

MAHENDRA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

(Affiliated to Periyar University)

[Accredited by NAAC "A" Grade & Recognized u/s 2(f) and 12(B) of the UGC act 1956]

KALIPPATTI-637501



BACHELOR OF SCIENCE

SYLLABUS FOR B.Sc. BIOTECHNOLOGY

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

**FOR THE STUDENTS ADMITTED FROM
THE ACADEMIC YEAR 2019 – 2020 ONWARDS**

MAHENDRA ARTS & SCIENCE COLLEGE
(Autonomous)
(Affiliated to Periyar University)

Department of Biotechnology

B.Sc. Biotechnology

I. PREAMBLE

The Biotechnology programme has the linkage between basic and applied research and new discoveries and innovations can find direct applications in agriculture, human health and environment. The breakthroughs in modern biotechnology mainly include our ability to produce useful organisms through genetic engineering and cell fusion techniques and improve bioprocess technology to purify novel molecules generated by such processes. It also involves targeting drugs, development of delivery systems and vaccines. Considering this background, the syllabus document is essentially to be formulated which focused on diverse areas from Cell Biology, Biochemistry, Immunology, Plant Biotechnology, Animal Biotechnology, Genetic Engineering and Bioinformatics with significant laboratory practices which will enable the students to have hands on experience in doing experiments themselves.

II. PROGRAMME OBJECTIVE

- ❖ To empower students to excel in various research fields of Life Sciences
- ❖ To inculcate sense of scientific responsibilities and social and environment awareness
- ❖ To help students build-up a progressive and successful career
- ❖ To contribute the field of biotechnology and allied industries designing, developing and providing solutions for product development

III. PROGRAMME OUTCOMES

- 1 Graduates will gain basic knowledge of Biotechnology, Science and Technology concepts.
- 2 Graduates will be able to understand appropriate tools and techniques in biotechnological manipulation.

3 Graduates will be able to apply biotechnological practices in health and environmental issues.

4 Graduates to analyze the biological products/concepts using biotechnological tools.

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 2019-20 and thereafter.

1. Eligibility for Admission:

Candidate for admission to the first year of the Bachelor of Science programme shall be required to have passed the Higher secondary examination (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted by the Syndicate, Subject to such conditions may be prescribed therefore shall be permitted to appear and qualify for B.Sc. programme examination in Biotechnology.

2. Duration of the Programme:

The programme of study of Bachelor of Science in Biotechnology shall consist of three academic years divided into six semesters with 143 credits. Each Semester consists of 90 working days.

3. Programme of Study:

The programme of study for the UG degree has been divided into the following five categories:

Part I : Tamil / Other Languages.

Part II : English Language.

Part III : Core Courses, Elective Courses and Allied Courses.

Part IV : Skill Enhancement Courses, Non-Major Elective Course, Enhancement Compulsory Courses.

Part V : Value added Courses, Extension Activity, etc.

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 reappear for the same in the subsequent semester examinations.

V. STRUCTURE OF THE PROGRAMME

SEMESTER: I

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE COURSE-I	Tamil - I / French - I / Hindi - I	M19UFA01	5	-	3	25	75	100
II	LANGUAGE COURSE-II	English - I	M19UFEN01	5	-	3	25	75	100
III	CORE COURSE-I	Cell Biology	M19UBT01	6	-	4	25	75	100
III	ALLIED COURSE-I	Biochemistry - I	M19UBCA01	6	-	4	25	75	100
III	CORE PRACTICAL -I	Practical-I-Cell Biology	M19UBTP01	-	3	3	40	60	100
III	ALLIED PRACTICAL -I	Allied Practical-I-Biochemistry-I	M19UBCAP01	-	3	3	40	60	100
V	ENHANCEMENT COMPULSORY COURSE	Value Education - Yoga	M19UVE01	2	-	2	25	75	100
Total				24	6	22	205	495	700

SEMESTER: II

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE COURSE-I	Tamil - II / French - II / Hindi - II	M19UFA02	5	-	3	25	75	100
II	LANGUAGE COURSE-II	English - II	M19UFEN02	5	-	3	25	75	100
III	CORE COURSE-II	Plant Biology	M19UBT02	6	-	4	25	75	100
III	ALLIED COURSE-II	Biochemistry - II	M19UBCA02	6	-	4	25	75	100
III	CORE PRACTICAL -II	Practical-II-Plant Biology	M19UBTP02	-	3	3	40	60	100
III	ALLIED PRACTICAL -II	Allied Practical-II-Biochemistry-II	M19UBCAP02	-	3	3	40	60	100
V	ENHANCEMENT COMPULSORY COURSE	Environmental studies	M19UES01	2	-	2	25	75	100
Total				24	6	22	205	495	700

SEMESTER: III

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE COURSE-I	Tamil - III / French - III / Hindi - III	M19UFA03	5	-	3	25	75	100
II	LANGUAGE COURSE-II	English - III	M19UFEN03	5	-	3	25	75	100
III	CORE COURSE-III	Animal Science	M19UBT03	5	-	4	25	75	100
III	ALLIED COURSE-III	Basic Microbiology	M19UMBA01	5	-	4	25	75	100
III	CORE PRACTICAL -III	Practical-III-Animal Science	M19UBTP03	-	3	3	40	60	100
III	ALLIED PRACTICAL -III	Allied Practical-III-Basic Microbiology	M19UMBAP01	-	3	3	40	60	100
IV	SEC- I	SEC-I-Biophysics and Bioinstrumentation	M19UBTS01	2	-	2	25	75	100
IV	NMEC-I			2	-	2	25	75	100
Total				24	6	24	230	570	800

SEMESTER: IV

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE COURSE-I	Tamil - IV / French - IV / Hindi - IV	M19UFA04	5	-	3	25	75	100
II	LANGUAGE COURSE-II	English - IV	M19UFEN04	5	-	3	25	75	100
III	CORE COURSE-IV	Genetics and Molecular Biology	M19UBT04	5	-	4	25	75	100
III	ALLIED COURSE-IV	Applied Microbiology	M19UMBA02	5	-	4	25	75	100
III	CORE PRACTICAL -IV	Practical-IV-Genetics and Molecular biology	M19UBTP04	-	3	3	40	60	100
III	ALLIED PRACTICAL -IV	Allied Practical-IV-Applied Microbiology	M19UMBAP02	-	3	3	40	60	100
IV	SEC- II	SEC-II-Bioinformatics	M19UBTS02	2	-	2	25	75	100
IV	NMEC-II			2	-	2	25	75	100
V	EXTENSION ACTIVITIES	Extension Activities	M19UEX01	-	-	1	-	-	-
Total				24	6	25	230	570	800

SEMESTER: V

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
III	CORE COURSE-V	Immunology	M19UBT05	6	-	4	25	75	100
III	CORE COURSE-VI	rDNA Technology	M19UBT06	6	-	4	25	75	100
III	CORE COURSE-VII	Bioprocess Technology	M19UBT07	5	-	4	25	75	100
III	ELECTIVE COURSE	Elective – I		5	-	4	25	75	100
III	CORE PRACTICAL – V	Practical-V- Immunology and rDNA Technology	M19UBTP05	-	3	3	40	60	100
III	CORE PRACTICAL – VI	Practical-VI- Bioprocess Technology	M19UBTP06	-	3	3	40	60	100
IV	SEC- III	Industrial Biotechnology and IPR	M19UBTS03	2	-	2	25	75	100
Total				24	6	24	205	495	700

SEMESTER: VI

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
III	CORE COURSE-VIII	Plant and Animal Biotechnology	M19UBT08	4	-	4	25	75	100
III	CORE COURSE-IX	Environmental Biotechnology	M19UBT09	4	-	4	25	75	100
III	ELECTIVE COURSE	Elective – II		4	-	4	25	75	100
III	CORE PRACTICAL –VII	Practical-VII- Plant and Animal Biotechnology	M19UBTP07	-	4	3	40	60	100
III	CORE PRACTICAL –VIII	Practical-VIII- Environmental Biotechnology	M19UBTP08	-	4	3	40	60	100
III	CORE PROJECT	Project	M19UBTPR1	-	4	3	40	60	100
IV	SEC- IV	Nano-biotechnology	M19UBTS04	2	-	2	25	75	100
V	SC-I-JOC	Self Employment Courses		4	-	3	25	75	100
V	Swayam	MOOC		-	-	-	-	-	-
Total				18	12	26	245	555	800
TOTAL				138	42	143*	1320	3180	4500

*The students will gain extra credits for successful completion of online courses from

SWAYAM / MOOC.

Summary of Credits, Hours and Mark Distribution

Part	Course Name	No. of Credits						Total Credits	Total Hours	No. of Courses	Max. Marks
		I	II	III	IV	V	VI				
I	Language – I	3	3	3	3	-	-	12	20	4	400
II	Language – II	3	3	3	3	-	-	12	20	4	400
III	Core	4	4	4	4	12	8	36	47	9	900
	Core Practical	3	3	3	3	6	6	24	26	8	800
	Elective	-	-	-	-	4	4	8	9	2	200
	Project	-	-	-	-	-	3	3	4	1	100
	Allied	4	4	4	4	-	-	16	22	4	400
	Allied Practical	3	3	3	3	-	-	12	12	4	400
IV	SEC	-	-	2	2	2	2	8	8	4	400
	NMEC	-	-	2	2	-	-	4	4	2	200
	Enhancement Compulsory Courses	2	2	-	-	-	-	4	4	2	200
V	Self Employment Courses	-	-	-	-	-	3	3	4	1	100
	Extension Activities	-	-	-	1	-	-	1	-	1	-
Total		22	22	24	25	24	26	143*	180	46	4500

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

ALLIED SUBJECTS FOR B.Sc., BIOTECHNOLOGY STUDENTS

Semester	Subject	Course Code
I	Biochemistry – I	
II	Biochemistry – II	
III	Basic Microbiology	
IV	Applied Microbiology	

ALLIED SUBJECTS OFFERED FOR OTHER MAJOR STUDENTS

Semester	Subject	Course Code
I	Biochemistry – I	
II	Biochemistry – II	

ELECTIVE SUBJECTS FOR B.Sc. BIOTECHNOLOGY STUDENTS

Semester	ELECTIVE - I	
	Course Title	Course Code
V	Bioethics and Bio-safety	
	Developmental Biology	
	Nursery and gardening	
	Herbal Technology	
ELECTIVE – II		
	Course Title	Course Code
VI	Food Biotechnology	
	Microbial Disease and Control	
	Pharmaceutical Biotechnology	
	Industrial Safety	

SKILL ENHANCEMENT COURSES

Semester	Course Title	Course Code
III	Biophysics and Bioinstrumentation	
IV	Bioinformatics	
V	Industrial Biotechnology and IPR	
VI	Nano-biotechnology	

SELF EMPLOYMENT COURSES

Semester	Course Title	Course Code
VI	Diagnostic Biotechnology	
	Food process Technology	

NON - MAJOR ELECTIVE COURSES: [FOR OTHER DEPARTMENTS]

Semester	Course Title	Course Code
III	1. Health and Hygiene	
	2. Food and Nutrition	
IV	1. Entrepreneurship in Biotechnology	
	2. Agricultural Biotechnology	

VI. SCHEME OF EXAMINATION

1. Question Paper Pattern for Theory Examination

Time: Three Hours

Maximum Marks: 75

Part A: (10 x 1 = 10)

Answer ALL Questions

(Objective Type - Two Questions from each unit)

Part B: (5 x 2 = 10)

Answer ALL Questions

(One Question from each unit)

Part C: (5 x 5 = 25)

Answer ALL Questions

(One Question from each unit with internal choice)

Part D: (3 x 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

QUESTION PATTERN

Major Practical	=	20 Marks
Minor Practical	=	10 Marks
Spotters (5X4=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 / Mini project / Project papers of UG programmes.

EndSE	EA Total	Passing Minimum for EA	CIA Total	Passing Minimum for CIA	Total Marks Allotted	Passing Minimum (ESE)
Theory	75	30	25	10	100	40
Practical	60	24	40	16	100	40
Project	60	24	40	16	100	40

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

THEORY

EVALUATION OF INTERNAL ASSESSMENT

Test : 15 Marks

Assignment : 05 Marks

Attendance : 05 Marks

Total : 25 Marks

The Passing minimum shall be 40% out of 25 marks (10 marks)

PRACTICAL

EVALUATION OF INTERNAL ASSESSMENT

Test 1 : 15 Marks

Attendance : 15 Marks

Observation: 10 Marks

Total : 40 Marks

The Passing minimum shall be 40% out of 40 marks (16 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 40% out of 40 marks (16 marks)

4. Passing Minimum:

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Theory Exam mark) with minimum of 30 marks in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 24 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.

