, insects and insect cell lines, mammalian cell lines and in plants. Processing of recombinant proteins-Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

## UNIT V

Transposon tagging- Role of gene tagging in gene analysis. Gene Knock in and out technologies, Transgenic animals (Mice, Cattle, Fish), Transgenic plants (Herbicide tolerance, Delayed ripening) Antisense RNA technology, Human Gene Therapy, Ethics and Philosophies in rDNA.

## TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	DNA Science - A First Course in Recombinant Technology	Mickloss D.A and G.A.Greyer	Cold Spring Harbor Laboratory Press, New York	1990
2.	Molecular biotechnology	Primrose, S.B P. R. Vittal and V. Malini,	Blackwell Scientific Publishers, Oxford (2nd Ed)	1994

## REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Recombinant DNA	James Watson	D. Scientific American Books. USA Road, Chennai-600029	2001
2.	Molecular Biotechnology	Glick, Pasternak, J.J	B ASM Press, Washington	2007

## Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	S	M	M	S	S
CO3	M	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	M	M

**S**- Strong; **M**-Medium.

## SEMESTER II

<b>Core - VI</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBT06</b>	<b>IMMUNOLOGY AND IMMUNOTECHNOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To impart the principles and applications of immunology and immunotechnology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	To understand the infection, immunity and immune system of living things	K1
CO2	To understand the various types of antigens and its characterization.	K2
CO3	To know about the antigen and antibody interaction and some practical approaches.	K3
CO4	To understand the concept of hypersensitivity and also the autoimmunity	K3
CO5	Give the sound knowledge about immunological techniques and immune diagnosis.	K3

### UNIT I

History and scope of immunology, Host - Parasite relationship, Infection – types – mode of transmission, Immunity – types- mechanisms, Haematopoiesis. Organs of the immune system.

## UNIT II

Antigen – properties- classes, haptens, mitogens, adjuvants, epitopes. Immunoglobulin- structure & function, molecular diversity. Immune responses-humoral immune response & cell mediated immune response. Generation of lymphocyte specificity and diversity, clonal selection of lymphocytes.

## UNIT III

Antigen – Antibody reactions. Complements- components, properties, and activation path ways. Cytokines. Major histocompatibility complex –general organization and inheritance of MHC, structure –function- role in antigen processing and presentation. Immunological tolerance.

## UNIT IV

Hypersensitivity – types, mechanisms, manifestations. Transplantation, immuno suppressive therapy, Autoimmunity- mechanism of auto immunization- types. Immunodeficiency diseases. Tumor immunology. Vaccines- Principles, Applications and development. Immunization Schedule.

## UNIT V

Antigen-isolation and purification from pathogenic bacteria. Antibody production-Hybridoma technology and engineered monoclonal antibodies. Purification of antibodies. Isolation of macrophages. Macrophage culture. Immuno screening of recombinant library. Detection of immune complex in tissues. FACS. Delayed type hypersensitivity assessment –Mantoux test. Molecular aspects of HLA typing.

### TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Immunology and Immunotechnology	Rajasekara Pandian M and Senthilkumar B	Panima Publishing Corporation , New Delhi	2007

2.	Immunology 6 <sup>th</sup> Edn	Goldsby RA, Kindt TJ.Osborne BA, Kuby J	WH Freeman &Co. New York	2003
3	Immunology 3 <sup>rd</sup> Edn	Kuby J	Freeman &Co. New York	1997
4	Immunology 4 <sup>th</sup> Edn	Benjamini E, Coico R and Sunshine G	A John Wiley & sons, Inc. Publication.	2000
5	Immunology 3 <sup>rd</sup> Edn	Roitt I,Brostoff J and Male D	Mosby	1993
6	Microbiology 5 <sup>th</sup> Edn	Pelczar MJ, Chan ECS and Krieg NR	Tata McGraw- Hill Publishing Company Ltd.New Delhi.	2006
7	Immunology 4 <sup>th</sup> Edn	Tizard IR	Saunders College Publishing Harcourt Brace College Publishers.	1995
8	A hand book of practical immunology. 2 <sup>nd</sup> Edn. VolIII.	Talwar GP and Guptha	CBSPublications.	2004

### Mapping with Programme Outcomes

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	S	M	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	S	M	M

**S-** Strong; **M**-Medium.

## SEMESTER II

Core - VII	M.Sc. Biotechnology	2019 - 2020
Code: M19PBT07	BIOPROCESS TECHNOLOGY	
Credit: 4		

### Objectives

To provide insight knowledge on wide-ranging topics related to bioprocess technology and its applications.

### Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the techniques for the isolation of microorganisms from the various sources.	K3
CO2	Describes the methodology of storage and maintenance of the microorganisms	K3
CO3	To understand the downstream and downstream process of the microbial production	K4
CO4	To understand the basic techniques and operating system of the instrument for the bioprocess technology	K3
CO5	Describes the concept of downstream process	K2

## **UNIT I**

Introduction to bioprocess engineering, isolation and screening of industrially important microbes. Advantages of bioprocess over chemical process. Strain improvement-various methods, Fermentations – submerged, solid state. Immobilization- principles and applications.

## **UNIT II**

Media formulation. Sterilization-Thermal death kinetics. Batch and continues sterilization systems, Sterilization of air. Fibrous filters. Bioreactor design, parts and their functions. Types of reactors – CSTR, Tower, jet loop, Air left, bubble column and packed bed.

## **UNIT III**

Transport phenomenon in bioprocess – Mass transfer, Mass transfer for gases and liquids. Dimensionless groups. Mass transfer resistance. Rate of oxygen transfer. Determination of oxygen transfer coefficients. Biological properties of medium. Biological heat transfer. Heat transfer coefficients.

## **UNIT IV**

Bioprocess control and monitoring of variable such as temperature, agitation, pressure, pH. On line measurement. On/Off control, PID, Control. Computer applications in fermentation technology- components of a computer linked system, Data logging, Data analysis, process control.

## **UNIT V**

Downstream processing - Foam separation, Precipitation, Filtration, Centrifugation, Cell disruption, Extraction, Chromatography, Membrane Process, Drying, Crystallization and whole broth processing.



**REFERENCES BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Principles of Fermentation Technology	Peter F. Stanbury. Butterworth-Heinemann	Elsevier Science Ltd	2016
2.	Biotechnology: A Text Book of Industrial Microbiology	Wulf Crueger and Anneliese Crueger	Science Tech Publishers.USA.	1991
3	Fermentation Biotechnology	Jayanto Achrekar	Dominant Publishers and Distributors. New Delhi.	2006
4	Separation Process in Biotechnology	Juan.A.Asenjo	Taylor & Francis group.	2007

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	S	M	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	S	M	M

**S-** Strong; **M**-Medium.

## SEMESTER II

### Elective

<b>Elective - II</b>	<b>M.Sc., Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTE05</b>	<b>CANCER BIOLOGY</b>	
<b>Credit: 3</b>		

### Objectives

To provide an in-depth idea about molecular and cellular basis of cancer cells and emphasize the biology of cancer.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand the regulation, signal of cell cycle, cell cycle in cancer	K2
CO2	Knowledge and understanding history, principle, metabolism of Carcinogenesis	K2
CO3	Impart knowledge Identification, detection of Oncogenes and growth factors related transformations.	K4
CO4	Understand the knowledge about tumour cell invasion, membrane disruptions and clinical significance.	K3
CO5	Knowledge about advanced detection of cancer and its different forms of therapy	K4

### UNIT I

Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, Modulation of cell cycle-in cancer, Different forms of cancers, Diet and cancer.

### UNIT II

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis.

### UNIT III

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes.

Growth factor and Growth factor receptors that are Oncogenes. Oncogenes / Proto Oncogenes activity. Growth factors related to transformations.

### UNIT IV

Clinical significances of invasion, heterogeneity of metastatic phenotype,

Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumor cell invasion.

### UNIT V

Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.

### TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Virology a practical approach,	Maly B.W.J	IRL press, Oxford	1987
2	Introduction to modern Virology,	Dunmock.N.J and Primrose S.B	Blackwell Scientific Publications Oxford	1988

### REFERENCES BOOK:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Cancer Biology	King R.J.B	Addision Wesley Longmann Ltd, U.K	1996
2	Cancer Biology,	Ruddon.R.W	Oxford University Press, Oxford	1995

### Mapping with Programme Outcomes

<b>Cos</b>	<b>P01</b>	<b>P02</b>	<b>P03</b>	<b>P04</b>	<b>P05</b>
<b>CO1</b>	S	S	S	M	S
<b>CO2</b>	S	M	S	M	M
<b>CO3</b>	M	S	S	S	S
<b>CO4</b>	M	S	M	S	M
<b>CO5</b>	M	S	S	S	S

**S**- Strong; **M**-Medium

### SEMESTER III

<b>Elective - VI</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code M19PBTE06</b>	<b>ENZYME AND ENZYME TECHNOLOGY</b>	
<b>Credit: 3</b>		

#### Objectives

To provide a deeper insight into the fundamental and functional aspects of enzymology with biocatalysis, molecular modeling, structural biology and diagnostics.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the basic knowledge about Enzymes and its types	K1
CO2	Understand the concept of enzyme substrate interaction and their mechanisms	K2
CO3	Describe the details of various pathway of regulations of the enzymes.	K2
CO4	Understand the concept of physical parameters of enzymes.	K2
CO5	Describes the application of the enzymes in industrial and product development	K3

#### Unit I

**Nomenclature and Classification of Enzymes.** Criteria of purity of enzymes- Specific activity. Enzyme activity- chemical, Protein and Non protein enzymes- Ribozymes and DNazymes. Metalloenzymes and metal activated enzymes. coenzymes. **Classification and its types.**

## Unit II

Enzyme substrate interaction: Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases-Chymotrypsin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens). Reversible Inhibition and its types.

## Unit III-

Enzyme Regulation: Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Organisation of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways.

## Unit IV

Enzyme Kinetics: Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation,  $K_m$ ,  $V_{max}$ , L.B Plot, Turnover number,  $K_{cat}$ . Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.

## Unit V

Application of Enzymes- Thermophilic enzymes, amylases, lipases, proteolytic enzymes in meat and leather industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes. Enzymes as thrombolytic agents, Anti-inflammatory agents, Biosensors. Enzyme Engineering and site directed mutagenesis, Designer enzymes

**TEXT BOOK:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Enzyme Technology	Ashok Pandey, Colin Webb, Carlos Ricardo Soccol, Christian Larroche	Springer	2006
2.	Enzymes	Trevor Palmer, Philip Bonner	East West	2008
3.	Enzymology and Enzyme Technology	Bhatt S.M.	S Chand & Company	2014
4.	Principles of Enzyme Technology	M. Y. Khan, Farha Khan	PHI Learning	2015

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	M	S	M	S	S
<b>CO2</b>	S	M	S	M	M
<b>CO3</b>	M	S	M	M	S
<b>CO4</b>	S	M	S	S	S
<b>CO5</b>	M	S	M	S	M

**S-** Strong; **M**-Medium.

## SEMESTER II

<b>ELECTIVE- II</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTE07</b>	<b>CLINICAL BIOCHEMISTRY</b>	
<b>Credit: 3</b>		

### Objective

To provide the knowledge about various metabolic diseases linked with biochemical parameters and their clinical manifestations.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand types of carbohydrate and lipid metabolic disorders	K1
CO2	Make knowledgeable about amino acid and nucleic acid disorders	K2
CO3	Impart knowledge on different disorders associated with circulatory, respiratory digestive system of human	K4
CO4	Understand hormonal disturbances and mineral metabolic disorders	K3
CO5	Learn about disorders related to blood, enzyme and detoxification mechanism of human body	K3



## UNIT I

Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypoglycemias, galactosemia and ketone bodies. Various types of glucose tolerance tests. Glycogen storage diseases. Physiology of lipids/lipoproteins. Lipidosis. Diagnostic tests for HDL-cholesterol, LDL-cholesterol and triglyceride disorders. Inborn errors of metabolism:

## UNIT II

Disorders of amino acid metabolism- Phenylalanemia, homocystinuria, tyrosinemia, MSUD, phenylketonuria, alkaptonuria, albinism and aminoacidurias. Disorders of nucleic acid metabolism- Disorders in purine/pyrimidine metabolism.

## UNIT III

Electrolytes, blood gases, respiration and acid-base balance. Disorders of acid-base balance and their respiratory and renal mechanisms. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

## UNIT IV

Hormonal disturbances: Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology. Disturbances in thyroid function. Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia and hyperphosphataemia.

## UNIT V

Biochemical aspects of hematology: Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias thrombosis and anemias. Laboratory tests to measure coagulation and thrombolysis. Detoxification in the body: enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion, Disorders of vitamins and trace elements.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Textbook of Medical Biochemistry	MN Chatterjea and Rana Shinde	Jaypee Brothers	2012
2.	Clinical Biochemistry	Richard Luxton	Scion Publishing Ltd	1999

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Lehninger Principles of Biochemistry	David L. Nelson and Michael M. Cox	WH Freeman and Company	2017
2.	Davidson's Principles and Practice of Medicine	Walk Er	Elsevier	2018
3.	Medical Biochemistry	John W. Baynes and Marek Dominiczak	Mosby	2018
4.	Harper's Biochemistry	Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell	Appelton and Lange.	1993
5.	Clinical Biochemistry: An Illustrated Colour Text	Michael Murphy, Rajeew Srivastava, Kevin Deans.	Elsevier	2018

### Mapping with Programme Outcomes

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	M	M	S	S
<b>CO2</b>	M	M	S	S	S
<b>CO3</b>	S	S	S	S	S
<b>CO4</b>	S	M	S	M	S
<b>CO5</b>	S	M	S	M	S

**S**- Strong; **M**-Medium

## SEMESTER II

<b>Elective- II</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTE08</b>	<b>AQUACULTURE</b>	
<b>Credit: 3</b>		

### Objective

To provide the knowledge about aquaculture and its applications.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand to setup the fish farms.	K1
CO2	Impart knowledge on identification of various types of aquaculture strategies.	K2
CO3	Provide knowledge seed culture development and cultivation.	K4
CO4	Understand about nutritional requirements and feed formulation to various crops.	K3
CO5	Provide knowledge about other economic important varieties in aquaculture.	K3

### UNIT I

Definition of aquaculture – Principles of site selection for fish farms, water, soil, types and other parameters.

### UNIT II

Types of aquaculture - Monoculture, Poly culture, Integrated farming, Pond culture, Pen and Cage culture, Raft culture, Race way culture, Warm and cold water fish culture .

### **UNIT III**

Criteria for selection of variety – Seed procurement and stocking management. Water quality management.

### **UNIT IV**

Nutritional requirements and formulation of artificial diets. Breeding and culture of fresh water fishes – Catla, Mrigala, Rohu and Tilapia.

### **UNIT V**

Mari culture – Culture of edible oyster, pearl oyster, mussels, clams, sea urchins, sea cucumbers.

### **TEXT BOOK**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Fish and Fisheries in India	Jhingran,V.G.,	Hindustan Publishing Corporation	1982
2.	Home Aquarium:aquatic gema and tropical fish	Annan, J.F, R.O.Smiterman and G. Tehebenoglous	Oregan State University	1983

## SEMESTER II

<b>Core Practical- III</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBTP03</b>	<b>PRACTICAL - III - GENETIC ENGINEERING AND rDNA TECHNOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To provide hands on training of versatile techniques employed in genetic engineering and recombinant DNA technology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Isolate genomic DNA, plasmid DNA and Phage DNA. Gain the knowledge about replica plating, Learn about bacteriophage Life cycle	K2
CO2	Quantify nucleic acid , protein content of sample	K2
CO3	Know about bacterial transformation , conjugation mechanism	K3
CO4	Understand the procedure of restriction, ligation, principle to amplify DNA sequence using PCR	K4
CO5	RFLP and RAPD	K1

1. Agarose gel electrophoresis
2. Selection of genetic marker – IPTG-X-Gal, GUS assay
3. Isolation of genomic DNA & Detection in AGE
4. Isolation of plasmid DNA & Detection in AGE
5. Screening of Bacteriophages.
6. Isolation of Auxotrophic mutants – Replica plate
7. Isolation of Lambda phage DNA

8. Quantification of Nucleic acid by UV spectrophotometer.
9. Quantification of protein by SDS-PAGE
10. Bacterial Transformation.
11. Bacterial Conjugation – Uninterrupted & Interrupted
12. Restriction digestion
13. Ligation
14. Determination of molecular weight of Nucleic acids by Gel Doc.
15. Amplification of DNA - PCR.
16. RFLP and RAPD (Demo).