6. 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/supervisor/teacher concerned.
2. The Project Report may consist of 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

a) SWAYAM / MOOC – Free Online Education

SWAYAM / MOOC is an instrument for self-actualization 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.

b) Add-on courses

Students are provided with additional courses during their course of study right from the First year. Students are free to choose the courses. On successful completion of each course, the students will gain one extra credit.

SEMESTER I

Core - I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT01	CELL BIOLOGY	
Credit: 4		

Objectives

To understand the structures and the basic components of prokaryotic and eukaryotic cells.

To study the structure and functions of cell organelles.

To know about specialized cell organelles.

To impart knowledge in cell division and structural organization of chromosomes.

To study about the cell signaling pathways.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles of cell structure, organization, cell division and signaling.	K1
CO2	Understand the structure and function of cellular components, organelles, chromosome, cell signaling pathway.	K2
CO3	Explain the significance of cell division in cell biology, cell cycle and cell adhesion.	K3
CO4	Classify prokaryotic and eukaryotic cell structure and its function.	K4

UNIT- I

Introduction and history of cell biology. Ultra structure of plant, animal and bacterial cell. Difference between prokaryotes and eukaryotes. Difference between Plant and Animal cells

UNIT -II

Structure and function of cell organelles: Cell wall, cell membrane, Chloroplast, mitochondria.

UNIT -III

Structure and function of Endoplasmic reticulum, Golgi complex, Peroxisomes, lysosome and vacuoles. Specialized cell organelles: cilia and flagella.

UNIT- IV

Structure and function of Nucleus, ribosome, Chromosomes and cell division: Morphology, Structural organization, ultra structure of chromosome, specialized chromosomes. Cell cycle, Mitosis and Meiosis.

UNIT- V

Cell-Cell adhesion, Cell signaling- types- G Protein Ras, Raf pathway. Cell staining methods.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	A Text Book of Cell Biology	Aminul Islam	Books and Allied (P) Ltd, Kolkatta.	2011
2.	Cell Biology First edition	Powar. C.B	Himalaya publishing house, New Delhi.	1983

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Cell Biology, Genetics, Molecular Biology, Evolution and Ecology	Verma P S and Agarwal V K	S Chand	2006
2	Cell Biology	Kimball T W	Brown (William C.) Co U.S.	1994
3	Cell Biology	T Devasena	Oxford University Press,	2012
4	Cell Biology and Molecular Biology	N Arumugam	Saras Publication	2011

Mapping with Programme Outcomes

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

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

SEMESTER I

Allied - I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBCA01	BIOCHEMISTRY - I	
Credit: 4		

Objectives

To study the structure and function of different biomolecules (proteins, lipids, and carbohydrates) found in living cells.

To provide fundamental knowledge/overview of enzymes and nucleic acids.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Remember the concepts of Carbohydrates, amino acids and enzymes	K1
CO2	Understand structure, functions and properties of bio-molecules	K2
CO3	Analyze the nature of the bonds based on their physical properties	K3
CO4	Apply the basic principles of enzyme substrate reactions and its kinetics	K4

UNIT-I

Introduction to Biochemistry: Concept of acids and bases. Buffers - Definition and determination of pH, Henderson Hasselbach Equation, Lab Solutions Preparation (Molarity, Molality, Normality and percentage solutions).

UNIT-II

Carbohydrates: Introduction, classification, monosaccharide-structure, stereoisomers and structural isomers, mutarotation, and chemical reactions. Oligosaccharides – Dissaccharides - structure and importance of sucrose, Lactose, maltose. Polysaccharides - structure and importance of homopolysaccharides and heteropolysaccharides.

UNIT-III

Amino acids: Classification, Essential & Non-essential amino acids, structure and properties. Protein: Definition, classification and functions – structural levels of organization.

UNIT -IV

Enzymes – Definition, classification with example, active site, lock & key model, induced fit hypothesis. Enzyme units – kinetics- factors affecting enzyme activity.

UNIT-V

Classification of Lipids and fatty acids, physical & Chemical properties of fatty acids. Components of nucleic acid - Nitrogenous bases, pentose sugar and phosphoric acid. Nucleoside and nucleotides.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Fundamentals of Biochemistry	J L Jain, Sunjay Jain, Nitin Jain	S. Chand publications	2016
2.	Essentials of Biochemistry	U. Sathyanarayanan	Books and allied (p) Ltd.	2002

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Harper's Biochemistry	Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell	Prentice Hall International. Inc	2006
2.	Fundamentals of Biochemistry	Donald Voet, Judith G.Voet and Charlotte W Pratt Jeremy M. Berg, Lubert	John Wiley & Sons, NY	1999
3.	Biochemistry	Stryer, John L. Tymoczko, Gregory J. Gatto	WH Freeman	2015
4.	Lehninger Principles of Biochemistry	David L. Nelson, Michael Cox	A John Wiley, In.	1997

Mapping with Programme Outcomes

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

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

SEMESTER I

Core: Practical-I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP01	PRACTICAL - I - CELL BIOLOGY	
Credit: 3		

Objectives

To provide hands on training like microscopy, cell counting, mitosis, meiosis cell division and staining of macromolecule in the field of cell biology and plant biology.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Know about microscope, microtome and micrometry parts and its working principles. Learning the structure and morphology about specialized cells	K1
CO2	Understand bio molecules of the cell, Learn the mounting of giant chromosomes	K2
CO3	Learn about RBC and WBC cell counting.	K3
CO4	Determine the sex chromatin of living cells.	K4
CO5	Understand the different stages of mitosis, meiosis during cell division	K4

1. Microscopes and its parts.
2. Micrometry - Stage and Ocular Micrometer
3. Cell Counting - Haemocytometer.
4. Mounting buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash.
6. Meiosis grasshopper testis squash/Anther of tradescantia flower.
7. Salivary gland squash preparation in Chironomous larvae for identification of giant Chromosome.
8. Staining of storage molecules - Carbohydrates and Lipids
9. Observation of slides (Cardiac muscle, Sperm cell, Muscle cell)
10. Microtomy (Demo).

TEXT BOOK:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Cell Biology : Practical Manual	Renu Gupta, SeemaMakhija, Dr. Ravi Toteja	Prestige	2018

REFERENCE BOOK:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Cell Biology, Genetics, Molecular Biology, Evolution and Ecology	Verma P S and Agarwal V K	S Chand	2006
2.	Cell Biology	Kimball T W	Brown (William C.) Co ,U.S.	1994
3.	Cell Biology	T Devasena	Oxford University Press,	2012
4.	Cell Biology and Molecular Biology	N Arumugam	Saras Publication	2011

SEMESTER – I

Allied Practical- I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBCAP01	ALLIED PRACTICAL - I - BIOCHEMISTRY-I	
Credit: 3		

Objectives

To provide the complete practical knowledge about preparation of starch, casein, and lecithin.

To learn about qualitative analysis carbohydrate and protein.

To determine the acid, saponification number of fat and salivary amylase enzyme activity.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Learn about buffer preparation with different pH.	K2
CO2	Prepare casein from milk and starch from potato	K4
CO4	Determine acid number of fat sample	K4
CO5	Learn about salivary amylase enzyme activity	K1
CO6	Measure the amount of ascorbic acid in sample by titration method	K4

1. Preparation of buffer solution (Phosphate, Acetate and Citrate) and determination of pH.
2. Estimation of starch from potato.
3. Preparation of casein from milk.
4. Determination of Acid number.
5. Determination of specific activity of salivary amylase enzyme
6. Estimation of ascorbic acid by 2,6 Dichloro phenol Indophenol method

SPOTTERS

1. pH Meter
2. pH Paper
3. Monosaccharides – Glucose, Fructose, Galactose, Ribose
4. Disaccharides – Sucrose, Lactose, Maltose
5. Polysaccharide – Starch, Cellulose
6. Aminoacids – Glycine, Serine, Cysteine, Histidine, Aspartic acid, Tyrosine
7. Nitrogenous Bases – Adenine, Guanine, Thymine, Cytosine, Uracil
8. Lipids – Lecithin, Cephalin, Plasmalogen, Ganglioside.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Introductory Practical Biochemistry	S.K. Sawhney, R. Singh	Alpha Science International Ltd	2005

REFERENCE BOOKS:-

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

SEMESTER - I

Value Education	B.Sc. Biotechnology	2019 - 2020
Code: M19UVE01	மனவளக்கலை யோகா	
Credit: 2		

பாடநோக்கம்

இளம் வயது முதல், உடல், மனம் இரண்டையும் பக்குவமாக வைத்துக் கொள்ள வேண்டியதன் அவசியத்தை மாணவர்களுக்கு உணரச் செய்தல்.

அலகு 1

யோகமும் உடல்நலமும்

உடலமைப்பு - எளியமுறை உடற்பயிற்சி - மகராசனம் - யோகாசனங்கள்

அலகு 2

இளமைகாத்தல் - பாலுணர்வும் ஆன்மீகமும் - மனதின் 10 படிநிலைகள் - மன அலைச்சுழல்.

அலகு 3

குணநலப்பேறு

வாழ்வின் நோக்கம் - எண்மை ஆராய்தல் - ஆசை சீரமைத்தல் - சினம் தவிர்த்தல்.

அலகு 4

கவலை ஒழித்தல் - வாழ்த்தும் பயனும் - நட்பு நலம் - தனிமனித அமைதி.

அலகு 5

செயல்விளைவுத் தத்துவம் - மனத்தூய்மை, வினைத்தூய்மை - அன்பும் கருணையும் - பண்பாட்டுக் கல்வி.

பாடநூல்: 'மனவளக்கலை யோகா'

உலக சமுதாய சேவா சங்கம்

வேதாத்திரி பதிப்பகம்

156, காந்திஜி ரோடு

ஈரோடு - 638 001.

போன்: 0424 - 2263845.

பார்வை நூல்கள்:

மனவளக்கலை யோகா -I - உலக சமுதாய சேவா சங்கம்

மனவளக்கலை யோகா -II- வேதாத்திரி பதிப்பகம்

மனவளக்கலை யோகா -III-156, காந்திஜி ரோடு

எளிமுறை உடற்பயிற்சி - ஈரோடு - 638 001.

யோகப்பயிற்சிகள் - போன்: 0422-2263845

SEMESTER II

Core - II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT02	PLANT BIOLOGY	
Credit: 4		

Objectives

To understand different classification system of plants, structure and modifications of root, stem, leaf and flowers.

To impart specific knowledge about pathways involved in plant systems and fertilization takes place in plants.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles plant biology and classification systems and different families.	K1
CO2	Understand the structure, modification of root, stem, leaf and structure and types of flowers, fruits, seeds.	K2
CO3	Apply the concept of fertilization and pollinations.	K3
CO4	Analyze the taxonomy, development of gametophytes and dicot plants	K4

UNIT-I

History and Classification of Plant taxonomy: Natural & Artificial (Linnaeus) – Two Kingdom and Five Kingdom System of classification. General outlines of Bentham and Hooker's classification. Economic importance of following families: Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae and Musaceae.

UNIT-II

Structure and modifications of Root, Stem and Leaf, Phyllotaxy - Structure and types of Inflorescences - Structure and types of flowers, fruits and seeds.

UNIT- III

Tissue and tissue systems – Meristem: types of meristem- Shoot and root apical meristem - anatomy of monocot and dicot roots, stems and leaves. Plant - Microbe interaction – Endophytic fungi.

UNIT-IV

Absorption of Water and movement - Diffusion, Osmosis, Plasmolysis, Mechanism of Stomatal opening and closing. Photosynthesis – significance – electron transport system – cyclic and non-cyclic photophosphorylation – C3 and C4 pathways.

UNIT-V

Modes of Reproduction in Angiosperms - Vegetative propagation - Sexual Reproduction: Structure of mature anther, Structure of mature Ovule and its types. Pollination: types – Double fertilization - Development of male and female gametophytes - Development of Dicot Embryo.