### **SPOTTERS**

1. Enzymes, Vectors
2. RAPD, RFLP, PCR, Electrophoresis, PAGE techniques
3. Conjugation, Transformation
4. Mutation

### **TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Laboratory Manual for Genetic Engineering	S. John Vennison	1st Edition, Kindle Edition	2014

### **REFERENCE BOOKS:**

<b>S.No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Genetic Engineering: Principles and Practice	by Sandhya Mittra	Kindle Edition	2013

### Mapping with Programme Outcomes

<b>Cos</b>	<b>P01</b>	<b>P02</b>	<b>P03</b>	<b>P04</b>	<b>P05</b>
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	M	M	S	S
<b>CO4</b>	M	M	S	M	S
<b>CO5</b>	S	S	M	M	M

**S**- Strong; **M**-Medium.



## SEMESTER II

<b>Core Practical - IV</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBTP04</b>	<b>Practical - IV - IMMUNOLOGY AND BIOPROCESS TECHNOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To provide the practical knowledge about techniques involved in immunology and bioprocess technology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand the separation of serum & plasma from the human blood samples and differential count of white blood cells	K1
CO2	Expertise to test, blood grouping, typhoid fever, antistreptolysin O (ASO) of group A <i>Streptococcus</i> infection. rheumatoid arthritis (RA) factor, pregnancy test from urine sample, rapid plasma reagin test to screen syphilis, various types of precipitation and agglutination reaction and measure antibodies, antigens, proteins and glycoproteins	K4
CO3	Knowing to antiserum development form laboratory animals	K4
CO4	Understand the technique for the isolation of Amylase antibiotic producing microbes, Culture optimization	K1
CO5	Produce industrial important products(amylase, protease, Antibiotics, citric acid, alcohol by submerged and solid state fermentation techniques.	K4

## **IMMUNOLOGY**

1. Differential count of white blood cells
2. Preparation of serum & plasma
3. ABO Blood grouping
4. Widal test for typhoid fever (qualitative and quantitative test)
5. Anti - Streptolysin O (ASO) test
6. Rheumatoid arthritis (RA) test
7. Pregnancy test – Detection of HCG
8. Rapid Plasma Regain Test (RPR)
9. Ouchterlony's Double Immunodiffusion Technique (ODD)
10. Counter Current Immunelectrophoresis (CIE)
11. Immuno Electrophoresis (IE)
12. Radial Immuno Diffusion (RID)
13. Rocket Immuno Electrophoresis (RIE)
14. Raising of antiserum in laboratory animals
15. ELISA

## **BIOPROCESS TECHNOLOGY**

1. Isolation of Amylase and protease producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH, Temperature, Carbon & Nitrogen sources).
4. Production and assay of amylase and protease by submerged fermentation .
5. Production and assay of amylase and protease by solid-state fermentation.
6. Bioassay of Antibiotics.
7. Microbial production of citric acid using *Aspergillus niger*.
8. Immobilization of cells for enzyme production.
9. Alcohol production by yeast fermentation and its estimation.
10. Purification of enzymes by salting and dialysis and column chromatography techniques

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Manual of Allergy and Immunology	Adelman	Wolters Kluwer India Pvt. Ltd.	2012
2.	Laboratory Manual On Biochemistry, Bioprocess & Microbiology	Palvannan T, Shanmugam S, Satish Kumar T,	Scitech Publications (India) Pvt Lt	2006

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Practical Immunology	Frank C. Hay, Olwyn M. R. Westwood	Wiley-Blackwell	2002

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>Immunology</b>					
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	M	M	S	S
<b>CO4</b>	M	M	S	M	S
<b>CO5</b>	S	S	M	M	M

**S-** Strong; **M-**Medium.

## SEMESTER II

<b>Enhancement Compulsory Course</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PHR01</b>	<b>HUMAN RIGHTS</b>	
<b>Credit: 2</b>		

### Objective

To present the different aspects of human and also to make the students to understand the duties to be carried out in the days to come.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO</b>	<b>Statement</b>	<b>Knowledge Level</b>
CO1	Remember the need and types of Human rights	K1
CO2	Understand the Classification of Human Rights	K2
CO3	Apply the Rights of Women and Children	K4
CO4	Learn the Rights of Labour	K2
CO5	Analyze the National and State level human Rights Commission	K3

### UNIT I

Human Rights : Meaning – Definitions – Origin and Growth of Human Rights in the World – Need and types of Human Rights – UNHRC (United nations Human Rights) – Human Rights in India.

### UNIT II

Right to Liberty – Right to Life – Right to Equality – Right to dignity – Right to against Exploitation – Educational Rights – Cultural Rights – Economic Rights – political Rights – Social Rights.

### **UNIT III Rights of Women and Children:**

Rights of Women – Female feticide and Infanticide and selective abortion – Physical assault and sexual harassment – Domestic Violence – Violence at work place – Remedial Measures. Rights of Children – Protection rights, survival rights – Participation rights – Development rights – Role of UN on convention on rights of children.

### **UNIT IV Multi-Dimensional aspects of Human Rights:**

Labour rights – Bodend Labour – Child Labour – Contract Labour – Migrant Labour – Domestic Women Labour – Gender Equity – Rights of Ethnic refugees – Problems and remedies – Role of trade union in protecting the unorganized labourers.

### **UNIT V Grievance and Redressal Mechanism:**

Redressal Mechanism at national level – Structure and functions of National and State level human Rights Commission – constitutional remedies and directive principles of state policy.

### **REFERENCE BOOKS:**

<b>S. No.</b>	<b>Author</b>	<b>Title of the book</b>	<b>Publishers / Edition</b>	<b>Year of Publication</b>
1.	Barat Sergio and Swaronjali Ghosh	Teaching of Human Rights	Dominant Publishers and distributors, New Delhi	2009
2.	Roy A.N	Human Rights Achievements and Challenges	Vista International Publishing House, Delhi	2005
3.	Asish Kumar das and Prasant KumarMonaty	Human Rights in India	Sarup and Sons, New Delhi	2007
4.	Bani Bargohain	Human Rights Social justice and political change	Kanishka publishers and distributors, New Delhi	2007

5.	Velan G,	Human Rights and Development Issues	Ambala Cantt	2008
6.	Meena P K	Human rights Theory and Practice	Murali lal and Sons, New Delhi	2008
7.	Bhavani Prasad Panda	Human Rights Development and Environmental Law	Academic Excellence, Delhi.	2007
8.	Vishvanathan V N	Human Rights – Twenty first Century Challenges	Kalpaz Publications, New Delhi.	2008
9.	Ansari M.R	Protecting Human Rights	Max Ford Books, New Delhi.	2006
10.	Rao M.S.A	Social Movements in Indi – Social Movements and Social Transformation in India	Vol 1& 2: Manohar Publications, New Delhi.	1978

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	S	M
CO2	M	M	S	M	M
CO3	S	S	M	S	S
CO4	M	M	S	M	S
CO5	S	M	S	S	M

**S**- Strong; **M**-Medium.

### SEMESTER III

<b>Core - VIII</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code :M19PBT08</b>	<b>PLANT BIOTECHNOLOGY</b>	
<b>Credit: 4</b>		

#### Objective

To focus on classical and modern plant biotechnology processes and their applications.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the concept of plant tissue culture, media preparation.	K1
CO2	Understand the sterilization techniques, somatic embryogenesis.	K2
CO3	Understand the concept protoplast isolation, somoclonal variation and secondary metabolites.	K3
CO4	Develop a deeper understanding gene transfer techniques, plant pathogen interaction and terminator seed concept.	K3
CO5	Understand the plant breeding, cryopreservation techniques, etc.	K3

#### UNIT I

History of plant tissue culture - Laboratory organization - Nutritional requirements of plant tissue culture. Media preparation – Types of media – MS media, Nitshs media, Whites media, Gamborgs media – Plant growth regulators. Plant tissue culture - principles. The concept of totipotency of cells.

## **UNIT II**

Sterilization techniques; Plant micro propagation – micro grafting – advantages – virus elimination by culturing of meristem and shoot tip cultures;, Establishment and maintenance of callus and suspension cultures. Somatic embryogenesis - Synthetic seeds.

## **UNIT III**

Haploid plant production, triploid production, Anther and microspore culture, embryo culture and embryo rescue. *In-vitro* pollination and fertilization. Protoplast isolation – fusion - Culture regeneration - somatic hybrids - cybrids. Somoclonal and Gametoclonal variation, Secondary metabolites.

## **UNIT IV**

Gene transfer techniques in plants. Transgenic plants for insect resistance, fungus resistance, virus resistance, drought, cold and saline resistance. Molecular biology of plant pathogen interactions. Terminator seed concept.

## **UNIT V**

Role of RFLP in Plant breeding, current status of plant transformation technologies. Production of therapeutic antibodies in plants. Edible vaccines from plants, Cryopreservation, Role of tissue culture in agriculture, forestry. Cryopreservation and germplasm conservation.

### **TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Plant Biotechnology	J. Hammond, P. McGarvey and V. Yusibov (Eds.)	Springer verlag	2000
2	Biotechnology in crop improvement	H.S. Chawla	International Book distributing Company	1998
3	Biotechnology	U.Satyanarayanan	Books and allied (p) Ltd.,	2005
4	Plant tissue culture	Kalyan Kumar De	New Central Book Agency; 1 <sup>st</sup> edition	2008



**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Plant Cell and Tissue Culture for the Production of Food ingredients Practical	T-J.Fu, G.Singh and W.R.Curtis (Eds)	Kluwer Academic/Plenum Press	1999
2.	Application of plant Molecular biology	R.J. Henry	Chapman and hall.	1997
3.	Elements of Biotechnology	P.K. Guptha	Rastogi and Co. Meerut	1996
4.	Tissue Culture Theory and Practice	S.S. Bhojwani and M.K. razdan		2004

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	M	S	S
<b>CO2</b>	S	M	S	S	S
<b>CO3</b>	M	M	S	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	M	S	S

**S-** Strong; **M**-Medium.

### SEMESTER III

<b>Core - IX</b>	<b>M.Sc., Biotechnology</b>	<b>2019-2021</b>
<b>Code: M19PBT09</b>	<b>ANIMAL BIOTECHNOLOGY</b>	
<b>Credits : 4</b>		

#### Objective

To focus on the basic principles of animal cell culture, its commercial production and applications.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the fundamental principles of <i>In vitro</i> fertilization techniques	K1 & K2
CO2	Understand the Basic requirements of Animal cell culture	K2
CO3	Understand the basic gene transfer methods employed for animal cells	K2
CO4	Develop a deeper understanding and application of molecular techniques involved in animal cell culture	K1
CO5	Understand the production and recovery of products from transgenic animals	K2

#### UNIT I

Gametogenesis and fertilization in animals, Molecular events during fertilization, Artificial Fertilization methods (IVF, IUF, ICSI) and embryo transfer, Superovulation, Polycystic ovarian syndrome (PCOS), Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

## **UNIT II**

Fundamentals. Facilities and Applications. Media preparation for Animal cells culture. Types of cell culture: Primary and secondary cell culture, cell transformation, cell lines, stem cell culture. Tests: cell viability and cytotoxicity, cell synchronization, senescence and apoptosis. Organ culture and transplantation, Cryopreservation.

## **UNIT III**

GMO (Genetically modified organism), methods of DNA transfer into animal cells - calcium phosphate co precipitation, micro-injection, electrooration, Liposome encapsulation. Hybridoma technology, Vaccine production.

## **UNIT IV**

Mapping of human genome, Human Genome Project (HGP). RFLP, RAPD and its applications. Gene silencing, DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

## **UNIT V**

Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones, insulin Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

# REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Developmental Biology	Beril, N.J.	Tata McGraw -Hill Publishing Company Ltd. New Delhi	1974
2.	An Introduction to Embryology	Balinsky, B.I.	Saunders, Philadelphia	1975.
3.	Genetic Engineering of Animals	Puller, A. (Ed).	VCH Publishers, New York	1993
4.	Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7.	Watson, J.D., N.H.Hopkins, T.W.Roberts, J.A.Steitz and A.M. Weiner. E.J. Murray (Ed).	Humana Press,Totowa, NJ.	1991
5.	Recombinant DNA	Watson, J.D., M. Gilman, J. Witkouski and M.Zoller.	Scientific American Books, New York.	1992
6.	Animal Cell Culture: A practical approach.	Freshney, E. D.	John Wiley Pub.New York.	2000
7.	Animal Cell Culture Methods (Methods in Cell Biology. Vol. 57). Mammalian Cell	Mather, J.P. and Barnes, D. (Eds.).	Academic Press, London.	1998
8.	Biotechnology - A Practical Approach.	Butler, M. (Ed.).	Oxford Univ. Press, Oxford	1990
	Exploring Genetic Mechanisms	Singer, M. and P. Berg. (Ed.).	University Science Books, Sausilato, CA, USA.	1997

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Textbook of Animal biotechnology	B Singh, SK Gautam and MS Chauhan.	The Energy and Research Institute	1993
2.	Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology)	M.K. Sateesh	2nd Edition. New Age International	2010

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	S	M	S
<b>CO2</b>	S	S	S	S	M
<b>CO3</b>	M	S	S	S	S
<b>CO4</b>	S	S	M	M	M
<b>CO5</b>	M	S	S	S	S

**S-** Strong; **M**-Medium

### SEMESTER III

Core - X	M.Sc. Biotechnology	2019 - 2020
Code : M19PBT10	ENVIRONMENT BIOTECHNOLOGY AND	
Credit: 4	NANOTECHNOLOGY	

#### Objective

To provide an insight into the fundamentals and applications of environmental biotechnology and Nanotechnology.

#### Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the basic concept of air pollution and greenhouse effect	K1
CO2	Understand the concept of water pollution and waste water treatment	K1
CO3	Describe the necessity of degradation of inorganic wastes and degradation of xenobiotics	K2
CO4	Understand the basic knowledge nanotechnology and nanomaterials	K2
CO5	Understand the importance of nano sensors and drug delivery systems.	K3

#### UNIT I

Introduction, types, Measurement of air pollution. Global environmental problems in atmosphere - ozone depletion, greenhouse effect and acid rain.

## **UNIT II**

Introduction, types, sources of water pollution. Biomonitoring of water pollution using algae, bacteria, plankton, macrophytes (Bioindicators). Waste water treatment - physical, chemical and biological treatment processes. Biotechnological approaches for industrial waste water treatment - dairy, distillery, tannery, sugar, and pharmaceutical industries. Bioremediation of oil spills.

## **UNIT III**

Introduction, types of solid wastes. Biodegradation of inorganic and organic wastes and lignin. Solid waste disposal - land filling, incineration, composting, mushroom farming, vermiculture and biogas production. Processing of sugar factory wastes, residential and municipal wastes, coir wastes and sago wastes. Biodegradation of xenobiotics.

## **UNIT IV**

Definition of a nano system - dimensionality and size dependent phenomena, Quantum dots, Nanowires and Nanotubes, 2D films. Methods for synthesis of Nanoscale Materials. Basic concepts and properties of nanostructured materials. Gold Nanoparticles. Nanopores. Characterization of Nanomaterials.

## **UNIT V**

Nanosensors - types and its applications. Nanocarriers for Drug Delivery - Polymeric Nanoparticles as Drug Carriers. Micelles for Drug Delivery. Microarray and Genome Chips. Microemulsions as Drug Delivery Vehicles, Lipoproteins as Pharmaceutical Carriers. Solid Lipid Nanoparticles as Drug Carriers. Nanocapsules – preparation, characterization and Applications.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Environmental Biotechnology.	Alan Scragg.	Pearson Education Limited, England	1999
2.	Environmental Chemistry	De,A.K.	Wiley Eastern Ltd. New Delhi.	2004
3.	Introduction to Biodeterioration.	Allsopp, D. and K.J. Seal.	ELBS/Edward Arnold, London	1986
4.	Nanotechnology: A Gentle Introduction to the Next Big idea.	Ratner, M. and Ratner, D	Pearson Education, Inc. NJ, USA.	2005
5.	Nanobiotechnology: Concepts, Application and Properties.	Christef M. Niemeyer, C. A. Mirkin	Wiley – VCH Publishers, New York.	2004
6.	Nanotechnology in Biology and Medicine: Methods, Devices and Applications.	Tuan Vo-Dinh.	Taylor and Francis Inc., London	2007
7.	Biological pharmaceutical	Challa S.S.R. Kumar (Ed).	Nanomaterial, Wiley- VCH Verlag Gmbh & Co, KgaA. Weinham, Germany.	2006
8.	Nanoparticulates as Drug Carriers.	Vladimir P.Torchilin (Ed.).	Imperial College Press, North Eastern University, USA. ISBN 1-86094	2006
9	Wastewater Engineering – Treatment, Disposal and Reuse.	Technoglous, G., Burton, F.L. and Stensel, H.D.	3 <sup>rd</sup> Edition. Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi.	1995
10	Environmental Biotechnology	Jogdand, S.N.	1 <sup>st</sup> Edition. Himalaya	1995



			Publishing House, Bombay.	
10	Nanobio-Technology in Molecular Diagnostics: Current Techniques and Applications.	Jain, K.K.	Horizon Biosciences, India.	2006
11	Nano Medicines	Parag Diwan and Ashish Bharadwaj	Pentagon Press. ISBN 81- 8274- 139-4.	2006

### Mapping with Programme Outcomes

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	M	M	M	S
<b>CO2</b>	S	S	M	M	M
<b>CO3</b>	M	S	M	S	M
<b>CO4</b>	S	S	S	M	M
<b>CO5</b>	S	M	S	M	S

**S**- Strong; **M**-Medium.

### SEMESTER III

<b>Core - XI</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBT11</b>	<b>PROTEOMICS AND GENOMICS</b>	
<b>Credit: 4</b>		

#### Objective

To appraise the students to basic and high throughput techniques in Genomics and Proteomics and their applications.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	To understand the concept of sequencing techniques and molecular based techniques.	K1
CO2	To understand the various types of polymerase techniques, this is applicable in the field of diagnostic purposes.	K3
CO3	Describe the detailed information about the gene expression	K2
CO4	Application of the biological based tools for the protein and nucleotides.	K3
CO5	To understand the concept of separation techniques for the protein molecules.	K3

## **UNIT I**

Introduction to Genomics: Definition of Genome, Genome sequencing, Genome mapping: Genetic mapping- DNA markers-RFLP,SSLP, SNP-Pedigree analysis; Physical mapping- Restriction site mapping, FISH, STS; Human genome project, Map repositories: NCBI – Entrez Human genome map viewer, OMIM (Online Mendelian Inheritance in Man).