REFERENCES BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Plant Physiology	Pandey, S.N.	Tata McGraw Hill Publishers (P) Ltd., New Delhi.	1991
2.	A Text Book of Plant Physiology	Verma, V.,	Emkay Publications, New Delhi	1991
3.	Introduction to Principles of Plant Taxonomy	Sivarajan, V.V	Oxford & IBH Publishing Co., New Delhi.	1993
4.	Economic Botany	Sen, S	New Central Book Agency, Calcutta.	1992
5.	Morphology of	Earnes, A.J	Tata McGraw Hill	1936

- Lower Vascular
Plants.
6. Plant Anatomy Esau, K Publishing Co., New
Delhi
Wiley Eastern Private
Limited. New Delhi. 1960

Mapping with Programme Outcomes

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

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

SEMESTER II

Allied - II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBCA02	Allied - II - BIOCHEMISTRY – II	
Credit: 4		

Objectives

To provide knowledge about the synthesis and metabolisms of bio-molecules, metabolic pathways and their regulations inside the living cells.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Discuss the concepts of thermodynamics and metabolism	K1
CO2	Understand basic theoretical foundation in thermodynamic principles and mechanism of respiration.	K2
CO3	Analyze the nature of the carbohydrate, protein, lipids and vitamins metabolism	K3
CO4	Apply various mechanisms of metabolic control played by the vitamins and hormones.	K4

UNIT-I

Bioenergetics- Laws of Thermodynamics, Redox potential, Respiratory chain, Oxidative phosphorylation (Theories and Mechanism).

UNIT-II

Carbohydrate metabolism - Glycolysis, Pyruvate Oxidation and Citric acid cycle HMP shunt, Gluconeogenesis, Glycogenesis, Glycogenolysis.

UNIT-III

Protein metabolism - Transamination, oxidative and non-oxidative deamination, decarboxylation - urea cycle. Nucleic acid metabolism - De novo and salvage pathway.

UNIT-IV

Lipid metabolism- Biosynthesis of fatty acids and Oxidation of fatty acids (alpha, beta and omega oxidation). Cholesterol Biosynthesis.

UNIT-V

Vitamins: Classification, occurrence, deficiency symptoms, and biochemical functions of fat soluble and water soluble Vitamins. Hormones – Definition, Classification of Hormones, Biological function and disorders of Hormones - Insulin, thyroxine, adrenaline and nor-adrenaline.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Fundamentals of Biochemistry	J.L. Jain	S.Chand publications	2004.
2.	Schaum's Outline of Biochemistry	Philip W Kuchel	Schaum's Outlines	1997

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Harper's Biochemistry	Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell	Prentice Hall International. Inc	2006
2.	Fundamentals of Biochemistry	Donald Voet, Judith G.Voet and Charlotte W Pratt	John Wiley & Sons, NY	1999
3.	Lehninger Principles of Biochemistry	David L. Nelson, Michael M. Cox	W H Freeman & Co	2017
4.	Biochemistry	Christopher K. Mathews, K. E. Van Holde , Dean R. Appling	Pearson College Div	2012

Mapping with Programme Outcomes

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

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

SEMESTER II

Core Practical-II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP02	PRACTICAL - II - PLANT BIOLOGY	
Credit: 3		

Objectives

To understand plant family description, morphology, monocot, dicot sectioning, the concept of osmosis and photosynthesis of oxygen evolution by hands on training.

Course Outcomes

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

CO1	Understand the plant families' description.	K4
CO2	Learn about morphology of plants.	K4
CO3	Understand the T.S of Monocot and Dicot stem, root, leaf	K4
CO4	Understand the concept of osmosis and photosynthesis of oxygen evolution	K4
CO5	Learn the dissection of embryos	K4

1. Description of plant family - Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae & Musaceae.
2. Observation of Plant Morphology.
3. Primary T.S of Monocot and Dicot stem, root, leaf.
4. Osmosis, Plasmolysis and Photosynthesis by O₂ evolution.
5. Dissection of embryo.

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Plant biology laboratory manual	Graham, wilcox	Benjamin Cummings	2006
2.	Plant biology laboratory manual	Dr. Peter LEE	Lakehead University	2014
3.	Laboratory Manual for Stern's Introductory Plant Biology	James Bidlack and Shelley Jansky and Kingsley Stern	McGraw-Hill Education	2018

SEMESTER II

Allied Practical - II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBCAP02	ALLIED PRACTICAL - II - BIOCHEMISTRY - II	
Credit: 3		

Objectives

To give hands on training on qualitative analysis of biomolecules, paper chromatography, thin layer chromatography and quantitative titration and colorimetric methods to determine the amount of biomolecules in the sample.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Qualitatively analyze the carbohydrate samples by simple color reactions	K4
CO2	Qualitatively analyze the amino acid samples by simple color reactions	K4
CO3	Measure the amount of amino acid in sample by titration method	K4
CO4	Quantitatively measure the amount of reducing sugar in sample	K4
CO5	Estimate the amount of protein content of sample	K4
CO6	Measure the amount of cholesterol level of plasma sample	K4
CO7	Separate amino acid by paper and thin layer chromatography	K4

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids
3. Estimation of amino acid by formal titration method
4. Estimation of reducing sugar by DNS method
5. Estimation of protein by Biuret method
6. Estimation of cholesterol by Zak's method
7. Separation of amino acid by paper and thin layer chromatography

SPOTTERS

1. Paper Chromatography – Ascending, Descending, Radial
2. Thin Layer Chromatography
3. Column Chromatography
4. Endocrine Glands – Pituitary, Thyroid, Adrenal, Pancrease
5. Thyroid Hormone Disorders – Goiter, Graves Disease, Myxedema
6. Growth Hormone Disorder – Gigantism, Acromegaly

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Practical Clinical Biochemistry	Harold Varley	CBS publications	2005

REFERENCE BOOKS:-

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
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 |

SEMESTER II

ECC-I	B.Sc. Biotechnology	2019 - 2020
Code: M19UES01	ENVIRONMENTAL STUDIES	
Credit: 2		

Objectives

This course provides the basic idea about our environment ecosystem, natural resources, pollution and environmental policies and practices.

Course Outcomes

After completing this course, students will be able to:

CO Number	CO Statement	Knowledge Level
CO1	Describe the natural resources, conventional and non-conventional sources of energy and their advantages and disadvantages.	K1
CO2	Understand the environment in terms of ecosystem and its structural and functional aspects. Also explore the interconnectedness among all the biotic and abiotic components of environment and the dynamic nature of the ecological processes for sustainable development	K2
CO3	Demonstrate and appreciate various concepts and issues concerning biodiversity and conservation at local, regional and global levels.	K3
CO4	Gain the knowledge about various types of pollution, pollutants, nuclear and natural hazards. It emphasis on understanding mechanisms of pollutants impacting on human health by different types, their sources and mitigation measures and implementation of Environmental Acts for control of pollution.	K4

UNIT-I

Environment – definition – scope – structure and function of ecosystems- producers, consumers and decomposers - energy flow in the ecosystem - ecological succession – food chain, food webs and ecological pyramids – concept of sustainable development.

UNIT-II

Natural resources: renewable - air, water, soil, land and wildlife resources. Non – renewable – mineral coal, oil and gas. Environmental problems related to the extraction and use of natural resources.

UNIT-III

Biodiversity – definition – values – consumption use, productive social, ethical, aesthetic and option values threats to bio diversity – hotspots of bio diversity – conservation of bio - diversity: *in - situ*, *ex - situ*. Bio – wealth - National and global level.

UNIT-IV

Environmental Pollution: definition – causes, effects and mitigation measures – air pollution, water pollution, soil pollution noise pollution, thermal pollution – nuclear hazards– solid wastes, acid rain – climate change and global warming. Environmental laws and regulations in India.

UNIT-V

Social Issues and the Environment - urban problems related to energy. Water conservation, rain water harvesting, watershed management, wasteland reclamation, Environment Protection Act- Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act, wildlife Protection Act, forest Conservation Act.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Textbook for Environmental Studies for Undergraduate Courses of all branches of higher education	Erach Bharucha	University Grants Commission and bharatvidya peeth institute of environment education and research, Pune New Age	2004
2.	Environmental Studies	Anubha Kaushik	International Publishers, NewDellhi	2012
3.	Environmental Studies for Undergraduate Courses - As Per UGC Notified Syllabus	Sushmita Baskar and R. Baskar	Unicorn Books Publishers	2007
4.	Textbook of Environmental Studies for Undergraduate Courses	Erach Bharucha	Second edition Orient Black Swan Publishers	2013

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Environmental Pollution: Causes, Effects and Control.	K.C. Agarwal	Nidhi Publishers (India), Bikanir.	2001
2.	Essentials of Ecology and Environmental Sciences	S.V.S.Rana	Prentice Hall of India Private Limited, New Delhi, India.	2005
3.	Modern Concepts of Ecology	H.D.Kumar	Vikas Publishing House Private Ltd.	1982
4.	Environmental Studies	Sanjay Kumar Batra, Kanchan Batra, Harpreet Kaur and Parul Pant	Taxmans publication	2018
5.	Ecology: From Individuals to Ecosystems	Michael Begon, Colin R. Townsend, and John L. Harper	Blackwell Publishing company	2006

Mapping with Programme Outcomes

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

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

SEMESTER III

Core - III	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT03	ANIMAL SCIENCE	
Credit: 4		

Objectives

To understand the animal classification, taxonomy, diversity, structure and functions of the organ and organ systems.

Course Outcomes

After completing this course, students will be able to:

CO Number	CO Statement	Knowledge Level
CO1	Describe the classification and nomenclature of invertebrates and vertebrates	K1
CO2	Understand the types, structure and functions of animal tissues	K2
CO3	Judge anatomy and physiology of different systems	K3
CO4	Categorize the reproduction and fertilization changes	K4

UNIT-I

Classification: concept of species; binomial nomenclature; Salient features, classification and detailed study of invertebrates and vertebrates up to class level.

UNIT-II

Animal tissue - epithelium (covering), connective (support), muscle (movement) and nervous (control).

UNIT-III

Anatomy and physiology of different systems - digestive, circulatory, respiratory, endocrine and excretory system of human beings.

UNIT-IV

Modes of reproduction-Asexual and sexual reproduction; Modes- Binary fission, sporulation, budding, gemmule, fragmentation. Gametogenesis - spermatogenesis and oogenesis; Menstrual cycle; Fertilization and post-fertilization changes.

UNIT-V

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, biosphere reserves, national parks and sanctuaries.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Invertebrate Zoology	N.C Nair, S. Leelavathy, N Arumugam, N. Soundara Pandian	Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002	2013
2.	Chordate Zoology	A. Thangamani, S.Prasannakumar, N.Arumugam and L.M.Narayanan	Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002	2013
3.	Text book of Invertebrates	N.C Nair, S. Leelavathy, N Arumugam, N. Soundara Pandian	Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002	2010
4.	Invertebrate Zoology	E.L.Jordan and P.S.Verma	S.Chand & Co., Ltd, New Delhi	2011
5.	Animal Physiology	P.S. Verma, B.S. Tyagi and V.K. Agarwal	S. Chand & Co, New Delhi	2000

6. Animal Physiology Mariakuttikan A and Arumugam N, Saras Publications
A.R. Camp Road,
Periyavilai, Kottar Post, 2017
Nagercoil, Tamil Nadu
629002

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Vertebrate Life	Pough F. Harvey	Prentice Hall, Inc.	2013
2.	Biology of Invertebrates	Pechenik	McGraw-Hill Publishing Company	2015
3.	Biological Science	Scott Freeman	Prentice Hall, Inc.	2014
4.	Animal Structure and Function	Starr	Brooks/Cole Publishing Co.	2013
5.	Wildlife Biology	Raymond F. Dasmann	John Wiley & Sons, Inc.	1981
6.	General and Comparative physiology	Hoar, W.S	PrenticeHall, Inc.	1987
7.	Campbell Biology	Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky and Robert B. Jackson	Pearson India Education Services Pvt. Ltd.Bengaluru, 560025.	2013
8.	General and Comparative Animal Physiology,	WilliamS.Hoar,	Prentice Hall, India	1975
9.	Animal Physiology,	RichardW, Gordon, A AndMargaret A.	Sinauer Associates, USA.	2012

Mapping with Programme Outcomes

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

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

SEMESTER III

Allied -III	B.Sc. Biotechnology	2019 - 2020
Code: M19UMBA01	ALLIED - III - BASIC MICROBIOLOGY	
Credit: 4		

Objectives

The main objective of the course is to provide knowledge on the understanding of the concepts and fundamental principles of microbiology and basis to face the study of the bacteriology, virology, Phycology and Mycology which includes key features of the structure, growth, physiology and behavior of bacteria, viruses, fungi, algae and protozoa.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the history, development and the basic principles of microbiology	K1
CO2	Understand the microbial diversity, Systems of Classification taxonomy and dynamics of microbes	K2
CO3	Apply	K3
CO4		K4

UNIT-I

Introduction and History of Microbiology. Spontaneous generation vs biogenesis. Establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff.

UNIT-II

General characteristics of Bacteria, Systems of classification, Numerical taxonomy, Bergey's Manual of Systematic Bacteriology (up to section level), Classification of bacteria on the basis of Nutritional types, Environmental factors. General characteristics of Archaeobacteria, Rickettsia, Mycoplasma, Cyanobacteria and Actinomycetes.

UNIT-III

General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles.

UNIT-IV

General characteristics of fungi including habitat, distribution, nutritional requirements. Fungal cell ultra-structure, mycelium and hyphae organization and aggregation. Multicellular organization. Sexual and asexual reproduction. Yeast reproduction – budding.

UNIT-V

General introduction, characteristics and life cycle of viruses with special reference to the structure of the following: TMV, poliovirus, T4 and λ -phage, lytic and lysogenic cycles.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Microbiology 5 th Edition	Pelzer, Chan and Kreig.	McGraw-Hil.	1986
2.	Microbiology. 5 th Edition	Prescott, Harley, Klein.	McGraw Hill Publ.	2003

REFERENCE BOOKS:

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

Mapping with Programme Outcomes

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

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

SEMESTER III

Core Practical-III	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP03	PRACTICAL - III - ANIMAL SCIENCE	
Credit: 3		

Objectives

To give hands on training to study anatomy of the animals and provide technical skills in microscopic observation of museum specimens mounting, spotters and dissections.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the anatomy and mouth parts of cockroach and Honey bee	K2
CO2	Learn the methodology of blood and urine specimen collection	K2
CO3	To estimate sugar in urine and blood	K4
CO4	Learn the methods of hemoglobin estimation	K2
CO5	To observe parasites, chick embryo, Frog fertilization and transverse section of internal organs and .	K4

1. Cockroach – Digestive system and Reproductive systems.
2. Mounting - Mouth parts of Cockroach and Honey bee.
3. Collection and handling of Blood specimen
4. Collection and handling of Urine specimen
5. Qualitative analysis of Urine sample
6. Estimation of hemoglobin
7. Estimation of sugar in Urine
8. Estimation of sugar in Blood
9. Observation of Amoeba, paramecium, Plasmodium, Tapeworm – Scolex, Earth worm, Starfish
10. Observation of Chick embryos (24, 33 & 48 Hours).

11. Observation of Frog post-fertilization stages- 2, 4 & 8 cell stages.
12. Observation of Transverse section of Ovum, ovary, testis, kidney
Pancreas, pituitary thymus and thyroid gland.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Advanced Practical Zoology	P S Verma and P C Srivastava	S Chand Publishing	2012
2.	Practical Zoology Volume 1 Invertebrata,	N. Arumugam, N.C Nair, S. Leelavathy, N. SoundaraPandian, T. Murugan and Jayasurya	Saras Publication	2012
3.	Practical Zoology Volume 2 Chordata,	N. Arumugam, A. Thangamani, S. Prasannakumar, L.M. Narayanan, Jayasurya,	Saras Publication	2012
4.	A Manual of Practical Zoology: Chordates	P.S.Verma	S. Chand Publishing, company, New Delhi.	2000
5.	A Manual of Practical Zoology: Invertebrates	P S Verma	S. Chand Publishing, Company, New Delhi.	1971

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Practical Zoology For Advanced Level and Intermediate Students	C.J. Wallis	6 th Edition, Butterworth-Heinemann, Elsevier Ltd.	1974
2.	Practical Zoology	Robert William Hegner	Andesite Press	2015

SEMESTER III

Allied Practical-III	B.Sc. Biotechnology	2019 - 2020
Code: M19UMBAP01	ALLIED PRACTICAL - III - BASIC MICROBIOLOGY	
Credit: 3		

Objectives

To provide good laboratory practices about basics of microbiology techniques.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Gain the knowledge about importance of cleaning glassware's, sterilization methods,	K1
CO2	Learn the Preparation of Microbiological media, identify the bacteria and count the microbes	K2
CO3	Get practical knowledge about culture techniques, preservation	K3
CO4	Isolate microbes from different samples	K4
CO5	Get practical knowledge about identification of fungi, bacteria and movement of bacteria	K3

1. Cleaning and Preparation of glassware.
2. Preparation of Microbiological media.
3. Sterilization – glassware and media – wet, dry and filtration.
4. Isolation of microorganisms from various samples.
5. Counting of microbes – Use of haemocytometer, colony counting.
6. Identification of microbes – Microscopy & Macroscopy.
7. Motility of Bacteria by Hanging drop method.
8. Staining of bacteria – Simple & differentia staining - Gram, spore, capsule, flagella.
9. Culture Techniques - Pure culture - slant, stab, streak etc.
10. Maintenance and storage of bacterial strains.
11. Staining of fungi.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Practical Microbiology - A Laboratory Manual	B. Senthilkumar, Zothanzanga, D. Senbagam, N. Senthilkumar, G. Gurusubramanium	Panima Publishing Corp	2014
2.	Experimental procedures in Life Sciences	S. Rajan and R. Selvi Christy	Anjanaa Book house, Chennai	2012
3.	Manual for Medical Laboratory Technology	S. Rajan	Anjanaa Book house, Chennai	2012

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Laboratory Manuel in Microbiology	Gunesekaran P	New Age international, India	1996
2.	Experiments in Microbiology, Plant pathology and Biotechnology. 4 th Edition	Aneja KR	New Age International Publishers, Chennai.	2005

SEMESTER III
SKILL ENHANCEMENT COURSES - I

SEC - I	B.Sc. Biotechnology	2019 - 2020
Code:M19UBTS01	SEC - I - BIOPHYSICS AND BIOINSTRUMENTATION	
Credit: 2		

Objectives

To provide the basic knowledge about basic principles and working mechanism of bioinstrumentation techniques involved in separation, identification and purification of biological substances.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the basic concepts of chemical bonds and instrumentation principles	K1
CO2	Understand the various types of microscope	K2
CO3	Apply various physical laws depending upon their applications and properties	K3
CO4	Analyze the various sample using biological instruments	K4

UNIT-I

Nature of chemical bond, Bonds in biological system. Laws of thermodynamics and concept of free energy, Biophysics of Water.

UNIT-II

Spectroscopy – Beer-Lamberts law, Colorimetry, IR spectrophotometer, Atomic Absorption spectrophotometer. Flame photometer.

UNIT-III

Microscopes - Principles, applications and types – Bright & Dark-field, Phase-contrast, fluorescence and Electron microscopy – SEM and TEM.

UNIT-IV

Centrifugation – Principle, preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation – Rate zonal and Isopycnic. Rotor and its types. Chromatography – Principle, gas liquid chromatography, HPLC, Ion exchange chromatography, affinity chromatography and gel permeation chromatography.

UNIT-V

Electrophoresis – Agarose gel electrophoresis and PAGE. Methods of Imaging – X-ray, CT Scan, ECG, EEG, Concept of Radioactivity, methods for measuring radioactivity – GM counter.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
	General			
1.	Biophysics, vol. I & II	H.V. Volkones	Academic Press	1983
2.	Biophysics	S. Mahesh	New Age International (P), Ltd	2003

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Microbial genetics	David Freifelder David M. Freifelder and John E. Cronan	Jones & Bartlett Publishers	1994

2. Biophysical chemistry Upadhyay Himalaya Publication 2005
3. Techniques and methods in Biology K.L Ghatak PHI Learning Private Limited 2001

Mapping with Programme Outcomes

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

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

SEMESTER IV

Core - IV	B.Sc. Biotechnology	2019 - 2020
Code:M19UBT04	GENETICS AND MOLECULAR BIOLOGY	
Credit: 4		

Objectives

To understand the central theories and methodologies that define the field of genetics and molecular biology.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles of Mendelian, non-Mendelian and extended inheritance with example	K1
CO2	Understand the chromosomal aberrations, genetics disorders and genome organization in bacteria, plant and animal	K2
CO3	Apply the structure, formation and function of DNA, RNA and describe the prokaryotic and eukaryotic cells replication, different types of mutations and DNA-repair system	K3
CO4	Analyze the microbial genetics, biology of N ₂ fixation and molecular marker techniques	K4

UNIT-I

Mendelian laws of inheritance, Non-Mendelian inheritance; Linkage and Crossing-over. Chromosomal theory of inheritance. Cytoplasmic inheritance - Snail coiling, kappa particle in paramecium; Haemophilia, Color blindness.

UNIT-II

Chromosome aberrations - Numeral (Euploid, Aneuploid) and Structural aberration. Albinism, Sickle Cell Anemia, Phenyl Ketonuria.

UNIT-III

Structure, types, forms & functions of DNA and RNA. DNA replication in Prokaryotes and Eukaryotes. Mutations: Spontaneous and induced mutations. Mutagens and its types. DNA Repair.

UNIT-IV

Central dogma of Molecular Biology – Transcription and Translation, Genetic code. Regulation of gene expression-lac and trp operons.

UNIT-V

Microbial genetics – Conjugation, Transformation and Transduction, Two-component regulatory system. Molecular biology of N₂ fixation. Molecular marker techniques - RFLP, RAPD, AFLP and QTL.

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Molecular genetics of Photosynthesis	Anderson B, Salter H	IRL press, Oxford	1996
2.	Cell and Molecular Biology	Robertis <i>et al.</i>	Waverly publication, edition 8	1995
3.	Genetics	Strickberger	M.W.Printice hall, edition 4	1997
4.	Molecular Biology of the Cell	Alberts	Garland publication, edition 4	2002
5.	Principles of Genetics	E.J.Gardener, M.J.Simmons and D.P.Snustad	John Wiley & Sons Publications	1997

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Plant biochemistry and Molecular biology	Lea P.J & Leegood	John Wiley & sons	1993
2.	Text Book of Cell and Molecular Biology	Ajay Paul	Books and Allied (P) Ltd, 2 edition	2007

Mapping with Programme Outcomes

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

S- Strong; **M-**Medium

SEMESTER IV

Allied- IV	B.Sc. Biotechnology	2019 - 2020
Code: M19UMBA02	ALLIED- IV - APPLIED MICROBIOLOGY	
Credit: 4		

Objectives

To understand the basic principles of Microbiology and their applications.

To create awareness of microbial diseases and causes of human beings.

To understand the application of microbes involved in food, environment and industries.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the principles of sterilization, antibiotics mode of action and culture techniques	K1
CO2	Understand the Morphology, culture, biochemical, pathogenicity, laboratory diagnosis of microbial diseases	K2
CO3	Explain the various factors affecting food and dairy industry	K3
CO4	Analyze microorganisms in biodegradation and bioconversion	K4

UNIT-I

Sterilization techniques - Physical and chemical Methods. Media and its types. Culture techniques - Pure culture, anaerobic culture - preservation of cultures. Growth of bacteria - multiplication - growth curve - Determination of growth. Collection and transport of clinical specimens for microbiological examinations.

UNIT-II

Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of microbial disease - *Staphylococcus aureus*, *Mycobacterium tuberculosis*, *Salmonella typhi*, *Escherichia coli*, Dengue virus, Nipah virus, H1N1 virus, *Aspergillosis*, *Candidiasis*, Malaria parasite.

UNIT-III

Importance of studying food and dairy microbiology. Primary sources of microorganisms in foods. Factors influencing microbial growth in foods - extrinsic and intrinsic. Principles of food preservation - preservation methods - irradiations - drying, heat processing, chilling and freezing, high pressure, modification of atmosphere and chemical preservatives. Nutritional value of fermented foods. Microbiology of milk, Cheese, Yogurt (curd), Idli, Kinema.

UNIT-IV

Biodegradation of oil, bio-deterioration of materials - paint, paper, wood and leather- mode of deterioration - organism involved. Tannery technology- Treatment of tannery effluents by microbes. Bioconversions - Biomining and bioleaching of ores (Use of microorganisms in Bio-gas production, Bio-leaching and Bio-diesel

UNIT-V

Environmental Microbiology: Microbiology of air - composition of air, number and types of organisms in air. Distribution and sources of air borne organisms. Enumeration of bacteria in air - Air sampling devices. Air sanitation. Air borne diseases and their control. Microbiology of water - determination of water quality - bacteriological examination of water - indicator organisms - water borne pathogens.