## **UNIT II**

Genome Annotations: Locating the Genes in a Genome Sequence, ORF Scanning, Exon-intron boundaries, cDNA hybridization, RT-PCR (Reverse transcriptase PCR), RACE (rapid amplification of cDNA ends) , heterpduplex analysis, Exon trapping, Gene inactivation, Genetic footprinting, RNA interference, computational gene analysis homologous genes-orthologous, paralogous, ORF Finder, Genscan and GenomeThreader.

## **UNIT III**

Functional Genomics: Transcriptomes, Transcriptome analysis, cDNA micro arrays, Raw data from microarrays, data quality, Gene expression matrices, grouping expression data, clustering methods, Feature reduction, Microarray data format, Micro array data analysis tools, gene pathway reconstruction, SAGE (Serial analysis of gene expression).

## **UNIT IV**

Proteomics, amino acids-peptides and proteins- life cycle of a protein, sequencing of protein-N and C terminal sequencing- proteomics- tools and application of proteomics, 3D structure of protein- overview-protein secondary, tertiary, quaternary structure- protein Denaturation-protein folding- reverse turns- Ramachandran plot- Expasy tools.

## **UNIT V**

Analytical proteomics-analytical protein and protein separation techniques- 1D SDSPAGE, isoelectric focusing, 2D SDS-PAGE, image analysis of 2D gels-HPLC-protein digestion techniques. Protein identification and analysis- Mass spectrometry-tandem mass spectrometry-peptide mass finger printing- SALSA algorithm-protein arrays, Protein expression profiling, protein-

protein interactions, prediction interactions based on domain fusion (yeast two hybrid system), mapping protein modifications.

#### REFERENCES BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Genomes, 2nd Edition	T.A.Brown	Oxford: Wiley-Liss.	2002
2.	Data analysis and visualization in genomics and proteomics,	Francisco Azuaje and Joaquin Dopazo	John wiley and sons, Lts	2005
3	Microarrays for Intergartive Genomics	Isaac S. Kohane, Alvin T Kho, Atul J.Butte	The MIT Press England	2003
4	Bioinformatics Instant notes series	D.R.Westhead, J.H.Parish and R.M. Twyman	BIOS Scientific Publishers ltd.	2002
5	Introduction to Proteomics- Tools for the New Biology	Daniel C Liebler	Springer Scintific Bussiness media LLC	2002
6	Principles of proteomics	Twyman R.M.	York: Garland Science/Bios Scientific publishers.	(2004)

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	M	M	S	S
CO3	S	S	M	M	S
CO4	S	M	S	M	M
CO5	S	M	S	M	M

**S-** Strong; **M**-Medium.

**SEMESTER III****Elective**

<b>Elective - III</b>	<b>M.Sc., Biotechnology</b>	<b>2019-2020</b>
<b>Code: M19PBTE09</b>	<b>BIOSTATISTICS</b>	
<b>Credits : 3</b>		

**Objective**

To understand the present up-to-date theory and techniques of statistical inference (estimation theory) in a logically integrated and practical form.

**Course Outcomes**

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Know the correlation and methods of correlation	K1
CO2	Learn the basic concepts of inferential statistics	K2
CO3	Obtain the testing of hypothesis using statistical data	K3
CO4	Analyze the statistical data using single means and difference of mean	K4
CO5	Analyze data using the chi square test	K4

**UNIT I**

Correlation -Types and methods of correlation-Rank correlation.

**UNIT II**

Sampling Methods-Population, sample -Parameter- Statistics-Estimation-Estimator-standard error.

**UNIT III**

Test of significance-Hypothesis – Simple hypothesis – types of errors – level of significance – Tests based on small samples (t-test)

#### UNIT IV

Tests based on large samples – tests for single means, tests for difference of two means.

#### UNIT V

Chi – Square test- uses of Chi – square test goodness of fit and independence of attributes- Simple problems.

#### REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Fundamentals of Mathematical Statistics a Modern Approach	S.C.Gupta and V.K. Kapoor	Sultan Chand Publications- 10th Edition 2000	2000
2.	Statistics	R.S.N.Pillai. and V. Bagavathi.	S.Chand Ltd., New Delhi	2003

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	S	M	M	S	S
CO3	M	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	S	S

**S-** Strong; **M**-Medium.

### SEMESTER III

<b>Elective - III</b>	<b>M.Sc., Biotechnology</b>	<b>2019-2020</b>
<b>Code: M19PBTE10</b>	<b>MARINE BIOTECHNOLOGY</b>	
<b>Credits : 3</b>		

#### Objective

To provide insight knowledge of marine biodiversity, its products, applications and its conservations.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the fundamentals of oceans and seas, abiotic and biotic factors	K1 & K2
CO2	Understand the importance of marine biological diversity and role of phytoplankton, deep sea adaptation	K2
CO3	Identify the Marine bioactive compounds and organisms involved in the production of bioactive compounds	K2
CO4	Develop a deeper understanding and application of anti-cancer, anti-viral, anti-fungal, herbicides and biopesticides	K2
CO5	Understand the concept of marine conservation, factors creating diversity, protected areas and risk factors	K3

#### UNIT I

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology – biogeochemical cycles – food chain and food web.

## UNIT II

Importance of Marine biological diversity: species- Phytoplanktons – zooplanktons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – deep sea animals and adaptation.

## UNIT III

Identification of Marine bioactive compounds containing organisms, sea weeds, sea grasses, sponges, mollusks, Echinoderms – associated microbes.

## UNIT IV

Anticancer – antiviral – antibacterial – antifungal compounds, Biopesticides, herbicides from Marine Microbes.

## UNIT V

Marine conservation: Factors creating diversity in the sea; area of diversity, area to be protected, risk factors for population and species.

### REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Handbook of Marine Biotechnology	Kim, Se-Kwon (Ed.)	Springer	2015
2.	Marine Biotechnology I	Le Gal, Yves, Ulber, Roland (Eds.)	Springer	2005
3.	Recent advances in Marine Biotechnology	M.Fingermann, R.Nagabushanam and Mary Frances Thompson	CRC Press, Francis and Taylor	2003



**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Nutrients and Bioactive substances and aquatic organisms	K.Devadasan and M.K.Mukundan	Society of Fisheries Technologists India; Cochin (India)	1994

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	M	M	M
<b>CO2</b>	S	S	S	M	M
<b>CO3</b>	M	S	S	S	S
<b>CO4</b>	S	S	S	S	M
<b>CO5</b>	M	S	S	S	S

**S-** Strong; **M-**Medium

### SEMESTER - III

<b>Elective - III</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code : M19PBTE11</b>	<b>STEM CELL BIOLOGY AND TISSUE</b>	
<b>Credit: 3</b>	<b>ENGINEERING</b>	

#### Objective

To enable students to understand the principles, techniques and applications of stem cells and tissue engineering.

#### Course Outcomes

By the end of the course, the student should be able

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Describe the fundamental characteristics, properties and classification of stem cells	K2
CO2	To understand the potency, specification, differentiation of stem cells in model organisms, cell signaling in control pathways and checkpoints	K1
CO3	To provide the detailed knowledge of gene expression and stem cell communication. To understand the stem cell regeneration in various organs, tissues and stem cell disease, disorders	K3
CO4	Describe the principles of tissue culture, tissue engineering. It provides the knowledge of synthesis of organ and tissues in invitro and in vivo and its regulations	K3
CO5	To understand the transplantation techniques, bio artificial. bioprinting of tissues and organs.	K3

## UNIT I

Stem Cells – Basics, Properties and Classification, Types of Stem cells – Hematopoietic Stem Cells, Mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells, Adult Stem cells and their Characteristics.

## UNIT II

Pluripotency, niche specification – Drosophila germ line stem cells, self renewal and differentiation, Characteristics of stem cell – Cell cycle, Ras/Raf pathway, PI3 cell signaling, p53 check points, role of LIF pathway in cell cycle control.

## UNIT III

Stem cell communications – gap junctions, cell fusion. Stem Cells in Gastrointestinal, Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration, Stem Cells in Eye Diseases and Disorders

## UNIT IV

Morphogenesis, Principles of Tissue Culture, Bioreactor Design, Mechanochemical Regulation of Cell Behaviour, *In vitro* and *In vivo* Synthesis of Tissues and Organs.

## UNIT V

Tissue Engineering and Transplantation Techniques, Immuno isolation Techniques, Modes of Cell and Tissue Delivery, Regeneration of Bone and Cartilage, Islet Cell transplantation and Bioartificial Pancreas, Bioprinting of Organs and Tissues.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	The Stem Cell Hope: How Stem Cell Medicine Can Change Our Lives	Alice Park	Hudson street press	2012
2.	Adult Stem Cells: Biology and Methods of Analysis	Donald G. Phinney	Humana press	2014
3.	Stem Cells: An Insider's Guide	Paul Knoepfler	World scientific-kindle edition	2009
4.	Stem Cell Therapy: A Rising Tide: How Stem Cells Are Disrupting Medicine and Transforming Lives	Neil H Riordan	Kindle edition	2017
5.	Stem Cells: A Very Short Introduction	Jonathan Slack	Kindle edition	2012

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Essential of Stem Cell Biology.	R. Lanza, J. Gearhart et al (Eds)	Elsevier Academic press	2009
2.	Essential Stem Cells Methods.	R. Lanza and I. Klimanskaya.	Academic Press	2009
3.	Translational Approaches in Tissue Engineering & Regenerative Medicine	J. J. Mao, G. Vunjak-Novakovic et al (Ed)	Artech House, INC Publications	2008

- |    |   |                      |                 |      |
|----|---|----------------------|-----------------|------|
| 4. | Principles of Tissue Engineering Human Stem Cell Technology and         | Robert Lanza et al., | Academic Press  | 2007 |
| 5. | Biology: A Research Guide and Laboratory Manual. Handbook of Stem Cells | Stein et al          | Wiley-Blackwell | 2011 |
| 6. | Embryonic Stem Cells; Volume 2- Adult & Fetal Stem Cells)               | Lanza et al          | Academic Press  | 2004 |

### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	S	M	M	S	S
CO3	M	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	M	M

**S-** Strong; **M**-Medium

### SEMESTER III

<b>Elective - III</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTE12</b>	<b>APICULTURE</b>	
<b>Credit: 3</b>		

#### Objective

To emphasis on development of entrepreneurial potential and skills amongst the students in apiculture.

#### Course Outcomes

After completing this course, students will be able to:

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand about the taxonomy, Bio-ecology and life history of honey bee.	K1
CO2	Gain the knowledge about bee colony, types and structure of bee hives.	K2
CO3	Learn the skills about apiary care and management.	K2
CO4	Gain the knowledge about Honey composition, bee wax and its uses and also explore the diseases of honey bees and their control methods	K2
CO5	Understanding the self employment and business enterprises of apiculture.	K3

## **UNIT I**

Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.

## **UNIT II**

Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.

## **UNIT III**

Apiary – Care and Management – Artificial bee hives – types – construction of space frames – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.

## **UNIT IV**

Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods.

## **UNIT V**

Apiculture as Self - employment venture – Preparing proposals for financial assistance and funding agencies – Economics of bee culture.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Apiculture	N.Arumugam,.K.V. Jayashree, and C.S Tharadevi	Saras Publications Periyavilai, Nagercoil, Tamil Nadu	2013
2.	Honey bees and their management in India	Mishra, R.C	ICAR, Publications, New Delhi.	1985
3.	Apiculture	J. K. Gupta V. V. Belavadi and Sh. Mohinder Singh	ICAR Agremoon publishers	2005
4.	Hand book of bee keeping	Sharma, P. and Singh L.	Controller Printing and Stationery, Chandigarh.	1987
5.	Introduction to Bee keeping	Rare, S.	Vikas Publishing house. New Delhi.	1998
6.	Bee Keeping	Singh, S	ICAR, Publications New Delhi	1982
7.	Economics zoology	Shukla, G.S. and Upadhyay V.B	Rastogi Publication, Meerut.	1997

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	The Beekeeper's Handbook	Diana Sammataro, Alphonse Avitabile and Dewey M. Caron	Publisher Cornell University Press	2011
2.	The Beekeeper's Lament : How One Man and Half a Billion Honey Bees	Hannah Nordhaus	HarperCollins Publishers Inc.	2011



- |    |   |                             |  |      |
|----|---|-----------------------------|--|------|
| 3. | The Bee-friendly<br>Beekeeper : A<br>Sustainable<br>Approach                      | David Heaf                  | Northern Bee Books<br>Publication, Oxford,<br>United Kingdom.  | 2015 |
| 4. | The Hive  | Bee Wilson                  | Hodder & Stoughton<br>General Division,<br>Imprint John Murray<br>Publishers Ltd<br>Publication, London,<br>United Kingdom | 2005 |
| 5. | The ABC and XYZ<br>of Bee culture   | Morse, R.A                  | 40th edition A.1 Root<br>& co., Ohio.  | 1990 |
| 6. | Honey Bees,<br>Disease,<br>Parasites, Pests,<br>Predators and<br>their Management | Nagaraja.N &<br>Rajagopal.D | MJP Publishers ,<br>Chennai.   | 2000 |

### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	M	M	S	S
CO3	M	S	M	S	S
CO4	S	S	S	M	S
CO5	S	M	S	M	M

**S-** Strong; **M-**Medium.

### SEMESTER III

<b>Core Practical-V</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTP05</b>	<b>PRACTICAL - V - PLANT AND ANIMAL BIOTECHNOLOGY</b>	
<b>Credit: 4</b>		

#### Objective

To provide hands on training in the field of plant and animal biotechnology.

#### Course Outcomes

By the end of the course, the student should be able to:

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
<b>Plant Biotechnology</b>		
CO1	Understand media preparation, Sterilization Techniques for animal and plant tissue culture techniques.	K2
CO2	Perform organ cultures, Callus propagation, organogenesis, transfer of plants, hardening process, Protoplast isolation and Anther and pollen cultures	K4
CO3	Learn about gene transfer technique	K1
CO4	Prepare single cell suspension from spleen and thymus	K3
CO5	Know the technique of Cell counting and cell viability, Trypsinization of monolayer and sub-culturing, Embryonated Egg inoculation and Preparation of chick embryo fibroblast culture (monolayer	K4

### **Plant Biotechnology**

1. Preparation of media.
2. Sterilization Techniques.
3. Organ cultures.
4. Callus propagation, organogenesis, transfer of plants, hardening process.
5. Protoplast isolation.
6. Anther and pollen cultures - production of haploids.
7. Isolation of plant DNA
8. Agrobacterium mediated Gene Transfer (Demo)

### **Animal Biotechnology**

1. Preparation of tissue culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Trypsinization of monolayer and sub-culturing.
5. Embryonated Egg inoculation.
6. Preparation of chick embryo fibroblast culture (monolayer)

### **TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Plant Biotechnology laboratory Manual	Anjana,R and Roy,P.P	Kerala Agricultural University, Ernakulum, Kerala	2014
2.	Biotechnology Procedures and Experiments Handbook	S. Harisha,	Infinity Science Press LLC. and Laxmi Publications Pvt. Ltd	2007
3.	A Practical Manual On Basic Techniques In Biotechnology & Nanotechnology	S. R. Madhan Shankar & E. M. Rajesh	International E – Publication	2013
4.	Biotechnology, (Practical Manual Series-4)	K.M. Thara	BookVistas (New Delhi, India)	

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year of Publication</b>
1.	Plant Biotechnology: Practical Manual	C.C. Giri and Archana Giri	I K International Publications, New Delhi.	2007
2.	Practical Book of Biotechnology & Plant Tissue Culture	Nagar Santosh and Adhav Madhavi	S Chand & Company	2010
3.	Practical Biotechnology: Methods & Protocols	S. Janarthanan and S.Vincent	Universities Press India Pvt.Ltd.	2007
4.	Culture of Animal Cells,	I. Freshney	5th Edition, Wiley-Liss	2005
5.	Animal Cell Culture Techniques	Ed. Martin Clynes	Springer	1998
6.	Animal Cell Culture - Practical Approach	Ed. John R.W. Masters	3rd Edition, Oxford University Press	2000

**Mapping with Programme Outcomes**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	S	M	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	S	M	M

**S-** Strong; **M**-Medium.

### SEMESTER III

<b>Core Practical-VI</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19PBTP06</b>	<b>PRACTICAL -VI - ENVIRONMENTAL BIOTECHNOLOGY, PROTEOMICS AND GENOMICS</b>	
<b>Credit: 4</b>		

#### Objective

To provide hands on training in environmental biotechnology, proteomics and genomics.

#### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Determine dissolved sulphate, residual chlorine, silicate and BOD in water	K2
CO4	Perform the effect of heavy metal toxicity on behavioral changes in fish and Impact of heavy metal on oxygen consumption of fresh water fish	K4
CO7	ORF-Predict and Genome Annotation- GEN SCAN	K3
CO9	Protein Secondary and Tertiary structure analysis- EXPASY Tools	K3
CO10	Molecular Docking	K2

1. Determination of dissolved sulphate in water
2. Determination of residual chlorine
3. Determination of silicate in water
4. Effect of heavy metal toxicity on behavioral changes in fish
5. Impact of heavy metal on oxygen consumption of fresh water fish
6. Determination of BOD in water
7. ORF-Prediction
8. Genome Annotation- GEN SCAN
9. Protein Secondary and Tertiary structure analysis- EXPASY Tools.
10. *In-silico* analysis - Molecular Docking

#### TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Environmental Sampling and Analysis: Lab Manual	Maria Csuros	CRC Press	1997

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	M	M	S	S	S
<b>CO2</b>	S	M	M	S	S
<b>CO3</b>	M	S	M	S	S
<b>CO4</b>	S	S	S	M	S
<b>CO5</b>	S	M	S	M	M

**S**- Strong; **M**-Medium.

## SEMESTER IV

Core -XII	M.Sc., Biotechnology	2019-2021
Code: M19PBT12	RESEARCH METHODOLOGY AND RESEARCH PROPOSAL DEVELOPMENT	
Credits : 4		

### Objective

To develop a research orientated approach among the students and to acquaint them with fundamentals of research methods.

### Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental research; Definitions, characteristics, types of research, topic selection and problem identification	K1 & K2
CO2	Understand the Literature review, Source of information, Organization of information on index cards. Objectives Formulation of the research objectives.	K2
CO3	Understand the basic Research methodology, Sampling, Plan and Methods of for data collection, Ethical considerations	K3
CO4	Develop a deeper understanding the work Plan, Major components and outline of research, Summary, Research report and proposal writing	K3
CO5	Understand the concept of measures of Mean, Analysis of Variance and use of bioinformatics tools	K3 & K4

## **UNIT I**

Introduction to research; Definitions and characteristics of research; Types of research; Main components of any research work. Topic Selection; Learning Objectives; Problem identification; Criteria for prioritizing problems for research.

## **UNIT II**

Literature review: Uses of literature review; Source of information; Organization of information on index cards. Objectives: Learning Objectives; Definitions; Formulation of the research objectives.

## **UNIT III**

Research methodologies: Study population; Variables; Sampling; Sample size determination; Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.

## **UNIT IV**

Work Plan; Major components and outline of the different phases in a research process; Summary of the major components of a research proposal; Fieldwork; Preparation of Research report – Thesis - dissertation - Manuscript/research article – monograph/review.

## **UNIT V**

Measures of Mean, Median and Mode: Standard Deviation and Standard Error. Regression and Correlation coefficient analysis; Student's t-test; Analysis of Variance (ANOVA); Chi-Square test. Bioinformatics: BLAST N & P, Gene discovery using EST. Genbank Database- NCBI, EMBL & DDBJ.



## REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Biostatistics: A foundation for Analysis in the Health Sciences Experiments of	Wayne W. Daniel,	Wiley Series in Probability and Statistics, 7E	1996
2.	Instrumental methods, Laboratory Manual	A Charles Norwood Reilley and Donald Turner Sawyer	McGraw-Hill, New York	1961
3.	Instrumental Methods of Analysis	Hoburt Willard, Lynne L. Meritt J.R. John Dean	East West Press Pvt Ltd	1965
4.	Introduction to Bioinformatics: Protein Purification	Atwood, T. K. and Parry-Smith, D. J. Ed by Robert Scopes,	Springer Verlag Publication	1982

## TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Laboratory Instrumentation	M. Prakash, C.K.Arora	Anmol Publications Pvt Ltd.,	2005
2.	Introductory Statistics	Prem S. Mann	John Wiley and Sons(ASIA) Pvt. Ltd. Fifth Edition.	2004
3.	Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery	S.C. Rastogi, N. Mendiratta, and P. Rastogi	PHI Learning Private Limited	2013

### Mapping with Programme Outcomes

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	S	M	S
<b>CO2</b>	S	S	M	M	M
<b>CO3</b>	M	S	S	S	S
<b>CO4</b>	S	S	S	M	M
<b>CO5</b>	M	S	S	S	S

**S**- Strong; **M**-Medium

## SEMESTER II

### Extra Disciplinary Course

<b>EDC - I</b>	<b>M.Sc., Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19EBT01</b>	<b>AGROBIOTECHNOLOGY</b>	
<b>Credit: 4</b>		

### Objective

To emphasis on development of entrepreneurial potential and skills amongst the students in agricultural biotechnology.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Impart knowledge of types of earthwarm, Vermicompost production method and it nutrient values	K2
CO2	Understand the knowledge of biofertilizer production and its uses.	K2
CO3	Make knowledgeable and learn about chemical fertilizers of merits and demerits	K4
CO4	Understand the significance of management of pests and diseases.	K3
CO5	Knowledge about farm implementation, economic importance of vermicomposting.	K4

## UNIT I

Vermicomposting - Definition, introduction and scope: Ecological classification: Humus feeders, Humus formers, Useful, local and exotic species of earthworms, Vermicomposting - Methods - Advantages -Nutritional Composition of Vermicompost.

## UNIT II

Biofertilizers: Introduction, Nitrogen fixing Bacteria, mycorrhiza and phosphate solubilizing Bacteria. Types of organic manure-Green manure, farm yard manure, farm compost, urban waste compost, rural waste compost.

## UNIT III

Chemical Fertilizers: Chemical fertilizers and their impact on environment. Pollution of soil, surface and ground water due to over use of fertilizers and remedial measures,

## UNIT IV

Pesticides: Introduction, relevance in management of pests and diseases, ill-effects with particular reference to bio-magnification and other environmental hazards.

## UNIT V

Organic Farming: Economics of Farming: Economics and basic knowledge of farm implements -ploughs, spray pumps, tractors. Harvesters and thrashers – harvest combines, reapers, chaff cutters, sugarcane crushers.

## TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Ecology of earthworms	Edwards, C.A. and Bohlen, P.J.	Chapman and hall.	1996
2	Agroecology: The Science of Sustainable Agriculture	Altieri, M.	Westview Press, Boulder, CO	1990
3	Sustainability through organic farming.	Joshi, M., Setty, T.K.P. and Prabhakarasetty	Kalyani Publishers	2006

4	Principles of Agronomy.	Reddy, T. Y. and Reddy, G.H.S	Kalyani Publishers.	2013
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### REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	Organic Agriculture Handbook of	Kristensen, P., Taji, A. and Reganold, J.	A Global Perspective. CSIRO Press	2006
2	Agricultural Sciences	Singh, S.S., Gupta. P. and Gupta, A.K	Kalyani Pub	1994

### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	S	M	M	M	S
<b>CO2</b>	M	M	M	S	S
<b>CO3</b>	S	S	M	M	S
<b>CO4</b>	S	M	S	S	S
<b>CO5</b>	S	S	S	M	S

**S-** Strong; **M**-Medium.

## SEMESTER II

<b>EDC-II</b>	<b>M.Sc. Biotechnology</b>	<b>2019 - 2020</b>
<b>Code: M19EBT02</b>	<b>HEALTH CARE AND ENVIRONMENTAL</b>	
<b>Credit: 4</b>	<b>BIOTECHNOLOGY</b>	

### Objective

To make the students understand public health and keep healthy environment.

### Course Outcomes

On the successful completion of the course, students will be able to

<b>CO</b>	<b>Statement</b>	<b>Knowledge Level</b>
CO1	Understand the Public Health	K1
CO2	Understand the concepts of Epidemiology	K2
CO3	Important environmental issues and protection	K3
CO4	Describe the use of biotechnological processes to protect the environment	K3
CO5	Understand the principle of industrial waste management	K3

## **UNIT I**

Introduction to Public Health Evolution of Public Health. Important Public Health Acts, Health problems of developed and developing countries, Health problems in India, Environment and Health.

## **UNIT II**

Basic Epidemiology Definition and Concepts of Epidemiology, Concepts of Health and Disease. Role of Genetics in Health and Disease, Levels of Prevention, Types of Epidemiology, Uses of Epidemiology.

## **UNIT III**

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.

## **UNIT IV**

Biodegradation of xenobiotics- Ecological considerations, decay behavior and degradative plasmids, hydrocarbon, hydrocarbon substitutes, pesticides and surfactants. Phytoremediation.

## **UNIT V**

Air pollution and its control through biotechnology. Waste water treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Environmental Science and Biotechnology: theory and Techniques	Murugesan AG and Rajakumari C.	MJP Publishers	2008
2	Environmental Biology	Sharma PD	Rastogi Publications	1994

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publisher</b>	<b>Year of Publication</b>
1	Environmental Biotechnology and cleaner Bioprocesses	Eugenia J.Olguin	Taylor and Francis	2000

**Mapping with Programme Outcomes**

<b>COS</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>CO1</b>	S	S	S	S	M
<b>CO2</b>	S	S	S	S	M
<b>CO3</b>	S	S	M	S	M
<b>CO4</b>	S	M	S	M	M
<b>CO5</b>	S	M	M	S	M

**S-** Strong; **M-**Medium.





# MAHENDRA ARTS & SCIENCE COLLEGE (Autonomous)

Affiliated to Periyar University, Salem.

Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956

Kalippatti - 637 501, Namakkal (Dt), Tamil Nadu.

## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations - 2016)

Programme : M.Sc. Biotechnology

S.No.	Course Name	Course Code	Employability	Entrepreneurship	Skill Development
1.	Microbiology	M16PBT04			✓
2.	Soil Science	M16PBTE02			✓
3.	Human Physiology	M16PBTE03	✓		
4.	Horticulture	M16PBTE04		✓	
5.	Biophysics & Bioinstrumentation	M16PBTE01			✓
6.	Genetic Engineering and rDNA Technology	M16PBT05			✓
7.	Bioprocess Technology	M16PBT07			✓
8.	Industrial Safety	M19UBTE08			✓
9.	Clinical Biochemistry	M16PBTE07			✓
10.	Aquaculture	M16PBTE08			✓
11.	Apiculture	M16PBTE12	✓		
12.	Marine Biotechnology	M16PBTE10			✓
13.	Vermicomposting Technology	M16PBTE01		✓	
14.	Environmental Biotechnology & Nanotechnology	M16PBT10			✓
15.	Research methodology & Research Proposal Development	M16PBT12			✓

**PRINCIPAL**  
MAHENDRA ARTS & SCIENCE COLLEGE  
(Autonomous)  
Kalippatti (PO) - 637 501, Namakkal (Dt)

**Head of the Department**  
**HEAD OF THE DEPARTMENT**

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Namakkal (Dt), Tamil Nadu, India.

**Principal**

**PRINCIPAL**  
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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations - 2016)

#### Programme : M.Sc. Biotechnology

S.No.	Name of the Course	Course Code	Employability/ Entrepreneurship/ Skill development	Year of introduction (during the last five years)
1.	Microbiology	M16PBT04	Skill development	2016 - 2017
2.	Soil Science	M16PBTE02	Skill development	2016 - 2017
3.	Human Physiology	M16PBTE03	Employability	2016 - 2017
4.	Horticulture	M16PBTE04	Entrepreneurship	2016 - 2017
5.	Biophysics & Bioinstrumentation	M16PBTE01	Skill development	2016 - 2017
6.	Genetic Engineering and rDNA Technology	M16PBT05	Skill development	2016 - 2017
7.	Bioprocess Technology	M16PBT07	Skill development	2016 - 2017
8.	Industrial Safety	M16UBTE08	Skill development	2016 - 2017
9.	Clinical Biochemistry	M16PBTE07	Skill development	2016 - 2017
10.	Aquaculture	M16PBTE08	Entrepreneurship	2016 - 2017
11.	Vermicomposting Technology	M16PBTE01	Entrepreneurship	2016 - 2017
12.	Apiculture	M16PBTE12	Employability	2017 - 2018
13.	Marine Biotechnology	M16PBTE10	Skill Development	2017 - 2018
14.	Environmental Biotechnology & Nanotechnology	M16PBT10	Skill Development	2017 - 2018
15.	Research methodology & Research Proposal Development	M16PBT12	Skill Development	2017 - 2018

Head of the Department

**HEAD OF THE DEPARTMENT**

Department of Biotechnology,  
Mahendra Arts & Science College (Autonomous),  
Kalippatti (Po) - 637 501, Tiruchengode (Tk),  
Namakkal (Dt), Tamil Nadu, India.

**PRINCIPAL**

MAHENDRA ARTS & SCIENCE COLLEGE  
(Autonomous)  
Kalippatti (PO) - 637 501, Namakkal (Dt)

Principal

**PRINCIPAL**

MAHENDRA ARTS & SCIENCE COLLEGE  
(Autonomous)  
Kalippatti (PO) - 637 501, Namakkal (Dt)

# **MAHENDRA ARTS & SCIENCE COLLEGE**

**(Autonomous)**

**Affiliated to Periyar University, Salem.**

**Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956**

**Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.**



## **MASTER OF SCIENCE**

### **CHOICE BASED CREDIT SYSTEM**

### **SYLLABUS FOR M.Sc. BIOTECHNOLOGY**

**For the students  
admitted from the  
Academic Year 2016-2017 onwards**

**PRINCIPAL**  
**MAHENDRA ARTS & SCIENCE COLLEGE**  
**(Autonomous)**  
Kalippatti (PO) - 637 501, Namakkal (Dt)

## **M.Sc. BIOTECHNOLOGY**

### **REGULATIONS**

#### **Condition for Admission:**

A candidate who has passed a Bachelor degree in Science with Biotechnology, Botany, Zoology, Biology, Microbiology, Microbial Gene technology, Bioinstrumentation, Bioinformatics, Biochemistry, Chemistry, Agriculture, Marine Biology, Home Science, Farm Science, Nutrition and Dietetics, Integrated Biology, Plant science, Animal Science, Fisheries Science, Aquaculture, Mathematics with Physics, Chemistry as Ancillary, Medical Lab Technology, MBBS, BDS, B.Pharm, BSMS, BHMS of this university or any of the above degree of any other university accepted by syndicates as equivalent thereto, subject to such conditions as may prescribed therefore shall be permitted to appear and qualify for the M.Sc., Biotechnology Degree Examination of this University after a course of study of two academic years.

#### **Duration of the Course:**

The Course for the degree of Master of Biotechnology shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

#### **Course of Study:**

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

#### **Examinations:**

The theory examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to reappear for each failed subject(s) in the subsequent examination.

The practical examinations for PG course should be conducted at the end of the semester. At the end of the 4<sup>th</sup> Semester Viva-Voce will be conducted on the basics of the Dissertation / Project report submitted by the student. One internal and one external examiner the Viva-Voce will be conducted by jointly.