REFERENCES BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Chemical Microbiology – An introduction to microbial physiology	AH Rose.	Butterworth, London .	1976
2.	Brock Biology of Microorganisms	MT Madigan, JM Martinko & Jack Parker	10 th Edition – Pearson and Education Inc., New Jersey.	2002
3.	Microbiology	Prescott, Harley, Klein.	5 th Edition. McGraw Hill Publ	2003
4.	Molecular Biotechnology	Bernard R. Glick & Jack J. Pasternak,	Indian edition. Panima Publishing Corporation.	2002
5.	Microbiology	Pelzer, Chan and Kreig.	5 th Edition. McGraw-Hill	1986
6.	Microbial Physiology	S.Meenakumari	MJP Publishers	2009

Mapping with Programme Outcomes

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

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

SEMESTER IV

Core Practical- IV	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP04	PRACTICAL - IV - GENETICS AND MOLECULAR	
Credit: 3	BIOLOGY	

Objectives

To give hands on training in theoretical and practical introduction to important methods and techniques in genetics and molecular biology.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental concepts of Karyotype analysis and Understand the Mendel's laws of genetics, Drosophila morphology.	K1
CO2	Understand about genetic model organisms	K2
CO3	Prepare, purify the plasmid DNA and chromosomal DNA	K3
CO4	Analyze the quantity of nucleic acids, physical and chemical mutagenesis	K4

1. Karyotype analysis: Man- Normal and Abnormal- Down and Turner's Syndromes.
2. Mendel's laws of genetics-Mono and Dihybrid crosses.
3. Rearing morphology of drosophila.
4. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorabditis elegans*)
5. Isolation and purification of plasmid DNA.
6. Observation of DNA - Agarose gel electrophoresis
7. Quantification of nucleic acids - DNA & RNA - Chemical and UV method.

8. Bacterial mutagenesis – physical & chemical.
9. Preparation of *E. coli* competent cells.
10. Transformation of bacteria– CaCl₂ method.
11. Bacterial conjugation.
12. Transduction

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Plant biochemistry and Molecular biology	Lea P.J & Leegood	John Wiley & sons	1993
2.	Text Book of Cell and Molecular Biology	Ajay Paul	Books and Allied (P) Ltd, 2 edi	2007

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Molecular genetics of Photosynthesis	Anderson B, Salter H	IRL press, Oxford	1996
2.	Cell and Molecular Biology	Robertis <i>et al.</i>	3Waverly publication, edition 8	1995
3.	Genetics	Strickberger	M.W. Printice hall, edition 4	1997
4.	Molecular Biology of the Cell	Alberts	Garland publication, edition 4	2002

SEMESTER IV

Allied Practical-IV	B.Sc. Biotechnology	2019 - 2020
Code: M19UMBAP02	PRACTICAL - IV - APPLIED MICROBIOLOGY	
Credit: 3		

Objectives

To give hands on training on applied microbiological techniques. It includes identification of bacteria, culture characterization on different media, growth pattern and determination of water portability.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Learn the culture characterization of microbes	K1
CO2	Prepare different selective media for isolation and culturing of microbes and to understand pattern of bacterial growth	K3
CO3	Gain the knowledge about antibiotic resistance potential	K4
CO4	Determine techniques of portability of water and milk quality	K3
CO5	Identification <i>Lactobacilli</i> from curd	K4

1. Biochemical characterization of Bacteria – Catalase test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
2. Cultural characteristics of microorganisms on Basal medium, Selective medium,
3. Differential medium, Enriched medium, Enrichment medium.
4. Growth - Growth curve
5. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
6. Determination of portability of water by MPN method.
7. Isolation of *Lactobacilli* from curd.
8. Methylene blue reductase test.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Practical Microbiology - A Laboratory Manual	B. Senthilkumar, Zothanzanga, D. Senbagam, N. Senthilkumar, G. Gurusubramanium	Panima Publishing Corp	2014
2.	Experimental procedures in Life Sciences	S. Rajan and R. Selvi Christy	Anjanaa Book house, Chennai	2012
3.	Manual for Medical Laboratory Technology	S. Rajan	Anjanaa Book house, Chennai	2012

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Laboratory Manuel in Microbiology	Gunesekaran P	New Age international, India	1996
2.	Experiments in Microbiology, Plant pathology and Biotechnology. 4 th Edition	Aneja KR	New Age International Publishers, Chennai.	2005

SEMESTER IV

SKILL ENHANCEMENT COURSES - II

SEC - II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTS02	SEC - II - BIOINFORMATICS	
Credit: 2		

Objectives

To understand the creation and development of databases, software, computational, statistical techniques and also solving problems generated from the management and analysis of biological data.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles bioinformatics and understand the concept of website and its application	K1
CO2	Understand the useful and application of database search both sequence and structural databases	K2
CO3	Apply the tools and algorithms for phylogenetic tree	K3
CO4	Analyze structure of nucleotide using gene prediction tools	K4

UNIT-I

Introduction to Bioinformatics - Databases - Data Storage System - DBMS - Scope and application of Bioinformatics, Important contributions in Biological aspects - aims and tasks of Bioinformatics.

UNIT-II

Biological Databases - structural Databases (PDB, SCOP, CATH), Sequence Databases (NCBI, EMBL, DDBJ, PIR), Specialized Database: HGP, OMIM, SNP, KEGG.

UNIT-III

Sequence analysis: Sequence Alignment, Pairwise alignment and multiple sequence alignment, Global and Local Alignment, computational tools: BLAST, FASTA, Clustal W, T-coffee.

UNIT-IV

Structural Analysis: Omic X, SCFBio, JPRED, PHD, HMMSTR and APPSP2. Visualization tools: Rasmol, Pymol and Gene Prediction Tools.

UNIT-V

Phylogenetic analysis tools: MEGA, MOLPHY, PAML, PHYLIP, JSTree. Drug Discovery – Docking – Autodock - HADDOCK.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Bioinformatics methods and application – Proteomics, Genomics and Drug Discovery.	S.C.Rastogi N. Mendiratta P.Rastogi	PHL Pvt Ltd	2013
2.	Introduction to bioinformatics	Arthur M. Lesk	Oxford University Press	2014
3.	Bioinformatics Computing	Bryan Bergeron M.D	Pearson Education India	2015
4.	BIOS Instant Notes Bioinformatics 2 nd Edn	Charlie Hodgman Andrew French David Westhead	T & F / Routledge	2015

Mapping with Programme Outcomes

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

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

SEMESTER V

Core - V	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT05	IMMUNOLOGY	
Credit: 4		

Objectives

To understand different attributes of immune system, immune mechanism and its responses in living beings.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the history, types of immune system and the organs involved	K1
CO2	Understand the antigen characteristics and its activation	K2
CO3	Discover diagnostic methods of antigen and antibody interaction and the gene expression	K3
CO4	Analyze transplantation and autoimmunity systems	K4

UNIT-I

Historical perspectives and Scope of Immunology, Innate and Acquired immunity, Cells of the Immune system, Haematopoiesis, Organs of the Immune System: Primary and Secondary Lymphoid Organs.

UNIT-II

Antigen – Characteristics, Classes, Factors that influence immunogenicity. Haptens, Mitogens, Adjuvants. Humoral Immune response – B cell activation and proliferation. Cell mediated Immune response – T cell receptors and its activation.

UNIT-III

Immunoglobulins – Structure and functions. Antigen – Antibody reactions –Agglutination, precipitation, RIA, ELISA, FACS.

UNIT-IV

Cytokines: Types and function, Complement – Classical and Alternative pathway. Major Histocompatibility Complex (MHC), Hybridoma technology. Hypersensitivity and its types.

UNIT-V

Transplantation immunology. Autoimmunity, Cancer immunology, Vaccines. Immunotherapeutics. Immuno tolerance, Immunity to infectious diseases-AIDS.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Immunology	Kubey, J	Freeman and company	1993
2.	Immuno-biology	Janeway, C.A	Paul Travers	1994
3.	Text Book of Immunology	SeemiFarhatBasir	PHI Learning	2012
4.	A Text Book of Immunology	MadhaveeLatha, P	S. Chand & Company Ltd	2012
5.	Textbook of Immunology : including Immunotechnology& Immunotherapy	Ajoy Paul.	S. Chand & Company Ltd	2015
6.	Immunology and Immunotechnology.	Rajasekarapandian M and Senthil kumar B	Panima publishing corporation	2007

Mapping with Programme Outcomes

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

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

SEMESTER V

Core - VI	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT06	rDNA TECHNOLOGY	
Credit: 4		

Objectives

To understand basic principles and methods of rDNA technology and to provide knowledge about enzymes and vectors involved in rDNA technology, DNA amplification, hybridization techniques, gene transfer methods and transgenic products.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles rDNA technology, DNA modifying enzymes	K1
CO2	Understand the various types of vectors involved in rDNA technology	K2
CO3	Explain deeper understanding DNA hybridization, sequencing methods	K3
CO4	Analyze the transgenic plants and animals and pharmaceutical products.	K4

UNIT-I

Introduction to recombinant DNA technology. Enzymes in rDNA technology – Restriction enzymes, DNA modifying enzymes - Polymerase, Transferase, alkaline phosphatase, polynucleotide kinase. Cohesive and blunt end ligation, linkers, adaptors and homopolymeric tailing.

UNIT-II

Vectors - Plasmids - pBR322, PUC19, Phage vectors, Cosmids, Phagemids, lambda phage virus vectors, Shuttle vectors and expression vectors. Artificial chromosome vectors (YAC, BAC), animal virus derived vectors - SV40. Plant based vectors - Ti plasmid.

UNIT-III

Construction of genomic libraries and cDNA Libraries. Recombinant selection and screening, DNA amplification – Principles and application of Polymerase chain reaction (PCR).

UNIT-IV

Principles of DNA hybridization. Southern, Northern and Western blotting techniques. DNA Sequencing methods – sangers and maxam gilbert. Site directed mutagenesis, Chromosome jumping, DNA Microarray.

UNIT-V

Transgenic plants - pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt). Transgenic animals – Pharmaceutical products – Insulin, Recombinant Vaccine production. Ethical issues and safety regulations in rDNA technology.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Molecular Biology of the Cell.	Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter	4th Edition. Garland Sciences	2002
2.	Microbial genetics	Stanley Maloy	2nd Edition. Jones and Bartlett publisher	1994
3.	Modern Microbial Genetics	Uldis N. Streips and Ronald E. Yasbin.	2nd Edition. Wiley-Blackwell.	2002
4.	Principles of Gene Manipulation	Sandy B. Primrose, Richard M. Twyman, Robert W. Old.	6th Edition. Blackwell Science	2008
5.	Genomes.	Brown TA.	3rd Edition. New York: Garland Publishing Co. New York: Garland Science.	2008.
6.	Principles of Gene Manipulation: An Introduction to Genetic Engineering	Old, R.W and S.B. Primrose	2nd Edition. Blackwell Scientific Publications, Oxford	1996
7.	DNA Cloning: A Practical Approach	Glover, DM. and BD. Hames	2nd Edition. IRL Press, Oxford.	1995
8.	Recombinant DNA	Watson J.D., Gilman M., Witkowski, J. and Zoller M	2nd Edition. Scientific American Books, New York.	1992
9.	Analysis of Genes and Genomes	Daniel L. Hartl	Analysis of Genes and Genomes.	2011
10.	Recombinant DNA Technology	Keya Chaudhuri	The Energy and Resources Institute, TERI	2012.

Mapping with Programme Outcomes

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

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

SEMESTER V

Core – VII	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT07	BIOPROCESS TECHNOLOGY	
Credit: 4		

Objectives

To understand the various fermentation techniques in Bioprocess.

To learn about the technical and biological aspect of microbial utilization for production and purification of metabolites.

Course Outcomes

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

CO Number	Statement	Knowledge Level
CO1	Describe the methods of involved in the microbial technology	K1
CO2	Understand the designing of bioreactors and control necessary for enhancing production	K2
CO3	Apply the knowledge about media optimization for production of microbial metabolites	K3
CO4	Analyze the production methods of industrially important enzymes, antibiotics by downstream process	K4

UNIT-I

Introduction to bioprocess technology. Isolation and screening of industrially important microbes. Primary and Secondary screening. Improvement of the strains for increased yield and other desirable characteristics.

UNIT-II

Fermentation types - solid state and submerged. Bioreactor design, parts and their functions. Types of fermentor - CSTR, Tower, Jet Loop, Air lift, Bubble column, Packed bed. Immobilization of cells.

UNIT- III

Media formulation, Biological properties of medium. Sterilization - Batch and continuous sterilization systems, Sterilization of air - Fibrous filters. Measurement and control of bioprocess parameters - pH, Temperature, Dissolved oxygen, Antifoam agents, Aeration and Agitation.