**Pattern of Question paper**

**Model Question Paper Pattern: Theory**

**(Including the special paper – Human Rights)**

Time : 3Hours

Max.Marks:75

**Section – A**

Answer all the questions:

5 x 5 = 25 Marks

(2 Questions from each unit with internal Choice)

**Section – B**

Answer all the questions

10 x 5 = 50 Marks

(2 Question from each unit with internal choice)

**Model Question Paper Pattern: Practical**

Time : 7 Hours

Max.Marks : 60

Major	:	20 Marks
Minor	:	10 Marks
Spotters(5x4)	:	20 Marks
Record	:	5 Marks
Viva Voce	:	5 Marks
Total	:	50 Marks



**Norms for examiners:**

Internal examiner – for evaluation of theory papers : Faculty only from the colleges offering M.Sc., Biotechnology course, Periyar University for Internal examiner ship should be considered; Preferably faculty with minimum of 3 years teaching experience. Examiners panel submitted by the Board of studies to be followed.

**Faculty Eligibility:**

M.Sc., Degree in Biotechnology, Microbiology, Biochemistry, Botany, Zoology, Immunology, Plant Science, Life Science with SLET, National level Eligibility Test (NET) or Ph.D., in the relevant field.

**Dissertation:****No. of Copies / Distribution of dissertation:**

The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners.

**Format to be followed:**

The formats / certificate for dissertation to be submitted by the students are given below.

**Format for the preparation of Project work:**

- (a) Title Page
- (b) Bonafide certificate
- (c) Acknowledgement
- (d) Table of contents

## CONTENTS

<b>S. No:</b>	<b>Title</b>	<b>Page No.</b>
1	Introduction	
2	Review of Literature	
3	Materials and Methods	
4	Results	
5	Discussion	
6	Summary	
7	Reference, Bibliography	

**Format of the Title Page:**

**Title of the Dissertation**

Dissertation submitted in partial fulfillment of the requirement for the Degree of Master of  
Science in Biotechnology to the Periyar University,  
Salem – 636 011.

Student Name

Register Number

College

Year



**Format of the Certificate:**

**CERTIFICATE**

This is to certify that the dissertation entitled \_\_\_\_\_

Submitted in partial fulfillment of the requirement of the degree of Master of Science in Biotechnology to the College is a record of bonafide research work carried out by \_\_\_\_\_ under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

**Signature of the Guide**

**Signature of the Head**

Examiner 1

Examiner 2

**Passing Minimum :**

The candidate shall be declared to have passed the examination if the candidate secure not less than 50% of marks in the internal and university examination in each theory paper.

For the practical paper, a minimum of 50 percentage marks out of the stipulated maximum marks in the internal and university examination and the record notebook taken together. There is no passing minimum for record notebook. However submission of a record notebook is a must.

For the project work and viva-voce the candidate should secure 50% of the marks for pass in the internal and university examinations. The candidates should compulsory attend viva – voce examination to secured pass in that paper.

Candidate who does not obtain the required minimum marks for a pass in a paper / Project report shall be required to appear and pass the same at a subsequent appearance.

**Classification of Successful Candidates**

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class.

All other successful candidates shall be declared have passed in the second class.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in first class with distinction provided they pass all the examination in first class with distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within a period of two academic years from the year of admission to the course only are eligible for University Ranking.

**Maximum Duration for the completion of the PG Programme**

The maximum duration for completion of the PG programme shall not exceed 8 semesters.

**Commencement of this regulation**

These regulation shall taken effect from the academic year 2015-2016, i.e., for students who are to be admitted to the first year of the course during the academic year 2015-16 and thereafter.

**Transitory Provision**

Candidates who were admitted to the PG course of study before 2015-2016 shall be permitted to appear for the examination under those regulations for a period of three years i.e., up to and inclusive of the examination of April / May 2018. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

**MAHENDRA ARTS AND SCIENCE COLLEGE**

**(Autonomous)**

**DEPARTMENT OF BIOTECHNOLOGY**

**M.Sc., Biotechnology – Course Structure (CBCS Pattern- 2016-2017 Onwards)**

Pa rt	Sem.	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Core I	I	M16PBT01	Cell Biology	4	4	25	75
Core II		M16PBT02	Biological Chemistry	4	4	25	75
Core III		M16PBT03	Molecular Biology	4	4	25	75
Core IV		M16PBT04	Microbiology	4	4	25	75
Elective			Elective	3	4	25	75
Core Practical-I		M16PBTP01	Lab in Cell Biology & Biological Chemistry	4	5	40	60
Core Practical-II		M16PBTP02	Lab in Microbiology & Molecular Biology	4	5	40	60
				27			
Core V	II	M16PBT05	Genetic Engineering & rDNA Technology	4	4	25	75
Core VI		M16PBT06	Immunology	4	4	25	75
Core VII		M16PBT07	Bioprocess Technology	4	4	25	75
Elective			Elective	3	4	25	75
EDC			EDC	4	4	25	75
Core Practical- III		M16PBTP03	Lab in Genetic engineering and rDNA technology	4	4	40	60
Core Practica l– IV		M16PBTP04	Lab in Immunology and Bioprocess technology	4	4	40	60
Part- IV		M16PHR01	Human Rights	2	2	25	75
				29			
Core VIII	III	M16PBT08	Plant Biotechnology	4	4	25	75
Core IX		M16PBT09	Animal Biotechnology	4	4	25	75
Core X		M16PBT10	Environmental Biotechnology & Nanotechnology	4	4	25	75
Core XI		M16PBT11	Proteomics & Genomics	4	4	25	75

Elective			Elective	3	4	25	75
Core Practical-V		M16PBTP05	Lab in plant & Animal Biotechnology	4	5	40	60
Core Practical-VI		M16PBTP06	Lab in Environmental Biotechnology, Proteomics and Genomics	4	5	40	60
				27			
Core XII	IV	M16PBT12	Research methodology & Research Proposal Development.	4	5	25	75
Project		M16PBTPR1	Project	4	23	25	75
Internship		M16PBTIS01	Internship	2	2	-	100
				10			
Total credits				93			

### LIST OF ELECTIVES

SEM	Paper Code	Title of the Paper	Credits	Marks		
				Lecture Hrs/Wk	Int. Marks	Ext. Marks
<b>I</b>	<b>M16PBTE01</b>	<b>Biophysics &amp; Bioinstrumentation</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>
	<b>M16PBTE02</b>	<b>Soil Science</b>	<b>3</b>	<b>4</b>	<b>25</b>	75
	<b>M16PBTE03</b>	<b>Human Physiology</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>
	<b>M16PBTE04</b>	<b>Horticulture</b>	<b>3</b>	<b>4</b>	<b>25</b>	75
<b>II</b>	M16PBTE05	Stem cell Biology & Tissue Engineering	3	4	25	75
	<b>M16PBTE06</b>	<b>Industrial safety</b>	<b>3</b>	<b>4</b>	<b>25</b>	75
	<b>M16PBTE07</b>	<b>Clinical Biochemistry</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>
	M16PBTE08	<b>Aquaculture</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>
<b>III</b>	M16PBTE09	Biostatistics	3	4	25	75
	M16PBTE10	<b>Marine Biotechnology</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>
	M16PBTE11	Cancer Biology	3	4	25	75
	M16PBTE12	<b>Apiculture</b>	<b>3</b>	<b>4</b>	<b>25</b>	<b>75</b>

### LIST OF EXTRA DISCIPLINARY COURSE

SEM	Paper Code	Title of the Paper	Credits	Marks		
				Lecture Hrs/Wk	Int. Marks	Ext. Marks
II	M16PBTED1	Vermicomposting Technology	4	4	25	75
	M16PBTED2	Health care and environmental biotechnology	4	4	25	75

## SEMESTER - I

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Core I	M16PBT01	Cell Biology	4	4	25	75
Core II	M16PBT02	Biological Chemistry	4	4	25	75
Core III	M16PBT03	Molecular Biology	4	4	25	75
Core IV	M16PBT04	Microbiology	4	4	25	75
Elective		Elective	3	4	25	75
Core Practical-I	M16PBTP01	Lab in Cell Biology & Biological Chemistry	4	5	40	60
Core Practical-II	M16PBTP02	Lab in Microbiology & Molecular Biology	4	5	40	60
			<b>27</b>			

## **CELL BIOLOGY – M16PBT01**

### **UNIT I**

Cell Theory, Emergence of modern cell biology, Structure of Prokaryotic and Eukaryotic cells- Cell-wall, Membrane, Cell organelles-organization and functions, Nucleus, Mitochondria, Plastids; Endoplasmic Reticulum, Golgi complex, Lysosomes, Microtubules, Centriole, Vacuole, Cytoskeleton, Cilia and Flagella.

### **UNIT II**

Chromosome structure and functions – Giant chromosomes, Lamp brush and Polytene Chromosomes, Karyotype analysis, Chromosome abnormalities.

### **UNIT III**

Cell cycle control and cell death: overview of cell cycle-control system, Regulation of the Cell Cycle, Mitosis, Meiosis, Molecular control involving checkpoints in cell division cycle. Differentiation, Cellular senescence.

### **UNIT IV**

Cell signaling – types , Chemical signals and cellular receptors ,G Protein-linked receptors, Protein Kinase-associated receptors, Growth factors as messengers, Cell signals and Apoptosis, Cytoskeleton: microfilaments-intermediate filaments-microtubules.

### **UNIT V**

Development of Multicellular organisms- yeast, *Caenorhabditis elegans* and *Arabidopsis thaliana*, *Drosophila melanogaster*, Stem cells, types, use of stem cells to repair damaged tissues.

### **REFERENCES**

1. Molecular Biology of the cell, Alberts, B et al. (1994)
2. Molecular Cell Biology , Lodish et al.
3. Reproduction in Eukaryotic cells, D.M.Presco, Academic Press.
4. Developmental Biology, SF.Gillbert, Sinaur Associates Inc.
5. Cell in Development and Inheritance, EB Wilson, MacMillan, New York.
6. Molecular Biology of steroid and nuclear hormone receptors, LP Freeman, Birkhauser.
7. Cell and Molecular Biology- DeRobertis and DeRobertis (2004)
8. Cell and Molecular Biology, Gerald Karp (1999)
9. Cell and Molecular Biology, P.K.Gupta, (2002)
10. The world of Cell-Becker,W.M *et.al*.6<sup>th</sup> edition.Pearson Education.2007.



## **BIOLOGICAL CHEMISTRY - M16PBT02**

### **UNIT I**

Principles of thermodynamics- First and second laws of Thermodynamics. Free energy – Concepts of metabolism: Types- Catabolism and anabolism with reference to pathways- pH, pK, acids, bases, buffers. Bonds in biomolecules – weak and strong bonds.

### **UNIT II**

Sugars-Classification and reactions, polysaccharides-types, structural features, methods for compositional analysis. EMP pathway, TCA cycle. Lipids-Classification, structure and functions. Beta oxidation of fatty acids cholesterol biosynthesis

### **UNIT III**

Aminoacids -Classification, chemical reactions. Proteins-Classification, hierarchy in structure, Ramachandran plot. Protein sequencing, Glyco and Lipoproteins- Structure and function. Biosynthesis of purines and pyrimidines, de Novo and salvage pathway.

### **UNIT IV**

Macromolecules and super molecular assemblies like membrances, ribosome and chromosomes. Secondary metabolites in living systems: Alkaloids, Steroids and Flavonoids.

### **UNIT V**

Vitamins-Fat soluble and water soluble vitamins, Minerals, role of vitamins and minerals in human health. Hormones: Definition, Classification of hormones. Biological functions and disorders of pancreatic hormone (Insulin), thyroid hormone (Thyroxin), Hypothalamus and pituitary hormone (GH,TSH,GTH,ADH) and Adrenal gland (Adrenaline, Nor adrenaline). Hormones and reproduction-Hormones in pharmaceuticals.

### **REFERENCES**

1. Biochemistry, D.Voet and J.G.Voet, John Wiley and Sons.
2. Biochemical Calculations, Irwin H.Segal, John Wiley and Sons Inc.
3. Text Book of Biochemistry.Devlin,T.M.,John Wiley and Sons.Inc.
4. Understanding Chemistry, CNR Rao, Universities Press, Hyderabad, 1999.
5. Principle of Biochemistry. Lehninger,A.L.,Nelson,D.L and Cox,M.M.2002.CBS Publishers
6. Biochemistry, Stryer, L., 2002, Fifth edition. W.H.Freeman and co
7. Biochemistry, U.Satyanarayana, (2005)
8. Fundamentals of Biochemistry, J.L.Jain (1999)

## **MOLECULAR BIOLOGY -M16PBT03**

### **UNIT I**

Introduction of molecular biology, Central dogma of molecular Biology. DNA Replication. Prokaryotic and Eukaryotic DNA replication, Mechanism of DNA replication, Enzymes and accessory proteins involved in DNA replication. DNA Repair – light and dark mechanisms.

### **UNIT II**

Transcription-Prokaryotics transcription, Eukaryotics transcription, RNA polymerase, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing. Modifications in RNA. 5' cap formation, transcription, 3'-end processing and Polyadenylation, Splicing, Editing, Nuclear export of mRNA.

### **UNIT III**

Translation -Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post-translational modifications of proteins. Protein Localization. Synthesis of Secretory and membrane proteins, import into nucleus, mitochondria and chloroplast.

### **UNIT IV**

Oncogenes and Tumor Suppressor Genes-Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, function and mechanisms of action of pRB and p53 tumor suppressor proteins.

### **UNIT V**

Molecular Mapping of Genome-Genetic and physical maps, physical mapping and map based cloning, Southern and fluorescence in situ hybridization in genome analysis, RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling.

### **REFERENCES**

1. Molecular cloning: A Laboratory Manual, J.Sambrook, E.F.Ritsch and I.Maniatis, Cold Spring Hratbor Laboratory Press, New York, 2000.
2. Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley and Son Ltd. New York, 1988.
3. Molecular Biology, Labfax, T.A.Brown, Bioscientific publishers ltd, Oxford, 1991.

4. Molecular Biology of gene (4<sup>th</sup> Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner. The Benjamin/Cummings publications C Inc.California, 1987.
5. Molecular Cell Biology (2<sup>nd</sup> Edition, J.Darnell, H.Lodish and D.Baltimore, Scientific American Book, USA, 1994.
6. Gene VII Benjamin Lewin. Oxford University Press. U.K.
7. Molecular Biology and Biotechnology. A comprehensive dies reference. R.A.Meyers (Edition).VCH Publishers, Inc., New York, 1995.
8. Genomes, T.S.Brown.
9. Molecular Biology and Biotechnology. J.M.Walker and R.Rapley. 2005.

## **MICROBIOLOGY - M16PBT04**

### **UNIT I**

History and development of microbiology. Microscopy- bright field, dark field, Electron. Sterilization, Control of microorganisms by physical and chemical methods. Bacterial taxonomy and classification according to Bergy's manual. Stains and staining methods-simple, differential and special staining.

### **UNIT II**

Microbial Growth-mathematical expression of growth, growth curve, measurement of growth. Synchronous culture and Continuous culture. Factors affecting microbial growth. Culture media and their types. Pure Culture Techniques-Serial dilution methods - spread plate – pour plate – streak plate technique. Culture collection and preservation of microbial cultures.

### **UNIT III**

Nutritional requirements and types of microorganisms, uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

### **UNIT IV**

Host – parasite relationship, normal microflora. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents.

### **UNIT V**

Mutation and Mutagenesis; UV and chemical mutagens; Types of mutation; Ames test for mutagenesis; Methods of genetic analysis – Transformation, Conjugation, Transduction, Recombination. Plasmids and Transposons. Bacterial genetic maps with reference to *E. coli* – Viruses and their genetic system – Phage life cycle, Genetic systems of yeast and *Neurospora*.

### **REFERENCES**

1. Pelczar MJ , Chan ECS, and Krieg NR, (2006) Microbiology, 5<sup>th</sup> Edition Tata McGraw Hill Publishing Company.
2. Prescott LM, Harley JP and Klein DA (2005) Microbiology, 6<sup>th</sup> Edition.

McGraw Hill.

3. Talero KP and Talero A (2002): Foundations in Microbiology. 4<sup>th</sup> Edition McGraw Hill.
4. Anantha Narayanan R and Panikar CKJ (2002). 6<sup>th</sup> Edition. Orient Longman Pvt.Ltd
5. Benson HJ (1999), Microbiological Applications: A Laboratory manual in General Microbiology. 7<sup>th</sup> Edition. McGraw Hill.
6. Modi HA (1995), Elementary Microbiology (Volume- 1 Fundamentals of Microbiology). Akta Prakashan Nadiad Publication.
7. Freifelder D (1995), Microbial Genetics, Narosa Publishing House.
8. Maloy SR, Cronan JE and Freifelder D Microbial Genetics, Jones Barlett Publishers.
9. Cappuccino JG and Sherman N (1996). Microbiology - a laboratory Manual. 5<sup>th</sup> edition. Editors: Wirth AE and Olsen L.

## **ELECTIVE – I- BIOPHYSICS & BIOINSTRUMENTATION - M16PBTE01**

### **UNIT I**

Scope and methods of Biophysics. Understanding various structure of proteins, globular and fibrous protein; protein stability; protein folding. The physics of nucleic acids: Forces stabilizing structures; Double helical structures, properties and forms of DNA.

### **UNIT II**

Colorimeter-Beer Lambert's law, UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometer, IR and Raman Spectroscopy, Spectrofluometry, Mass Spectrophotometry- Matrix assisted layer desorption ionization and surface enhanced laser desorption ionization.

### **UNIT III**

Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation. Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

### **UNIT IV**

Chromatography- Paper chromatography- Thin layer chromatography-Column chromatography- LPCC and HPLC, Affinity chromatography, Partition chromatography, Ion exchange chromatography, Gel Permeation chromatography.

### **UNIT V**

Basic concept of radioactivity and measurement of radioactivity. Radioisotope techniques – GM Counter, Liquid scintillation and Solid scintillation counter, fluorimetry and its types. Physical Biomedical method of Imaging techniques, Intact biological structures (X-ray, CAT-SCAN, ECG, EEG, NMR) Autoradiography, X ray crystallography.

### **REFERENCES**

1. Biochemistry (1995) Voet, D. & Voet, J.G. 2nd Edi. John Wiley & Sons.
2. Bioinstrumentation (2004) John Webster. John Wiley & Sons.
3. Bioinstrumentation (2006) Veerakumari, 1st Edi. MJP Publishers.
4. Molecular Biology of the Gene. (1987). James, D. Watson. Hopkins, N.H, Roberts.
5. Biochemistry. (1993). Zubay, G.L, 4th Edi. WmC. Brown Publishers.
6. A Biologist guide to principles and techniques of practical biochemistry. (1975). Bryan, W. & Keith, W.
7. Practical Biochemistry (1995) Wilson, K. & Walker, J. 5th Edi. Cambridge University Press.

## **ELECTIVE – I -SOIL SCIENCE- M16PBTE02**

### **UNIT I**

Definition and composition of soil, Soil as three phase system (solid, liquid and gas), Soil texture, Influence of soil texture on soil properties, Various methods of estimation of soil texture. Classification according to various systems, Soil mineralogical composition.

### **UNIT II**

Clay and its classification, Soil Structure and soil aggregation, Classification of soil structure. Factors influencing soil structures and plant growth. Bulk density, Particle density and Porosity. Factors Influencing Bulk density, Particle density and Porosity.

### **UNIT III**

Soil consistency, Cohesion, Adhesion. Forms of consistency, Factor influencing soil consistency, Plasticity. Soil moisture, Forms of soil water. Water – energy concept, Soil moisture potential.

### **UNIT IV**

Water flow in saturated and unsaturated soil. Infiltration, Redistribution, Evaporation, Water balance in field. Soil Moisture Characteristic Curve. Hysteresis. Soil water movement. Saturated Flow, Unsaturated Flow,

### **UNIT V**

Soil air and its composition, Significance. Factor Influencing Soil Air Composition. Effect of soil aeration on plant growth. Soil temperature and its importance, Thermal properties of soil. Factors influencing soil temperature. Effect of soil temperature on soil properties and on plant growth.

### **REFERENES**

1. Baver, L. D., Gardner, W. H. and Gardner, W. R. 1972. Soil Physics. John Wiley, New York.
2. Oswal, M. C. 1994. Soil Physics –Oxford IBH, New Delhi.
3. Hanks and Ascheroff. 1980. Applied Soil Physics. Springer– Verlag, Berlin.
4. Hillel, D. 1998. Environmental Soil Physics. Academic Press, New York.
5. Hillel, D. 1982. Introduction to Soil Physics. Academic Press, New York.
6. Hillel, D. 1980. Application of Soil Physics. Academic Press, New York.
7. Khanke, H. 1968. Soil Physics. McGraw Hill Publishing Co., New Delhi.
8. Kirkham, D. and Powers, W. L. 1972. Advanced Soil Physics. Wiley Interscience.
9. Ghildyal, B. P., K. P. Tripathi. 1987. Soil Physics. Wiley Eastern Limited, New Delhi.

## **ELECTIVE – I - HUMAN PHYSIOLOGY – M16PBTE03**

### **UNIT I**

Blood- Composition and functions of plasma, hemopoiesis, erythrocytes including Hb, leukocytes and thrombocytes, plasma proteins and their role. Blood coagulation – mechanism and regulation, Fibrinolysis, Blood groups and Rh factor. Transfers of blood gases -oxygen and carbon dioxide. Role of 2, 3-BPG, Bohr effect and chloride shift. Regulation of respiration, Pulmonary circulation.

### **UNIT II**

Digestive system- Composition, functions and regulation of salivary, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. Role of peristalsis and large intestine in digestion.

### **UNIT III**

Resting potentials and action potentials of excitable cells, contraction of skeletal, cardiac and smooth muscles. Neurophysiology: Types of neurons and synapses and transmission of nerve impulse across them, Neurochemistry of vision, gustation, olfaction and hearing. Sensory receptors in skin and muscles. Endocrinology- Secretion, mechanisms of action and effects of hormones of hypothalamus, pituitary, thyroid, adrenal gland and pancreas. Synthesis and functions of testosterone and ovarian hormones.

### **UNIT IV**

Rhythmical excitation of heart, basic theory of circulatory function, blood flow and resistance, function of arterial and venous systems Microcirculation and lymphatic system, control of blood flow, regulation of arterial pressure, cardiac output. Spinal cord and motor functions, role of brain stems in controlling motor functions, functions of cerebellum, functions of cortical areas, the limbic system and cerebrospinal fluid system.

### **UNIT V**

Excretory system- Structure of nephron, formation of urine (glomerular filtration, tubular reabsorption of glucose, water and electrolytes), tubular secretion, role of kidneys regulation of blood pressure. Control of body temperature, effect of low oxygen pressure on body, effects of acceleratory forces on body, effects of high partial pressures of gases on body



## REFERENCES

1. Textbook of Medical Physiology 10th Ed By Arthur C. Guyton and John E. Hall, Harcourt Asia Pte Ltd.
2. Essential Medical Physiology 3rd Ed By Leonard R. Johnson, Elsevier Academic Press.
3. Endocrinology: An Integrated Approach By SS Nussey and SA Whitehead. BIOS Scientific Publishers
4. Physiology 3rd Ed, By Linda Costanzo, Saunders Publishers.
5. Principles of Anatomy and Physiology 10th Edition By Gerard J. Tortora and Sandra Grabowski. Publisher: John Wiley and Sons.
6. Principles of Human Physiology (Paperback) By Cindy L. Stanfield and William J. Germann. Publisher: Pearson Education.
7. Samson Wright's Applied Physiology 13th Ed. CA Keele, E Neil & N Joels. Oxford University Press.
8. Principles of Biochemistry: Mammalian Biochemistry By Emil Smith. McGraw Hill Publications.
9. Human Physiology: The Mechanisms of Body Function (Paperback) By Arthur J. Vander, James Sherman, Dorothy S. Luciano, Eric P. Widmaier, Hershel Raff and Hershal Strang. McGraw Hill Education.
10. Medical Physiology: Principles for Clinical Medicine 3rd Ed. By Rodney R. Rhoades and David R. Bell. Lippincott Williams & Wilkins.

## **ELECTIVE – I – HORTICULTURE - M16PBTE04**

### **UNIT I**

Horticulture :- Importance and scope of Horticulture, Classification of horticultural crops – fruits, vegetables crops, climate, soil, water, nutrition needs of horticultural crops,

### **UNIT II**

Plant propagation methods, cutting, layering, grafting, budding, stock-seion relationship. Use of plant regulators in horticulture.

### **UNIT III**

Garden designs, types of gardens – formal, informal and kitchen garden, units of garden, hedge, border, popiary arches and lawn maintenance.

### **UNIT IV**

Floriculture, cultivation of commercial flowers – rose and jasmines. Cultivation of important fruit trees – Mangoes and Banana.

### **UNIT V**

Green house, Indoor gardening – Bonsai – flower arrangements – nursery management and maintenance.

### **REFERENCES**

1. Bose, T.K. & Mukherjee, D. (1972) : Gardening in India, Oxford & IBH Publishing Co., Kolkatta, Mumbai, New Delhi-385pp.,
2. Sandhu, M.K. (1989) : plant Propagation Wiley Eastern Ltd.,New Delhi, Bangalore, Bombay, Calcutta, Madras, Hyderabad, Pune-287pp.,
3. Lex Lauries & Victor H. Rice- (1950) : Floriculture – fundamental and practices. McGraw Hill Publishers, N.Y.
4. Kumar , N. (1997) : Introduction to Horticulture Rajalakshmi Publications, Nagercoil, India- (28 Chapters & approx. 300pages)
5. Naik South Indian Fruits and their culture Vardhachary & Co., Madras.
6. Edmond Musser & Andres ( ) : Fundamentals of Horticulture McGraw Hill Book Co.,
7. Gardener : Basic Horticulture Mac Millan, N.Y.
8. Randhawa : Ornamental Horticulture in India Today & Tomorrow Publishers, New Delhi

## **PRACTICAL – I- LAB IN CELL BIOLOGY AND BIOLOGICAL CHEMISTRY – M16PBTP01**

### **CELL BIOLOGY**

1. Principles of Microscopy and optics
2. Measurement of Cell size by Micrometry
3. Preparation of permanent slides – DPX mount
4. Mitosis and Meiosis
5. Giant Chromosomes (Polytene-Chironomous larvae)
6. Sex Chromatin (Barr Body)
7. Blood cells identification
8. Microtomy - Demo

### **BIOMOLECULES**

1. Preparation of Buffers
2. Calibration of P<sup>H</sup> meter
3. Verification of Berr Lambert's Law
4. Estimation of glucose (DNS method)
5. Estimation of DNA (Diphenylamine)
6. Estimation of RNA (Orcinol)
7. Estimation of Protein ( Lowry's and Bradford Methods)
8. Extraction and Estimation of starch from potato/ tapioca
9. Separation of aminoacids by Paper and Thin layer chromatography
10. Qualitative analysis of carbohydrate
11. Qualitative analysis of aminoacids.
12. Native PAGE and SDS-PAGE

## **PRACTICAL – II- LAB IN MICROBIOLOGY AND MOLECULAR BIOLOGY- M16PBTP02**

### **MICROBIOLOGY**

1. Safety guidelines in laboratory practices.
2. Preparation of washing solution.
3. Handling of Microscopes
4. Sterilization Techniques – Physical and chemical methods.
5. Preparation of broth and agar media
6. Maintenance of Microorganisms
7. Staining methods – Simple staining, differential staining, special staining, and LCB mount.
8. Motility of bacteria by hanging drop method.
9. Biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
10. Cultural characteristics of microorganisms on Basal medium, Selective medium, Differential medium, Enriched medium, Enrichment medium.
11. Isolation and pure culture of microorganisms from soil and water - Serial dilution methods, Plating, Streaking.
12. Growth - Growth curve, Measurement of bacterial population by turbidometry, haemocytometry and serial dilution methods.
13. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
14. Determination of potability of water by MPN method.

### **MOLECULAR BIOLOGY**

1. Single Cell Colony isolation – Checking for antibiotic resistant Markers.
2. Induced Mutagenesis (UV, NTG & EMS).
3. Isolation of antibiotic resistant Bacteria by gradient plate technique.
4. Detection of mutants by replica plate technique.
5. Study of Mutation by Ames test.

## SEMESTER - II

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Core V	M16PBT05	Genetic Engineering & rDNA Technology	4	4	25	75
Core VI	M16PBT06	Immunology	4	4	25	75
Core VII	M16PBT07	Bioprocess Technology	4	4	25	75
Elective		Elective	3	4	25	75
EDC		EDC	4	4	25	75
Core Practical-III	M16PBTP03	Lab in Genetic engineering and rDNA technology	4	4	40	60
Core Practical-IV	M16PBTP04	Lab in Immunology and Bioprocess technology	4	4	40	60
Part- IV	M16PHR01	Human Rights	2	2	25	75
			<b>29</b>			

## **GENETIC ENGINEERING AND rDNA TECHNOLOGY – M16PBT05**

### **UNIT I**

Manipulation of DNA- Restriction and modification enzymes: Restriction enzymes, Ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase. Linkers, Adaptors, Oligonucleotide primers & Homopolymer tailing.

### **UNIT II**

Gene cloning vectors- Plasmids, Construction of pBR322, Bacteriophages vectors, phagemids, cosmids, Yeast vectors and Expression vectors in Prokaryotic and Eukaryotic, Ti plasmids, Vector NTI database.

### **UNIT III**

DNA sequencing techniques- Maxam Gilbert method, Sanger's method, Next generation sequencing, DNA Amplification- PCR and its types, RFLP, RAPD, SAGE, Site-directed Mutagenesis, Molecular beacons, DNA hybridization and blotting techniques, Microarrays.

### **UNIT IV**

Cloning strategies- Gene Library construction, Screening of gene library, Expression strategies for heterologous genes- expression in bacteria, yeast, insects and insect cell lines, mammalian cell lines and in plants. Processing of recombinant proteins-Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

### **UNIT V**

Transposon tagging- Role of gene tagging in gene analysis. Gene Knock in and out technologies, Transgenic animals (Mice, Cattle, Fish), Transgenic plants(Herbicide tolerance, Delayed ripening) Antisense RNA technology, Human Gene Therapy, Ethics and Philosophies in rDNA.

### **REFERENCES**

1. Mickloss D.A and G.A.Greyer (1990) DNA Science - A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York.
2. Primrose, S.B (1994) Molecular biotechnology (2<sup>nd</sup> Edi). Blackwell Scientific Publishers, Oxford.

3. Davis J.A. and W.S.Roznikolf (1992) Milestones in Biotechnology. Classic papers on genetic Engineering, Butterworth-Helnemann, Boston.
4. Walker M.R. and R.Repley (1997) Route Maps in Gene Technology Blackwell Science Ltd., Oxford.
5. Kingsman S.M. and A.J.Kingsman, (1998) Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes. Blackwell Scientific Publications, Oxford.
6. James D. Watson. Recombinant DNA (2001). Scientific American Books. USA
7. Glick, B Pasternak, J.J (2007) Molecular Biotechnology. ASM Press, Washington.
8. Benjamin Lewin. Genes-VIII. Oxford University Press.
9. Glover, D.M and B.D Hames. DNA cloning 1-4(2006) Oxford University Press.
10. Mark Schena (2002) Microarray Analysis. 1<sup>st</sup> Edition. John Wiley & Sons Ltd.

## **IMMUNOLOGY - M16PBT06**

### **UNIT I**

History and scope of immunology, Host - Parasite relationship, Infection – types – mode of transmission , Immunity – types- mechanisms, Haematopoiesis-lymphoid cells – myeloid cells and their maturation .Organs of the immune system- primary and secondary lymphoid organs – structure and functions.

### **UNIT II**

Antigen – properties- classes, haptens, mitogens, adjuvants, epitopes. Immunoglobulin- basic structure, classes, function, molecular diversity of immunoglobulins. Immune responses- generation of immune response-humoral immune response - cell mediated immune response- recognition of antigen by humoral branch (B cells) and cell mediated branch (T cells).Generation of lymphocyte specificity and diversity, clonal selection of lymphocytes.

### **UNIT III**

Antigen – Antibody reactions. Complements- components, properties, activation pathways-alternative, classical, lectin. Cytokines – properties structure and functions. Major histocompatibility complex –general organization and inheritance of MHC, structure – function- role in antigen processing and presentation. Immunological tolerance.

### **UNIT IV**

Hypersensitivity – types, mechanisms, manifestations. Transplantation – classification, transplantation antigens, graft acceptance, rejection, process of graft rejection, immuno suppressive therapy, Molecular aspects of HLA typing. Autoimmunity- mechanism of auto immunization- types. Immunodeficiency diseases. Tumor immunology.

### **UNIT V**

Antigen-isolation and purification from pathogenic bacteria. Antibody production- Hybridoma technology and engineered monoclonal antibodies. Purification of antibodies. Isolation of macrophages. Macrophage culture. Immuno screening of recombinant library. Detection of immune complex in tissues. FACS. Delayed type hypersensitivity assessment – Mantoux test. Molecular aspects of HLA typing. Recent strategies of vaccines production and immunization schedule.