UNIT-IV

Production and application of industrial enzymes - Amylase and protease. Antibiotic production and applications - tetracycline, streptomycin. Production of probiotics - lactobacillus.

UNIT-V

Downstream Processing - Disruption of Microbial Cells, Precipitation, Centrifugation, Filtration, Ultra filtration, Flocculation, Liquid-Liquid Extraction. Drying and Crystallization.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Industrial Microbiology	A.H.Patel	Macillan Publication, India Ltd.	2008
2.	Bioprocess Technology	Kalaichelvan and Arulpandi	MJP. Publishers	2008

REFERENCE BOOKS:-

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Principles of Fermentation Technology	Stanbury, RF and Whitaker A	Pergamon press, Oxford	1997
2.	Bioprocess Engineering: Basic concepts	Shuler ML and Kargi F.	Hall, Engelwood Cliffs	2002
3.	Bioprocess Engineering Principle	Doran	Elsevier	2007
4.	Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3	Young M.M	Reed Elsevier India Private Ltd, India	2004

Mapping with Programme Outcomes

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

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

SEMESTER - V**Elective**

Elective - I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE01	BIOETHICS AND BIOSAFETY	
Credit: 4		

Objectives

To focus on health, maintenance of body weight and dieting. To impart Knowledge about personal hygiene, food contamination and role of international control of health and role of WHO.

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 bioethics nationally and internationally	K1
CO2	Understand the principles of bioethics and ethics in molecular technology and post genomic era	K2
CO3	Judge the intellectual property rights, WIPO, GATT, and TRIP	K3
CO4	Analyze the concept bio-safety, health hazards in bio-safety	K4

UNIT-I

Bioethics–Necessity of Bioethics, different paradigms of Bioethics – National and International.

UNIT-II

Ethical issues against the molecular technologies. Basics of bioethics principles, international codes and guidelines in India-Ethics in post-genomic era.

UNIT-III

Biosafety – Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

UNIT-IV

Biosafety – Risk for human health, environment and agriculture. Biosafety guidelines, regulation and operation.

UNIT-V

Intellectual Property Right: Introduction, intellectual property: trade secret, patent, copyright, plant variety protection, WIPO, GATT, TRIPs, plant breeder's rights.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Bioethics and biosafety	Sateesh MK	I.K. International Pvt. Ltd.	2010
2.	Bioethics and Biosafety in Biotechnology	Sree Krishna V	New age international publishers	2007

Mapping with Programme Outcomes

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

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

SEMESTER V

Elective - I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE02	DEVELOPMENTAL BIOLOGY	
Credit: 4		

Objectives

To provide a broad, comprehensive look at embryology with special emphasis on vertebrate models, focusing on both classical experiments and modern molecular and genetic techniques.

To understand the mechanisms involved in growth and development of complex organisms.

Course Outcomes

Students who successfully complete the course will be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the types and stages of sexual cycle and gametogenesis	K1
CO2	Learn the concepts and methods of assisted reproductive techniques for conservation of wild, rare or indigenous ungulates and solve the infertility problems	K3
CO3	Understand the developmental stages of multicellular organisms	K2
CO4	Gain the knowledge about various stages of plant embryology	K2
CO5	Understand how gene activation plays a role in differentiation and development in plant and animals	K2

UNIT-I

Reproductive cycle in mammals, Spermatogenesis and Oogenesis in mammals, Types of eggs and Fertilization.

UNIT-II

Reproductive hormones, Sperm Banking, Artificial Insemination, *In vitro* Fertilization, Embryo Transfer and surrogacy.

UNIT-III

Types and patters of cleavage, Blastulation, Gastrulation, outline of fate maps and morphogenetic movements, Metamorphosis (Insects and amphibians) and its hormone control.

UNIT-IV

Plant embryogenesis- Development of Microsporangium and Megasporangium, Pollination, Embryo development and double fertilization in plants and seed formation.

UNIT-V

Genetic control of development- pattern determination, Bithorax complex, genes controlling the flower development and Drosophila development.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Elements of Developmental Biology	P.C. Jain	Vishal Publication, New Delhi.	2013
2.	Developmental Biology	K. V. Sastry and Vinita Shukul Verma , P.S.,	Rastogi publications	2012
3.	Chordate embryology	Agarwal, V.K., and Tyagi.,	S. Chand & Co., New Delhi.	1995
4.	An Introduction to Embryology-	A.K. Berry	M K publications New Delhi-51	2016

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Developmental Biology,	Gilbert, S. F.	IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA	2010
2.	An introduction to Embryology	Balinsky, B.I.	International Thomson Computer Press.	2008
3.	Analysis of Biological Development	Kalthoff,	II Edition, McGraw-Hill Professional	2000
4.	Development and Reproduction in Humans and Animal Model Species	Werner A. Mueller, Monika Hassel and Maura Grealy	Springer Berlin Heidelberg	2015
5.	An Introduction to Developmental Biology	Chattopadhyay.S.	Books and Allied (P) Ltd, Kolkata. First Edition.	2016.

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 - V

Elective -I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE03	NURSERY AND GARDENING	
Credit: 4		

Objectives

To focus on basic principles and methods of nursery and gardening.

To provide knowledge about seed types, seed structure, vegetative propagation and various types of vegetable cultivation.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the basic concept of nursery, infrastructure and planting.	K1
CO2	Understand the basic knowledge about seeds structure, types, storage and production technology.	K2
CO3	Describe about vegetative propagation, hardening of plants and green house.	K3
CO4	Understand the basic knowledge about gardening and its types, gardening operations.	K2
CO5	Understand the importance of raising of seeds and cultivation, storage and marketing of different vegetables.	K2

UNIT-I

Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities-Planting-direct seeding and transplants.

UNIT-II

Seed: Structure and types- Seed Dormancy; causes and methods of breaking dormancy –Seed storage: Seed banks, factors affecting seed viability, genetic erosion- Seed production technology-seed testing and certification.

UNIT-III

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings-Hardening of plants-green house-mist chamber, shed root, shade house and glass house.

UNIT-IV

Gardening: definition, objectives and scope – different types of gardening- landscape and home gardening – parks and its components- plant materials and design – computer applications in land scaping- Gardening operations: soillaying, manuring, watering, management of pests and diseases and harvesting.

UNIT-V

Sowing/raising of seed sand seedlings – Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots-Storage and marketing procedures.

TEXT BOOKS:

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., New Delhi.	1972
2.	Plant Propagation	Sandhu, M.K.,	Wile Eastern Ltd., Bangalore, Madras	1989
3.	Introduction to Horticulture	Kumar, N	Rajalakshmi Publications, Nagercoil.	1997.
4.	Fundamentals of Horticulture	Edmond Musser & Andres	McGraw Hill Book Co., New Delhi.	2005
5.	Hand Book of Seed Technology	Agrawal, P.K	National Seed Corporation Ltd., New Delhi.	1993

Mapping with Programme Outcomes

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

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

SEMESTER V

Elective-I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE04	HERBAL TECHNOLOGY	
Credit: 4		

Objectives

To impart complete knowledge about herbal medicines, phytoconstituents and their importance in drug designing and disease management.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Impart knowledge about history and importance of herbal medicines	K1
CO2	Make knowledge about chemical constituents of plant and its systemic position	K4
CO3	Understand the basic principles of phytochemistry and methods	K3
CO4	Learn about herbal drugs	K3
CO5	Understand the knowledge about medicinal plant and their importance	K3

UNIT-I

Herbal medicines: history and scope - definition of medical terms –role of medicinal plants in Siddha systems of medicine; cultivation – harvesting - processing- storage –marketing and utilization of medicinal plants.

UNIT-II

Pharmacognosy - systematic position –chemical constitution and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Gooseberry and Ashoka.

UNIT-III

Phytochemistry – active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron Phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

UNIT-IV

Analytical pharmacognosy: Drug adulteration -types, methods of drug evaluation-Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds, fatty acids, tannins, glycosides and volatile oils).

UNIT-V

Medicinal Plant Biotechnology: Genetics as applied to medicinal herbs- mutation- polyploidy. Plant tissue culture a source of bio-medicinals- Historical developments- types of cultures- phyto-pharmaceuticals in tissue cultures.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Glossary of Indian medicinal plants	R.N.Chopra,S.L.N ayarand I.C.Chopra	C.S.I.R, New Delhi	1956
2.	The indigenous drugs of India	Kanny, Lall, Dey and Raj Bahadur	International Book Distributors	1984
3.	Herbal plants and Drugs Agnes	Arber	Mangal Deep Publications	1999

REFERENCE BOOKS:-

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Ayurvedic drugs and their plant source	V.V.Sivarajan and Balachandran	Oxford IBH publishing Co	1994
2.	Ayurvedaand Aromatherapy	Miller, Light andMiller, Bryan	Banarsidass, Delhi.	1998
3.	Principles of Ayurveda	Anne Green	Thomsons, London.	2000
4.	Pharmacognosy	Dr.C.K.Kokate	Nirali Prakashan.	1999

Mapping with Programme Outcomes

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

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

SEMESTER V

Core Practical-V	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP05	PRACTICAL - V - IMMUNOLOGY AND rDNA	
Credit: 3	TECHNOLOGY	

Objectives

To provides hands on training in the field of immunology and rDNA technology methods like blood sample analysis, WBC and RBC count, agglutination tests, precipitation tests.

To provide knowledge about the plasmid DNA isolation, restriction digestion, ligation and transformation.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the plasma and serum preparation	K1
CO2	Learn the various techniques of Agglutination and Precipitation	K2
CO3	Find out the principle and methods of ELISA	K4
CO4	Isolate and visualize plasmid DNA and learn the techniques of restriction digestion, ligation of Lamda DNA	K4
CO5	Isolate antibiotic resistant mutants	K3

1. Preparation of plasma and serum.
2. Total count of Blood cells (WBC & RBC) using Haemocytometer.
3. Agglutination tests:
 - a. ABO Blood grouping.
 - b. WIDAL test.
 - c. ASO test.
 - d. Pregnancy test.
 - e. RPR test.

4. Precipitations:
 - a. Radial immunodiffusion.
 - b. Double immnodiffusion.
5. ELISA
6. Isolation and visualization of plasmid DNA.
7. Restriction Digestion of Lamda DNA.
8. Ligation of DNA Fragments.
9. Isolation of Antibiotic Resistant Mutants.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Practical immunology	Frank C. Hay and olwyn M.R. Westwood	Wiley-Blackwell	2002
2.	Veterinary Immunology & Seriology: A Practical Manual	Varsha Sharma	Satish Serial Publishing House	2015
3.	Manual for Medical Laboratory Technology	S. Rajan	Anjanaa Book house, Chennai	2012
4.	Molecular Biology and Recombinant DNA Technology: Practical Manual Series (Vol II)	Ashok Kumar	Narendra Publishing House	2011

Mapping with Programme Outcomes

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

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

SEMESTER V

Core Practical - VI	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP06	PRACTICAL - VI - BIOPROCESS TECHNOLOGY	
Credit: 3		

Objectives

To provide good laboratory practices in the aspect of microbial utilization for production and purification of metabolites.

Course Outcomes

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

CO	Statement	Knowledge Level
CO1	Isolate industrially important microbes (amylase, antibiotic)	K1
CO2	Optimize microbial growth	K2
CO3	Produce and assay of industrial important enzyme	K4
CO4	Immobilize microbial cells and enzymes	K4
CO5	Learn the Citric acid, wine, alcohol production and estimation	K4

1. Isolation of Amylase producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH and Temperature).
4. Production of industrial enzyme by submerged fermentation- Amylase
5. Assay of Industrial important enzymes – Amylase.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Immobilization of yeast cells.
8. Wine production.
9. Alcohol production and estimation by chromic acid method.
10. Purification of Enzymes by Dialysis and Chromatography method - Demo.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Experimental procedures in life sciences Manual	Rajan, Selvi Christy	Anjanaa Publisher	2010

Mapping with Programme Outcomes

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

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

SEMESTER V

SEC-III	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTS03	SEC - III - INDUSTRIAL BIOTECHNOLOGY AND IPR	
Credit: 2		

Objectives

To understand the principles, methods and application of industrial biotechnology.