## REFERENCES

1. Rajasekara Pandian M and Senthilkumar B (2007) Immunology and Immunotechnology. Panima Publishing Corporation , New Delhi.
2. Goldsby RA, Kindt TJ,Osborne BA, Kuby J (2003) Immunology 6<sup>th</sup> Edn. WH Freeman &Co. New York.
3. Kuby J (1997) Immunology 3<sup>rd</sup> Edn .WH Freeman &Co. New York.
4. Benjamini E, Coico R and Sunshine G (2000). Immunology .4<sup>th</sup> Edn. A John Wiley & sons, Inc. Publication.
5. Roitt I,Brostoff J and Male D (1993). Immunology 3<sup>rd</sup> Edn. Mosby.
6. Pelczar MJ, Chan ECS and Krieg NR. Microbiology (2006) 5<sup>th</sup> Edn. Tata McGraw-Hill Publishing Company Ltd.New Delhi.
7. Tizard IR (1995).Immunology 4<sup>th</sup> Edn. Saunders College Publishing Harcourt Brace College Publishers.
8. Talwar GP and Guptha (2004). A hand book of practical immunology .2<sup>nd</sup> Edn. VolIII.CBSPublications.

## **BIOPROCESS TECHNOLOGY - M16PBT07**

### **UNIT I**

Introduction to bioprocess engineering isolation and screening of industrially important microbes. Primary & Secondary detection & assay of fermentation products. Improvement of the strains for increased yield and other desirable characteristics. Advantages of bioprocess over chemical process. Basic principles in bioprocess. Fermentations – submerged, solid state and immobilization.

### **UNIT II**

Media formulation. Sterilization. Thermal death kinetics. Batch and continuous sterilization systems, Sterilization of air. Fibrous filters. Reactor dynamics and stability, non ideal reactor, residence time distribution, mixing pattern, types of reactors – CSTR, Tower, jet loop, Air lift, bubble column, packed bed, Immobilized cells. Enzyme co-immobilization. Bioreactor design, parts and their functions.

### **UNIT III**

Transport phenomenon in bioprocess – Mass transfer, Mass transfer for gases and liquids. Dimensionless groups. Mass transfer resistance. Rate of oxygen transfer. Determination of oxygen transfer coefficients. Biological properties of medium. Biological heat transfer. Heat transfer coefficients.

### **UNIT IV**

Bioprocess control and monitoring of variable such as temperature, agitation, pressure, pH. On line measurement. On/Off control, PID, Control. Elementary idea of Canning & Packing Sterilization & Pasteurization and preservation of food products.

### **UNIT V**

Ultrafiltration centrifugation, Chromatography, Electrophoresis, Solvent extraction, Distillation, purification of biologicals (Downstream processing).

### **REFERENCES**

1. Principles of Fermentation Technology. Peter F. Stanbury. Butterworth-Heinemann, Elsevier Science Ltd.
2. Biotechnology: A Text Book of Industrial Microbiology, Wulf Crueger and Anneliese Crueger. Science Tech Publishers.USA.
3. Fermentation Biotechnology. Jayanto Achrekar. 2006. Dominant Publishers and Distributors. New Delhi.
4. Separation Process in Biotechnology. Juan.A.Asenjo. 2007. Taylor & Francis group.

## **ELECTIVE – II - STEM CELL BIOLOGY AND TISSUE ENGINEERING - M16PBTE05**

### **UNIT-I**

Stem Cells – Basics, Properties and Classification, Types of Stem cells – Hematopoietic Stem Cells, Mesenchymal Stem Cells, Embryonic Stem Cells, Fetal Stem Cells, Adult Stem cells and their Characteristics.

### **UNIT-II**

Pluripotency, niche specification – Drosophila germ line stem cells, self renewal and differentiation, Characteristics of stem cell – Cell cycle, Ras/Raf pathway, PI3 cell signaling, p53 check points, role of LIF pathway in cell cycle control.

### **UNIT-III**

Hypoxic condition and gene expression (pre implantation stage), stem cell communications – gap junctions, cell fusion, HOX genes, upstream transcriptional factors, embryonic genes. Stem Cells in Gastrointestinal , Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration ,Stem Cells in Eye Diseases and Disorders

### **UNIT-IV**

Morphogenesis and Tissue Engineering, Principles of Tissue Culture, Bioreactor Design, Mechanochemical Regulation of Cell Behaviour, In Vitro and In Vivo Synthesis of Tissues and Organs, Micro-Scale Patterning of Cells and their Environment, Three-Dimensional Scaffolds,

### **UNIT-V**

Tissue Engineering and Transplantation Techniques, Immunoisolation Techniques, Modes of Cell and Tissue Delivery, Regeneration of Bone and Cartilage, Islet Cell transplantation and Bioartificial Pancreas, Bioprinting of Organs and Tissues.

### **REFERENCES**

1. R. Lanza, J. Gearhart et al (Eds), Essential of Stem Cell Biology. (2009), Elsevier Academic press.
2. R. Lanza and I. Klimanskaya, Essential Stem Cells Methods. (2009), Academic Press
3. J. J. Mao, G. Vunjak-Novakovic et al (Ed): Translational Approaches in Tissue Engineering & Regenerative Medicine 2008, Artech House, INC Publications.
4. Robert Lanza et al. Principles of Tissue Engineering, 3rd Edition. Academic Press; 3 edition (August 21, 2007)

5. Stein et al. Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual. Wiley-Blackwell; 1 edition (January 4, 2011)
6. Lanza et al. Handbook of Stem Cells, Two-Volume Set: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells (v. 1). Academic Press (September 28, 2004)

## **ELECTIVE – II- INDUSTRIAL SAFETY - M16PBTE06**

### **UNIT I**

Site selection, plant layout- design for ventilation - basic rules and requirements which govern the chemical industries – social environmental setup – tolerance limit of the society.

### **UNIT II**

Chemical hazards classification – hazards due to fire and explosion – safety analysis – chemical and job safety – safe handling and operation of materials and machineries.

### **UNIT III**

Types of hazard analysis – hazard identification – HAZOP – hazard survey – Fault tree analysis - event tree analysis.

### **UNIT IV**

Effective steps to implement safety procedure – periodic advice and constant maintenance – personal protective equipments- types – firefighting equipments.

### **UNIT V**

Introduction – biosafety issues in Biotechnology – Historical background – primary contaminants for biohazards biosafet guidelines and regulations (National and International) – operation of Biosafety guidelines and regulation of Government of India – Risk analysis – risk assessment – risk management.

### **REFERENCES**

1. Fawcett H.H. and Wood W.S. Safety and Hazard prevention in chemical operation, Intersciences, 1965.
2. Blake R.P. Industrial safety Prentice Hall Inc. New Jersey, 2nd Edition, 1963.

## **ELECTIVE - II - CLINICAL BIOCHEMISTRY - M16PBTE07**

### **UNIT 1**

Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypoglycemia, galactosemia and ketone bodies. Various types of glucose tolerance tests. Glycogen storage diseases. Physiology of lipids/lipoproteins. Lipidosis. Clinical interrelationships of lipids (sphingolipidosis and multiple sclerosis), lipoproteins and apolipoproteins. Diagnostic tests for HDL-cholesterol, LDL-cholesterol and triglyceride disorders. Inborn errors of metabolism:

### **UNIT-II**

Disorders of amino acid metabolism- Phenylalanemia, homocystinuria, tyrosinemia, MSUD, phenylketonuria, alkaptonuria, albinism and aminoacidurias. Disorders of nucleic acid metabolism- Disorders in purine/ pyrimidine metabolism.

### **UNIT III**

Electrolytes, blood gases, respiration and acid-base balance. Disorders of acid-base balance and their respiratory and renal mechanisms. Evaluation of organ function tests: Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. Clinical importance of bilirubin. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

### **UNIT IV**

Hormonal disturbances: Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology. Disturbances in thyroid function. Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia and hyperphosphataemia.

### **UNIT V**

Biochemical aspects of hematology: Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias thrombosis and anemias. Laboratory tests to measure coagulation and thrombolysis. Detoxification in the body: enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion, Disorders of vitamins and trace elements.

## REFERENCES

1. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
2. Lehninger Principles of Biochemistry 5th Ed By David L. Nelson and Michael M. Cox, WH Freeman and Company.
3. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed By LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
4. Medical Biochemistry (Paperback) By John W. Baynes and Marek Dominiczak. Publisher: Mosby.
5. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.
6. Review of Medical Physiology (Lange Basic Science) (Paperback) By William F. Ganong. Publisher: McGraw-Hill Medical.
7. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
8. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd.
9. Principles of Medical Biochemistry: With STUDENT CONSULT Online Access (Paperback) By Gerhard Meisenberg and William H. Simmons. Publisher: Mosby.

## **ELECTIVE – II -AQUACULTURE - M16PBTE08**

### **UNIT – I**

Importance of aquaculture – over - exploitation of wild fish stocks – advantages of aquaculture – production trends in the world and in India. Scope for aquaculture in India. Basic Fish farm design : selection of site, grow - out and nursery ponds.

### **UNIT – II**

Cultivable species of fish, crustaceans, molluscs and algae. Selection of candidate species for aquaculture. Types of farming: extensive, intensive and semiintensive culture. Integrated farming. Advantages of polyculture, monosex and monoculture.

### **UNIT – III**

Culture of carp species –oyster culture: pearl oyster. Prawn culture: the problems in penaeid prawn culture due to socio-economic and environmental problems. Freshwater prawn culture. Potential for ornamental fish culture. Common species for ornamental fish farming.

### **UNIT – IV**

Fish disease management: Common bacterial, viral, fungal, protozoan and crustacean diseases, their symptoms and treatment. Water quality maintenance. Importance and composition of feeds; types of feed: wet and dry feeds.

### **UNIT – V**

Marketing the products: Marketing the fish to local markets and for export. Harvesting and transport. Quality control and norms of MPEDA for export of fishes. canning and freezing.

### **REFERENCES**

1. Arumugam, N. 2008. Aquaculture Saras Publications, Nagercoil.
2. Rath, R.K. (2000) Freshwater Aquaculture. Scientific Publishers, (India), PO. Box.91, Jodhpur.
2. Jhingran, AVG (1991) Fish and Fisheries of India. Hindustan Publishing Co.
3. Baradach, JE, JH Ryther and WO Mc Larney (1972) Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.



**PRACTICAL - III - LAB IN GENETIC ENGINEERING AND rDNA TECHNOLOGY**  
**- M16PBTP03**

1. Agarose gel electrophoresis
2. Selection of genetic marker – IPTG-X-Gal, GUS assay
3. Isolation of genomic DNA & Detection in AGE
4. Isolation of plasmid DNA & Detection in AGE
5. Screening of Bacteriophages.
6. Isolation of Auxotrophic mutants – Replica plate
7. Isolation of Lambda phage DNA
8. Quantification of Nucleic acid by UV spectrophotometer.
9. Quantification of protein by SDS-PAGE
10. Bacterial Transformation.
11. Bacterial Conjugation – Uninterrupted & Interrupted
12. Restriction digestion
13. Ligation
14. Determination of molecular weight of Nucleic acids by Gel Doc.
15. Amplification of DNA - PCR.
16. RFLP and RAPD (Demo)

## **PRACTICAL – IV- LAB IN IMMUNOLOGY AND BIOPROCESS TECHNOLOGY - M16PBTP04**

### **IMMUNOLOGY**

1. Differential count of white blood cells
2. Preparation of serum & plasma
3. ABO Blood grouping
4. Widal test for typhoid fever (qualitative and quantitative test)
5. Anti - Streptolysin O (ASO) test
6. Rheumatoid arthritis (RA) test
7. Pregnancy test – Detection of HCG
8. Rapid Plasma Regain Test (RPR)
9. Ouchterlony's Double Immunodiffusion Technique (ODD)
10. Counter Current Immunoelectrophoresis (CIE)
11. Immuno Electrophoresis (IE)
12. Radial Immuno Diffusion (RID)
13. Rocket Immuno Electrophoresis (RIE)
14. Raising of antiserum in laboratory animals
15. Antibody purification by column chromatography
16. ELISA
17. Western blott -Demonstration

### **BIOPROCESS TECHNOLOGY**

1. Isolation of Amylase and protease producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH, Temperature, Carbon & Nitrogen sources).
4. Production and assay of amylase and protease by submerged fermentation .
5. Production and assay of amylase and protease by solid-state fermentation.
6. Bioassay of Antibiotics.
7. Microbial production of citric acid using *Aspergillus niger*.
8. Immobilization of cells for enzyme production.
9. Alcohol production by yeast fermentation and its estimation.
10. Purification of enzymes by salting and dialysis and column chromatography techniques.

### SEMESTER - III

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Core VIII	M16PBT08	Plant Biotechnology	4	4	25	75
Core IX	M16PBT09	Animal Biotechnology	4	4	25	75
Core X	M16PBT10	Environmental Biotechnology & Nanotechnology	4	4	25	75
Core XI	M16PBT11	Proteomics & Genomics	4	4	25	75
Elective		Elective	3	4	25	75
Core Practical-V	M16PBTP05	Lab in plant & Animal Biotechnology	4	5	40	60
Core Practical-VI	M16PBTP06	Lab in Environmental Biotechnology, Proteomics and Genomics	4	5	40	60
			<b>27</b>			

## **PLANT BIOTECHNOLOGY - M16PBT08**

### **UNIT I**

History of plant tissue culture - Laboratory organization -Nutritional requirements of plant tissue culture. Media preparation –Types of media – MS media, Nitshs media, whites media, Gamborgs media – Plant growth regulators. Plant tissue culture-principles. The concept of totipotency of cells.

### **UNIT II**

Sterilization techniques; Plant micro propagation – micro grafting – advantages – virus elimination by culturing of meristem and shoot tip cultures;, Establishment and maintenance of callus and suspension cultures. Somatic embryogenesis - Synthetic seeds.

### **UNIT III**

Haploid plant production, triploid production, Anther and microspore culture, embryo culture and embryo rescue. Invitro pollination and fertilization. Protoplast isolation – fusion - Culture regeneration - somatic hybrids - cybrids. Somaclonal and Gametoclinal variation, Secondary metabolites,

### **UNIT IV**

Gene transfer techniques in plants. Transgenic plants for insect resistance, fungus resistance, virus resistance, drought, cold and saline resistance. Molecular biology of plant pathogen interactions. Terminator seed concept .

### **UNIT V**

Role of RFLP in Plant breeding, current status of plant transformation technologies. Production of therapeutic antibodies in plants. Edible vaccines from plants, Cryopreservation, Role of tissue culture in agriculture, forestry. Cryopreservation and germplasm conservation.

### **REFERENCES**

1. J.Hammond, P.McGarvey and V.Yusibov(Eds.): Plant Biotechnology. Springer verlag, 2000.
2. T-J.Fu, G.Singh and W.R.Curtis(Eds): Plant Cell and Tissue Cukture for the Production of Food ingredients. Kluwer Academic/Plenum Press.1999.
3. H.S.Chawla: Biotechnology in crop improvement. International Book distributing Company,1998.
4. R.J.Henry: Practical Application of plant Molecular biology. Chapman and hall.1997.
5. P.K. Guptha: Elements of Biotechnology. Rastogi and Co. Meerut,1996.
6. U.Satyanarayanan. Biotechnology, Books and allied (p) Ltd., 2005.
7. S.S. Bhojwani and M.K.razdan, Tissue Culture Theory and Practice, 2004.

## **ANIMAL BIOTECHNOLOGY - M16PBT09**

### **UNIT - I**

Gametogenesis and fertilization in animals, Molecular events during fertilization, Artificial Fertilization methods (IVF, IUF, ICSI) and embryo transfer, Superovulation, Polycystic ovarian syndrome (PCOS), Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

### **UNIT - II**

Fundamentals. Facilities and Applications. Media preparation for Animal cells culture. Types of cell culture: Primary and secondary cell culture, cell transformation, cell lines, stem cell culture. Tests: cell viability and cytotoxicity, cell synchronization, senescence and apoptosis. Organ culture and transplantation, Cryopreservation.

### **UNIT - III**

GMO (Genetically modified organism), methods of DNA transfer into animal cells - calcium phosphate co precipitation, micro-injection, electro oration, Liposome encapsulation. Hybridoma technology, Vaccine production.

### **UNIT - IV**

Mapping of human genome, Human Genome Project (HGP). RFLP, RAPD and its applications. Gene silencing, DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

### **UNIT - V**

Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones, inslulin Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

### **REFERENCES**

1. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub. New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. Vol. 57). Academic Press, London.
3. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology - A Practical Approach. Oxford Univ. Press, Oxford.
4. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausilato, CA, USA.

5. E.J. Murray (Ed). 1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press, Totowa, NJ.
6. Watson, J.D., N.H. Hopkins, T.W. Roberts, J.A. Steitz and A.M. Weiner. 1987. Molecular Biology of Gene. Benjamin Cummins, San Francisco.
7. Watson, J.D., M. Gilman, J. Witkouski and M. Zoller. 1992. Recombinant DNA. Scientific American Books, New York.
8. Puller, A. (Ed). 1993. Genetic Engineering of Animals. VCH Publishers, New York.
9. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
10. Beril, N.J. 1974. Developmental Biology. Tata McGraw -Hill Publishing Company Ltd. New Delhi.
11. B Singh, SK Gautam and MS Chauhan. 2013. Textbook of Animal biotechnology. The Energy and Research Institute.
12. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International.

## **ENVIRONMENT BIOTECHNOLOGY AND NANOTECHNOLOGY -**

### **M16PBT10**

#### **UNIT – I**

Introduction, types, Measurement of air pollution. Global environmental problems in atmosphere - ozone depletion, green house effect and acid rain.

#### **UNIT – II**

Introduction, types, sources of water pollution. Biomonitoring of water pollution using algae, bacteria, plankton, macrophytes, invertebrates, fishes (Bioindicators). Waste water treatment - physical, chemical and biological treatment processes. Biotechnological approaches for industrial waste water treatment - dairy, distillery, tannery, sugar, and pharmaceutical industries. Bioremediation of oil spills.

#### **UNIT – III**

Introduction, types of solid wastes. Biodegradation of inorganic and organic wastes, lignin, tannin. Solid waste disposal - land filling, incineration, composting, mushroom farming, vermiculture and biogas production. Processing of sugar factory wastes, residential and municipal wastes, coir wastes and sago wastes. Biodegradation of xenobiotics.

#### **UNIT – IV**

Definition of a nano system - dimensionality and size dependent phenomena, Quantum dots, Nanowires and Nanotubes, 2D films. Methods for synthesis of Nanoscale Materials.. Basic concepts and properties of nanostructured materials. Gold Nanoparticles. Nanopores. Characterisation of Nanomaterials.

#### **UNIT - V**

Nanosensors - types and its applications. Nanocarriers for Drug Delivery - Polymeric Nanoparticles as Drug Carriers. Micelles for Drug Delivery. Micro-array and Genome Chips. Microemulsions as Drug Delivery Vehicles, Lipoproteins as Pharmaceutical Carriers. Solid Lipid Nanoparticles as Drug Carriers. Nanocapsules – preparation, characterization and Applications.

#### **REFERENCES**

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited, England.
2. De, A.K. 2004. Environmental Chemistry. Wiley Eastern Ltd. New Delhi.

3. Allsopp, D. and K.J. Seal. 1986. Introduction to Biodeterioration. ELBS/Edward Arnold, London.
4. Ratner, M. and Ratner, D. 2005. Nanotechnology: A Gentle Introduction to the Next Big idea. Pearson Education, Inc. NJ, USA.
5. Christef M. Niemeyer, C. A. Mirkin. 2004. Nanobiotechnology: Concepts, Application and Properties. Wiley – VCH Publishers, New York.
6. Tuan Vo-Dinh. 2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications. Taylor and Francis Inc., London.
7. Pradeep, T. 2006. NANO. Tata McGraw Publishers, New Delhi, India
8. Challa S.S.R. Kumar (Ed). 2006. Biological pharmaceutical Nanomaterial, Wiley-VCH Verlag GmbH & Co, KGaA. Weinham, Germany.
9. Vladimir P. Torchilin (Ed.). 2006. Nanoparticulates as Drug Carriers. Imperial College Press, North Eastern University, USA. ISBN 1-86094.
10. Jogdand, S.N. 1995. Environmental Biotechnology. 1<sup>st</sup> Edition. Himalaya Publishing House, Bombay.
11. Technoglous, G., Burton, F.L. and Stensel, H.D. 1995. Wastewater Engineering – Treatment, Disposal and Reuse. 3<sup>rd</sup> Edition. Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi.
12. Jain, K.K. 2006. Nanobio-Technology in Molecular Diagnostics: Current Techniques and Applications. Horizon Biosciences, India.
13. Parag Diwan and Ashish Bharadwaj. 2006. Nano Medicines Pentagon Press. ISBN 81-8274-139-4.



## **PROTEOMICS AND GENOMICS - M16PBT11**

### **UNIT – I**

Introduction to Genomics: Definition of Genome, Genome sequencing-chain termination method (Sanger's Method), Chemical degradation method (Maxam and Gilbert method), Short-gun sequencing, whole genome sequencing, Genome mapping: Genetic mapping- DNA markers-RFLP,SSLP, SNP-Pedigree analysis; Physical mapping- Restriction site mapping, FISH, STS; Human genome project, Map repositories: NCBI – Entrez Human genome map viewer, OMIM (Online Mendelian Inheritance in Man).

### **UNIT-II**

Genome Annotations: Locating the Genes in a Genome Sequence, ORF Scanning, Exon-intron boundaries, cDNA hybridization, RT-PCR (Reverse transcriptase PCR), RACE (rapid amplification of cDNA ends), heterpduplex analysis, Exon trapping, Gene inactivation, Genetic footprinting, RNA interference, computational gene analysis-homologous genes-orthologous, paralogous, ORF Finder, Genscan and GenomeThreader.

### **UNIT – III**

Functional Genomics: Transcriptomes, Transcriptome analysis, cDNA micro arrays, Raw data from microarrays, data quality, Gene expression matrices, grouping expression data, clustering methods, Feature reduction, Microarray data format, Micro array data analysis tools, gene pathway reconstruction, SAGE (Serial analysis of gene expression).

### **UNIT-IV**

Proteomics, amino acids-peptides and proteins- life cycle of a protein, sequencing of protein-N and C terminal sequencing- proteomics- tools and application of proteomics, 3D structure of protein- overview-protein secondary, tertiary, quaternary structure- protein Denaturation-protein folding- reverse turns- Ramachandran plot- Expasy tools.

### **UNIT-V**

Analytical proteomics-analytical protein and protein separation techniques- 1D SDS-PAGE, isoelectric focusing, 2D SDS-PAGE, image analysis of 2D gels-HPLC-protein digestion techniques. Protein identification and analysis- Mass spectrometry-tandem mass spectrometry-peptide mass finger printing- SALSA algorithm-protein arrays, Protein expression profiling, protein-protein interactions, prediction interactions based on domain fusion (yeast two hybrid system), mapping protein modifications.

## REFERENCES

1. T.A.Brown (2002) Genomes, 2<sup>nd</sup> Edition, Oxford: Wiley-Liss.
2. Francisco Azuaje and Joaquin Dopazo (2005), Data analysis and visualization in genomics and proteomics, John wiley and sons, Lts.
3. Isaac S. Kohane, Alvin T Kho, Atul J.Butte (2003) Microarrays for Integrative Genomics, The MIT Press, England.
4. D.R.Westhead, J.H.Parish and R.M.Twyman (2002), Bioinformatics, Instant notes series, BIOS Scientific Publishers ltd.
- 5. Daniel C Liebler (2002) Introduction to Proteomics- Tools for the New Biology, Springer Scientific Bussiness media LLC.**
6. Twyman R.M. (2004). Principles of proteomics, York: Garland Science/Bios Scientific publishers.

## **BIOSTATISTICS - M16PBTE09**

### **UNIT - I**

Partial correlation - Partial correlation coefficient - Partial correlation in case of three variables - Multiple correlation.

### **UNIT - II**

Sampling Methods - population. Sample - Concept of Sampling distributions - Standard error.

### **UNIT - III**

Test of significance -Hypothesis - Simple hypothesis - Tests based on small samples (t-test and F-test)

### **UNIT - IV**

Test of significance -Hypothesis - Simple hypothesis - Tests based on large samples – Single mean, difference means and single Proportion and Difference of Proportion –

### **UNIT - V**

Chi – Square test – Assumptions and Characteristics, applications and uses – Chi – Square test for goodness of fit and independence of attributes – Simple problems.

### **REFERENCES**

1. Dr. Pranab Kumar Banarjee. An Introduction to Biostatistics ( A text book of Biometry). Revised and 4th enlarged Edition 2011, S. Chand and Company Ltd, Ram Nagar, New Delhi.
2. A.Indrayan, L. Sathyanarayana(2006).Biostatistics for Medical,Nursing and Pharmacy students. Prentice Hall of India Private Ltd, New Delhi.
3. Gupta.S.P. (2001), Statistical methods, Sultan Chand & Sons, New Delhi.
4. Pillai.R.S.N. and Bagavathi.V. (2005), Statistics, S.Chand & Company Ltd., New Delhi.

## **MARINE BIOTECHNOLOGY - M16PBTE10**

### **UNIT I**

World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology – biogeochemical cycles – food chain and food web.

### **UNIT II**

Importance of Marine biological diversity: species- Phytoplanktons – zooplanktons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – deep sea animals and adaptation.

### **UNIT III**

Identification of Marine bioactive compounds containing organisms, sea weeds, sea grasses, sponges, mollusks, Echinoderms – associated microbes.

### **UNIT IV**

Anticancer – antiviral – antibacterial – antifungal compounds, Biopesticides, herbicides from Marine Microbes.

### **UNIT V**

Marine conservation: Factors creating diversity in the sea; area of diversity, area to be protected, risk factors for population and species.

### **REFERENCES**

1. Pharmaceutical and the sea (1988) Carles W. Jerfford, Kenneth, L.Rinehart.
2. Recent advances in Marine Biotechnology, M.Fingermann, R.Nagabushanam and Mary Frances Thompson.
3. Trends in Marine Biotechnology Dr.S.Lazarus and Dr.S.G.Prakash Vincent.
4. Nutrients and Bioactive substances and aquatic organisms – K.Devadasan and M.K.Mukundan

## **CANCER BIOLOGY - M16PBTE11**

### **UNIT- I**

Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, Modulation of cell cycle-in cancer, Different forms of cancers, Diet and cancer.

### **UNIT -II**

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis.

### **UNIT -III**

Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes. Oncogenes / Proto Oncogenes activity. Growth factors related to transformations.

### **UNIT -IV**

Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion.

### **UNIT -V**

Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.

### **REFERENCES**

1. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
2. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications, Oxford, 1988.
3. King R.J.B., Cancer Biology, Addison Wesley Longmann Ltd, U.K., 1996.
4. Ruddon.R.W., Cancer Biology, Oxford University Press, Oxford, 1995.

## **APICULTURE - M16PBTE12**

### **UNIT – I**

Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.

### **UNIT – II**

Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.

### **UNIT – III**

Apiary – Care and Management – Artificial bee hives – types – construction of space frames – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.

### **UNIT – IV**

Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods.

### **UNIT – V**

Apiculture as Self - employment venture – Preparing proposals for financial assistance and funding agencies – Economics of bee culture.

## **REFERENCES**

1. Cherian, R. & K.R. Ramanathan, 1992 – Bee keeping in India
2. Mishra, R.C., 1985 – Honey bees and their management in India, ICAR
3. Singh, S. 1982 – Bee Keeping – ICAR
4. Sharma, P. and Singh L. 1987 – Hand book of bee keeping, Controller Printing and Stationery, Chandigar.
5. Rare, S. 1998 – Introduction to bee keeping, Vikas Publishing house.
6. Shukula, G.S. and Upadhyay V.B. (1997) Economic Zoology, Rastogi Publications, Meerut

## **LAB IN PLANT AND ANIMAL BIOTECHNOLOGY - M16PBTP05**

### **Plant Biotechnology**

1. Preparation of media.
2. Sterilization Techniques.
3. Organ cultures.
4. Callus propagation, organogenesis, transfer of plants, hardening process.
5. Protoplast isolation.
6. Anther and pollen cultures - production of haploids.
7. Isolation of plant DNA

### **Animal Biotechnology**

1. Preparation of tissue culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Trypsinization of monolayer and sub-culturing.
5. Embryonated Egg inoculation.
6. Preparation of chick embryo fibroblast culture (monolayer)

**LAB IN ENVIRONMENTAL BIOTECHNOLOGY, PROTEOMICS AND  
GENOMICS - M16PBTP06**

1. Determination of dissolved sulphate in water
2. Determination of iron in water
3. Determination of residual chlorine
4. Determination of silicate in water
5. Effect of heavy metal toxicity on behavioral changes in fish
6. Impact of heavy metal on oxygen consumption of fresh water fish
7. Determination of BOD in water
8. ORF-Prediction
9. Genome Annotation- GEN SCAN
10. Protein Secondary and Tertiary structure analysis- EXPASY Tools



### SEMESTER - IV

Part	Paper Code	Title of the Paper	Credits	Lecture Hrs/Wk	Int. Marks	Ext. Marks
Core XII	M16PBT12	Research methodology & Research Proposal Development.	4	5	25	75
Project	M16PBTPR1	Project	4	23	25	75
Internship	M16PBTIS01	Internship	2	2	-	100
			<b>10</b>			

## **RESEARCH METHODOLOGY AND RESEARCH PROPOSAL DEVELOPMENT -**

### **M16PBT12**

#### **UNIT I**

Introduction to research; Definitions and characteristics of research; Types of research; Main components of any research work. Topic Selection: Learning Objectives; Problem identification; Criteria for prioritizing problems for research.

#### **UNIT II**

Literature review: Uses of literature review; Source of information; Organization of information on index cards. Objectives: Learning Objectives; Definitions; Formulation of the research objectives.

#### **UNIT III**

Research methodologies: Study population; Variables; Sampling; Sample size determination; Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.

#### **UNIT IV**

Work Plan; Major components and outline of the different phases in a research process; Summary of the major components of a research proposal; Fieldwork; Preparation of Research report – Thesis - dissertation -Manuscript/research article – monograph/review.

#### **UNIT V**

Measures of Mean, Median and Mode: Standard Deviation and Standard Error. Regression and Correlation coefficient analysis; Student's t-test; Analysis of Variance (ANOVA); Chi-Square test. Bioinformatics: BLAST N & P, Gene discovery using EST. Genbank Database- NCBI, EMBL & DDBJ.

#### **REFERENCES**

1. Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
2. Prem S. Mann, 2004. Introductory Statistics. Fifth Edition. John Wiley and Sons (ASIA) Pvt. Ltd.
3. S. C. Rastogi, N. Mendiratta, and P. Rastogi. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery.
4. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J). Protein Purification by Robert Scopes, Springer Verlag Publication, 1982

5. M.Prakash, C.K.Arora , Laboratory Instrumentation,– Anmol Publications Pvt Ltd.,
6. Charles N.Relly, Donalds.T.Saweyer, Robert E.Krieger Huntington Experiments of Instrumental methods, A Laboratory Manual, New York.
7. Hoburt, H.Willard, Lynne L.Meritt J.R.John Dean, Instrumental Methods of Analysis, East West Press Pvt Ltd.

## **HEALTH CARE AND ENVIRONMENTAL BIOTECHNOLOGY-M16PBTD2**

### **UNIT I**

Introduction to Public Health Evolution of Public Health. Important Public Health Acts, Health problems of developed and developing countries, Health problems in India, Environment and Health.

### **UNIT II**

Basic Epidemiology Definition and Concepts of Epidemiology, Concepts of Health and Disease. Role of Genetics in Health and Disease, Levels of Prevention, Types of Epidemiology, Uses of Epidemiology.

### **UNIT III**

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.

### **UNIT IV**

Biodegradation of xenobiotics- Ecological considerations, decay behavior and degradative plasmids, hydrocarbon, hydrocarbon substitutes, pesticides and surfactants. Phytoremediation.

### **UNIT V**

Air pollution and its control through biotechnology. Waste water treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries.

## **REFERENCES**

1. Murugesan AG and Rajakumari C. (2008). Environmental Science and Biotechnology: theory and Techniques MJP Publishers.
2. Sharma P.D.( 1994). Environmental Biology Rastogi Publications.
3. Environmental Biotechnology and cleaner Bioprocesses Eugenia J.Olguin Tayloir and Francis 2000

## **VERMICOMPOSTING TECHNOLOGY-M16PBTED1**

### **UNIT-I:**

Vermicomposting - Definition, introduction and scope: Ecological classification: Humus feeders, Humus formers, Useful, local and exotic species of earthworms, economic importance of earthworms. Types of soil top soil and sub soil types.

### **UNIT-II:**

Physical, chemical and biological changes brought by earth worm in soil - burrows - drilosphere - earthworm casts, role as four r's of recycling reduce, reuse, recycle, restore.

### **UNIT-III:**

Optimal conditions for Vermiculture - temperature, moisture, pH, soil type, organic matter, protection from sunlight, rain, predators - food preference. Vermiculture Harvest.

### **UNIT-IV:**

Basic components for vermiculture - Culture practices - Home - School - Industries - Vermi wash collection, composition and use.

### **UNIT-V:**

Composting - Vermicomposting - Required conditions - Methods - Advantages - Cost-Benefit analysis of Vermicomposting. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers

### **REFERENCES:**

1. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3rd Edition, Chapman and hall.
2. Jsmail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.
3. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.
4. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) "Vermis 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.
5. Satchel, J.E. (1983) "Earthworm Ecology" Chapman Hall, London.

6. Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.
7. Kevin, A and K.E.Lee (1989) "Earthworm for Gardeners and Fisherman" (CSIRO,Australia, Division of Soils)