To know about the legal issues affecting the biotechnology research.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles, methods and application of various biotechnology food industries	K2
CO2	Understand the production, process control of organic acid and amino acids	K1
CO3	Knowledge about microbial production of ketone, acetone and antibiotics and its commercial importance	K3
CO4	Know the production, process and economic importance of SCP, biofertilizer and mushroom cultivation	K3
CO5	Understand the ethics and clearance to construct the industry for the biological production and research development	K3

UNIT-I

Introduction and history of industrial biotechnology. Application of industrial biotechnology in various industries- Food, beverages, textiles, papers, and medicines. Ketogenic fermentation process.

UNIT-II

Microbial processes, production and commercial importance of Organic acids - Citric acid and Acetic acid. Amino Acids - L-Glutamic acid and L-Lysine. Process control fermentation of amino acids.

UNIT-III

Microbial production of Butanol, Acetone and Ethanol. Microbial production of Antibiotics - Production, biosynthesis of Tetracycline, Aromatic antibiotics -Chloramphenicol, novobiocin.

UNIT-IV

Microbial production of Beer, wine, vinegar, and its commercial importance. SCP production and its economic importance. Industrial production of Biopesticides and Biofertilizers. Mushroom cultivation.

UNIT-V

Intellectual Property Rights (IPR) - different types of IPRs, studies on patents granted in India and other countries. IPR in genetically modified organisms; regulating the use of biotechnology – rDNA technology – Food and Agricultural ingredients – patenting biotechnology inventions.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Intellectual Property Issues: Therapeutics, Vaccines and Molecular Diagnostics	Wolfgang Flasche , Johanna Driehaus	Springer Briefs in Biotech Patents	2012

2.	Basic Industrial Biotechnology	S.M. Reddy, S.Ram Reddy, G.Narendra Babu	New age International Publishers	2012
3.	Industrial Biotechnology	Dr. N. N. Bandela, Dr. Jitendra Ambulge	Kindle edition	2016
4.	An Introduction To Intellectual Property Right	Venkataraman M	Kindle edition	2015
5.	Biotechnology and Intellectual Property Rights	Kshitij Kumar Singh	Kindle edition	2014

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Biotechnology- A text book of industrial microbiology	Wulfrueger and Anneliese crueger	Panima publishing corporation, New Delhi	2003
2.	Bioprocess Engineering: Basic concepts, 2nd Edition.	Shuler ML and Kargi F	Prentice Hall, Engelwood Cliffs	2002
3.	Microbial technology (Microbial processes). 2nd Edition	Peppler-Perlman.	Academic press	2004
4.	Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine	Young M.M., Reed.	Elsevier India Private Ltd, India.	2004

5. Fermentation Mansi EMTEL, Taylor & Francis 2007
Microbiology and Bryle CFA Ltd, UK
Biotechnology.
2nd Edition

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 VI

Core – VIII	B.Sc. Biotechnology	2019 – 2020
Code: M19UBT08	PLANT AND ANIMAL BIOTECHNOLOGY	
Credit: 4		

Objectives

To provide complete knowledge about plant and animal tissue culture techniques and their application.

To educate the elementary techniques for crop improvement and establishment of cell lines and monoclonal antibodies production.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental knowledge about plant tissue culture methods and their applications	K2
CO2	Understand the protoplast technology, somaclonal variation, Cryopreservation and secondary metabolites production	K2
CO3	Gain the knowledge about antisense RNA technology, plant viral vectors, and concept of gene transfer techniques, stress resistance plant production and crop improvement in plants	K3
CO4	Learn the different types of animal cell culture media, culture methods and application of animal cell culture	K3
CO5	Understand the molecular techniques in cell culture and transgenic animals, vaccine production	K3

UNIT-I

History and scope of plant tissue culture techniques, Laboratory organization. Micropropagation, Callus induction, organogenesis, Meristem culture, anther, pollen, embryo culture and their application.

UNIT-II

Protoplast technology – protoplast isolation, protoplast fusion and its application. Applications of plant tissue culture: - Elimination of pathogens, Germplasm conservation and Cryopreservation. Somoclonal variation, embryo rescue, synthetic seeds, Production of secondary metabolites.

UNIT-III

Antisense RNA technology – Delayed fruit ripening , Plant viral vectors-TMV, Cauliflower Mosaic Virus (CaMV). Resistance to herbicide, insecticide, virus and bacteria. Plant tissue culture techniques for crop improvement.

UNIT-IV

Animal Tissue culture – Culture media, Primary culture, sub-culture and establishment of cell lines, types of cell lines, maintenance of cell lines, cloning of cell lines. Application of animal tissue culture.

UNIT-V

Molecular techniques in cell culture – In situ Molecular Hybridization, Somatic cell fusion, Production of Monoclonal antibodies. DNA transfer – Physical, chemical and biological methods. Transgenic animals – Mice, Goat.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Plant Tissue Culture	Kalyan Kumar D	New Central Book Agency 1 st edition	2008
2.	Culture of Animal cells, A manual of basic technique	R. Ian Freshney,	John Wiley and Sons. 5 th edition,	2005
3.	Animal Biotechnology	M. Ranga	Agrobios Publications, 2 nd edition	2004

4. An Introduction to M.K. Razdan, Oxford and IBH 2000
plant tissue culture. Publishing
Company, New Delhi,
5. Plant Biotechnology: Slater *et al* Oxford University 2003.
The Genetic Press, Oxford, 3rd
Manipulation of edition
Plants
6. Plant Biotechnology Mantell S.H Cambridge University 1983
and Smith H Press, UK, 1st edition

Mapping with Programme Outcomes

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

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

SEMESTER VI

Core – IX	B.Sc. Biotechnology	2019 - 2020
Code: M19UBT09	ENVIRONMENTAL BIOTECHNOLOGY	
Credit: 4		

Objectives

To focus on the types of pollution and their microbial remediation.

To provide a foundation for biodiversity and its conservation.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the various types of Pollution and its control methods	K1
CO2	Learn the principles and methods of Biodegradation for removal of toxic components	K3
CO3	Understand the principles of Waste water treatment	K3
CO4	Know various methods of Bioremediation and Phytoremediation process for removal of wastes	K3
CO5	Understand about the Biodiversity and its conservation	K3

UNIT-I

Scope of environmental biotechnology. Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive. Biotechnological control of air, water and soil pollution. Green house effect, ozone and its importance, global warming and Acid rain. Bio accumulation and Bio magnification of heavy metals. Principles of environment Impact Assessment and environmental monitoring.

UNIT-II

Biodegradation of organic pollutants: Mechanisms. Biodegradation of Xenobiotic compounds: aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Surfactants and microbial treatment of oil pollution.

UNIT-III

Waste water treatment - Primary, secondary and tertiary treatment of waste water. Biological Treatment of anaerobic and aerobic; methanogenesis, methanogenic, acetogenic, and fermentative bacteria - biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.

UNIT-IV

Bioremediation: Intrinsic bioremediation, Biostimulation and Bioaugmentation. *In situ* and *ex situ* bioremediation technologies. Bioremediation of oil spills. Phytoremediation: types and methods. Use of GMO in bioremediation. Biotransformations and Bioleaching of ores by microorganisms (gold, copper and uranium).

UNIT-V

Scope of Biodiversity. Conservation of Biodiversity - Current Practices in conservation of Habitat or ecosystem approaches and Species based approaches. *in situ* and *ex situ* conservation. Role agencies (CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES) for conservation of biodiversity.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Textbook of Environmental Biotechnology	P. K. Mohapatra	I K International Publishing House Pvt. Ltd.	2010
2.	Environmental Biotechnology	V.Kumaresan and N.Arumugam	Saras Publications, A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002.	2014
3.	Environmental biotechnology (Industrial pollution management) -	S.N.Jogdand,	3rd edition, Himalaya publication, New Delhi.	2004
4.	Environmental biotechnology.	S.K.Agarwal	2nd Edition, TBHpublication, New Delhi.	1999

REFERENCE BOOKS:-

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Environmental Biotechnology- A Biosystems Approach	Daniel Vallero	2 nd Edition, Academic Press	2015
2.	Waste water engineering treatment and reuse	Metcalf&Eddy, Franklin L.Burton, H.DavidStensel,	4th edition, Tata McGraw Hill publication	2005

3. Ecology and Biotreatment EcEldowney, S. Longman Scientific 1993
Hardman D.J. Technical.
and Waite S.
4. Bioremediation Baker K.H. and McGraw Hill Inc., 1994
Herson. D. S
5. Environmental Ralph Mitchell John Wiley & Sons, 2010
Microbiology and Ji-Dong Inc., Hoboken, New
Gu Jersey

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 VI

Elective-II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE05	FOOD BIOTECHNOLOGY	
Credit: 4		

Objectives

To impart knowledge about food processing techniques, microbes associated with food and general procedure for food plant design, operation and quality checking.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Impart knowledge about scope and important of food biotechnology	K1
CO2	Make knowledge about food borne diseases and food colorants	K2
CO3	Understand the basic principles of food engineering operations	K4
CO4	Make the knowledge about importance of food quality	K2
CO5	Impart the knowledge about food industry design and functioning	K4

UNIT-I

Introduction, scope and important of food biotechnology. Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage-types. Canning of foods.

UNIT-II

Food borne diseases and prevention – infection, in-toxification – Salmonellosis, poliomyelitis. Food colors (natural and artificial food colourants), Food flavoring agents.

UNIT-III

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

UNIT-IV

Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plant - Cleaning and sanitation methods.

UNIT-V

General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Food Microbiology	William C.Frazier, Dennis C. Westhoff	McGraw Hill Publications	2017
2.	Fundamentals of Food Engineering	D.G. Rao	PHI Learning Pvt. Ltd.	2010

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Food Biotechnology	Yiu Hui & G. Khachatourians	Wiley-Inter science	1995
2.	Fundamentals of Food Microbiology	Bibek, Laramie & Bhunia	CRC Press	2004
3.	Food Processing & Preservation	B. Siva	PHI Learning Pvt. Ltd.	2011

Mapping with Programme Outcomes

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

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

SEMESTER VI

Elective-II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE06	MICROBIAL DISEASE AND CONTROL	
Credit: 4		

Objectives

To provide a brief knowledge about microbial pathogens (viral, bacterial, fungal, protozoan and parasitic) and its control measures.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the host microbial interactions, pathogenesis and its control measures	K1
CO2	Learn about the pathogenesis and its control measures of viral pathogens like HIV, Pox virus, and <i>Picornavirus</i>	K2
CO3	Gain the knowledge about pathogenesis and its control measures of bacterial pathogens	K3
CO4	Understand about pathogenesis and its control measures of fungal pathogens	K3
CO5	Know the pathogenesis and its control measures of parasitic pathogens	K3

UNIT-I

Microorganisms - microbial interactions - pathogens. General epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

UNIT-II

Virus: HIV, Pox virus, and *Picornavirus* -Epidemiology - pathogenesis - pathology - diagnostics procedure - clinical manifestation - prevention and control measures.

UNIT-III

Bacteria: *Streptococcus*, *Staphylococcus* and *Salmonella* - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

UNIT-IV

Fungi: *Aspergillus*, *Candida* and *Microspora*-Epidemiology - pathogenesis-pathology -diagnostic procedure - clinical manifestation- prevention and control measures.

UNIT-V

Protozoa: *Entamoeba histolytica*, *Plasmodium* species and *Trypanosoma gambiense* - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation-prevention and control measures - vectors.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Medical Microbiology: A Guide to Microbial Infections : Pathogenesis, Immunity, Laboratory Diagnosis and Control	David Green Wood Richard slack & John Peuthrer	Churchill Livingstone	1992
2.	Paniker'S Textbook of Medical Parasitology	Paniker and Sougata Ghosh	Jaypee Brothers Medical Publishers (P) Ltd.	2013
3.	Textbook of Microbiology	Anantanarayan & Panekar	Universities Press	2017

- | | | | | |
|----|---|-----------------|--|------|
| 4. | Principles of Bacteriology, Virology and Immunity | Wilson & Topley | Hodder Arnold;
8 th Revised edition
Jaypee Brothers | 1990 |
| 5. | Textbook of Medical Mycology | Jagdish Chander | Medical Publishers;
Fourth edition | 2018 |

REFERENCE BOOK:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Medical Microbiology	Jawetz Melnickand Adelbergs - Carroll	McGraw-Hill Company	2013
2.	Textbook of Virology	A. J. Rhodes, C. E. van Rooyen	Williams & Wilkins	1962
3.	Medical Microbiology	Geo. F. Brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse	McGraw Hill Education; 26 edition	2013

Mapping with Programme Outcomes

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

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

SEMESTER VI

Elective- II	B.Sc., Biotechnology	2019 - 2020
Code: M19UBTE07	PHARMACEUTICAL BIOTECHNOLGY	
Credits : 4		

Objectives

To focus on fundamental principles of Pharmacology, measurement of drug action.

To understand chemotherapeutic drugs mechanism, toxicology, drug evaluation.

To impart knowledge about therapeutic protein and tissue engineering.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles of Pharmacology, drug classification and drug action and pharmacokinetics of chemotherapeutic drugs	K1
CO2	Understand the knowledge of Chemo therapeutic drugs, anti cancer and anti inflammatory drugs.	K1 & K2
CO3	know the molecular techniques for production of pharmaceutical recombinant products	K2
CO4	Develop the skill in ergot alkaloids and probiotics production	K1
CO5	Knowledge about the concept of protein, tissue engineering and pharmaceutical bio assay	K2

UNIT-I

History & Principle of pharmacology. Drug nomenclature & Classification systems. General Principles of Drug action Pharmacokinetics, Pharmacodynamics, measurement of drug action.

UNIT-II

Chemo therapeutic drugs - Protein synthesis inhibitors, Antibacterial, antifungal, antiprotozoal, antiviral, Antihelmithic. chemotherapy in anticancer and antiinflammatory drugs.

UNIT-III

Techniques of r-DNA technology for production: Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII.

UNIT-IV

Production of Ergot alkaloids, Probiotics, Production of recombinant vaccines. ISO standard for industrial production.

UNIT-V

Protein and tissue engineering. Therapeutic proteins – Formulation, delivery and stability. Pharmaceutical bio-assay – toxin detection, antiviral and anticancer bioassay.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	A concise Text Book of Pharmacology, 6th Ed.	N.Muruges	Sathya Publishers, Madurai	2014
2.	A Text Book of Biotechnology	R.C. Dubey	S.Chand& Co Ltd, New Delhi.	1993

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Pharmaceutical Biotechnology	S.S. Purohit, Kakrani, Saluja	Agrobios, India	2003
2.	Pharmacology	Mary J. Myuk, Richard, A.Hoarey, Pamala	Lippinwitt Williams edition	2014
3.	Pharmacology	H.P. Rang, M.M. Pale, J.M. Moore	Blackwell Publishing Ltd (Churchill Livingston)	2003
4.	Integrated pharmacology	Page, Curtis, Sulter, Walker, Halfman. D. Golan, A. Tashjian,	Mosby Publishing co	2006
5.	Principles of Pharmacology	E.Armstrong, J.Galanter, A.W.Armstrong, R. Arnaout and H.Rose.	Lippincott Williams and Wilkins.	2005

Mapping with Programme Outcomes

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

S- Strong; **M-**Medium

SEMESTER VI

Elective – II	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTE08	INDUSTRIAL SAFETY	
Credit: 4		

Objectives

To teach student the concept of Industrial Safety and provide useful practical knowledge for workplace safety.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Learn the plant design and basic rules	K1
CO2	Understand the chemical hazards and safety	K2
CO3	Learn the identification and analysis chemical hazards	K3
CO4	Study of the safety procedure and equipments	K3
CO5	Learn the importance of safety guidelines and risk	K3

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 – fire fighting equipments.

UNIT - V

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

TEXT BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Industrial safety Prentice	Blake R.P.	Hall Inc. New Jersey, 2nd Edition	1963

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publisher	Year of Publication
1.	Safety and Hazard prevention in chemical operation	Fawcett H.H. and Wood W.S.	Inter sciences	1965

Mapping with Programme Outcomes

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

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

SEMESTER VI

Core Practical-VII	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP07	PRACTICAL - VII - PLANT AND ANIMAL	
Credit: 3	BIOTECHNOLOGY	

Objectives

To provide hands on training in the field of plant and animal biotechnology with familiarize the following techniques like plant and animal tissue culture media preparation, protoplast isolation, genomic DNA isolation, trypsinization, chick embryo fibroblast culture, virus cultivation.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the aseptic culture techniques, preparation of media, stock solutions for tissue culture,	K1
CO2	Learn the practical knowledge of meristem culture, callus culture and suspension culture	K2
CO3	Isolate protoplast, produce synthetic seeds, isolate genomic DNA isolation from plant samples	K4
CO4	Know the various types of sterilization techniques, media preparation disaggregation, fibroblast culture, viability methods for animal tissue culture	K1
CO5	Learn the techniques of virus cultivation in embryonated egg	K4

Plant Biotechnology

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Tissue culture media preparation: Preparation of stock solutions of MS, Whites and Gamborg media.
3. Establishment of meristem culture using MS medium
4. Isolation of protoplasts.
5. Establishment and maintenance of callus culture.
6. Establishment and maintenance of suspension culture.
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.

Animal Biotechnology

9. Preparation & sterilization of animal cell culture media: balanced salt solution and DMEM.
10. Disaggregation of tissues – Trypsinization.
11. Culture of chick embryo fibroblast (monolayer).
12. Viability test and cell counting.
13. Inoculation of virus and observation.
14. Applications of CO₂ incubator & inverted microscope.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
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

Mapping with Programme Outcomes

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

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

SEMESTER VI

Core Practical-VIII	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTP08	PRACTICAL-VIII - ENVIRONMENTAL	
Credit: 3	BIOTECHNOLOGY	

Objectives

To examine water quality parameters from water samples collected from polluted environment by using biotechnological methods.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Isolate and identify the microbes and halophiles	K2
CO2	Understand the methodology of heavy metal resistance microorganisms from polluted samples and sulphate, chlorine estimation and pH measurement	K3
CO3	Isolate coliforms from water	K4
CO4	Find the total solids, TDS estimation	K4
CO5	Analyze the dissolved oxygen, BOD and COD from water	K4

1. Isolation and enumeration of microorganism from air
2. Isolation of halophiles
3. Isolation of heavy metal resistance microorganisms
4. Determination of soil and water pH
5. Determination of dissolved sulphate in water
6. Determination of residual chlorine
7. Analysis of TDS in effluent
8. Estimation of total solids in the effluent sample
9. Isolation of coliforms from water

10. Dissolved oxygen (DO) Experiment
11. Biochemical Oxygen Demand (BOD) Experiment
12. Chemical Oxygen Demand (COD) Experiment

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Aquatic Ecology	Trivedy R.K and Ragothaman G	Published by Agrobios (India)	2007
2.	Enviromental Science A Practical Manual	G. Swarajya Lakshmi, P. Prabhu Prasadini and Ramesh Thatikunta	Bs Publications	2009
3.	A Lab Text Book On Environmental Studies	A.K. Jain, Era Upadhyay and Anupam Adhikary	School of Applied. Science Ansal Institute of Technology, Gurgaon , Haryana	2011

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Environmental microbiology: a laboratory manual.	Pepper, I. L., Gerba, C. P. and Brendecke, J. W.	Academic Press, San Diego, US	1995
2.	Environmental Biotechnology Laboratory Manual,	Ismail Saadoun,	Department of Applied Biological Sciences, Jordan University of Science and Technology, P.O. Box 3030, Irbid-22110,	2008

3. Environmental Microbiology Methods and Protocols John F. T. Spencer and Alicia L. Ragout de Spencer. Humana Press Inc. Totowa, New Jersey 07512 2004
4. Environmental Microbiology A Laboratory Manual, I.L. Pepper and C.P. Gerba SECOND EDITION: Elsevier 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 VI
SKILL ENCHANCEMENT COURSES - V

SEC - IV	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTS04	SEC - IV - NANO-BIOTECHNOLOGY	
Credit: 2		

Objectives

To understand the methods of nanoparticles preparation, characterization and its applications in various fields of science for the welfare of human as well as for environment.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts and terminologies of Nanobiotechnology	K2
CO2	Make knowledgeable about methods of Nanobiotechnology	K3
CO3	Impart knowledge about biosensors and imaging techniques	K2
CO4	Understand about drug delivery system and mechanical properties of nanoparticles	K4
CO5	Learn about applications and socio-economic status of Nanobiotechnology in medicine	K4

UNIT-I

Nanobiology - Concepts, definitions, prospects. Biological Nano objects -DNA, protein, lipids. Biological networks. Nanoparticles and nanocomposites.

UNIT-II

Methods of Nanobiotechnology - XRD, FT-IR, AFM, Scanning Probe Electron Microcopy, Lithography.

UNIT-III

Biosensors – definition, scope and types. Potential, Electrochemical and Biomembrane based sensors. Imaging techniques - digital & molecular imaging.

UNIT IV

Drug delivery systems – Polymer therapeutics - Polymer drug conjugates; polymericmicelles, Liposome. Determination of mechanical properties - Mechanical testing, Elasticity, Toughness.

UNIT-V

Application of Nanobiotechnology in medicine, Drug designing and Cancer treatment. Medical, Social and Ethical considerations of Nanobiotechnology.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Principles and Practices of Nanobiotechnology	Giorgio Salati	Syrawood Publishing House	2016
2.	An Introduction to Nanobiotechnology	Yashwanth Kumar	Book Enclave	2017

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Biomaterials Sciences: An Introduction to	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen	Academic Press, Elsevier	2012

- Materials in and Jack E. Lemons.
2. Principles of Biochemistry 2006
3. Nanobiotechnology: Concepts, applications and perspectives 2004
4. Bionanotechnology: Lessons from Nature 2006

Mapping with Programme Outcomes

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

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

SEMESTER VI

Self Employment Course

JOC-I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTJ01	DIAGNOSTICS BIOTECHNOLOGY	
Credit: 3		

Objectives

To Understand the common procedures used in disease diagnosis

To be familiar with various types of diseases diagnosis methods.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the techniques used for the diagnostic using enzymes	K1
CO2	Understand the concept of molecular techniques used diagnosis of diseases	K2
CO3	Describe the details knowledge of diagnosis of antigen and specific antibody	K3
CO4	Give the knowledge about the advanced molecular techniques	K2
CO5	Understand the concept of virus borne diseases	K3

UNIT-I

Enzyme Immunoassays: Enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Types of Immunoassays (Homogeneous and heterogeneous). Uses of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

UNIT-II

Molecular methods for diseases diagnostics- PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology – chemotherapy. Susceptibility tests- Micro-dilution and macro-dilution methods and diffusion.

UNIT-III

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and their applications. Immunodiagnostic tests - Immuno florescence and Radioimmunoassay.

UNIT-IV

Prenatal diagnosis - Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis - Molecular markers - Microarray technology - genomic and cDNA arrays. GLC, HPLC, Electron microscopy, flow cytometry and cell sorting. Transgenic animals.

UNIT-V

Pathogen Diagnostic techniques: Diagnosis of DNA and RNA viruses. Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiasis, Malaria, Trypanosomiasis, Leishmaniasis. Study of helminthic diseases Fasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics	Burtis, Carl A. and Bruns, David E	Elsevier	2014

2. Immunology and Molecular Diagnostics Jayanti Tokas Laxmi Publications 2015
3. Molecular Diagnostics Lela Buckingham and Maribeth L. Flaws F.A. Davis Company 2007
4. Single Cell Diagnostics: Methods and Protocols: 132 (Methods in Molecular Medicine) Alan R. Thornhill Humana Press; 2007

Mapping with Programme Outcomes

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

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

SEMESTER VI

JOC-I	B.Sc. Biotechnology	2019 - 2020
Code: M19UBTJ02	FOOD PROCESSING TECHNOLOGY	
Credit: 3		

Objectives

To develop skill in food processing (fruits and vegetables), operation and maintenance of modern equipments.

To understand the quality assurance and process of packaging, storing and marketing.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand and knowledge about food processing, preservation and packing	K1
CO2	Make knowledge about fruit, vegetable Processing , Classification and preservation by various techniques	K2
CO3	Understand the basic principles of composition and nutritive value of pulses and cereals	K4
CO4	Impart the knowledge of different types Flusy and sea food processing and storage methods	K2
CO5	Understand the importance of Dairy, oils processing, preservation, separation and value added	K4

UNIT-I

Definition and scope of Food processing, Historical evolution of food processing technology. Fundamentals of food preservation – Preservation, dehydration, Packaging and canning.

UNIT-II

Fruits and Vegetables - Processing- Classification, Pre- Processing, Processing and Preservation- Size reduction, Mixing, Separation, Concentration, Freezing and Refrigeration, Drying and Dehydration, Chemicals, Processing by using Pulsed Light and Irradiation

UNIT-III

Pulses and cereals - Processing of pulses, composition and nutritive value, processing methods, toxic constituents. Processing of cereals- structure, composition and nutritive value, Processing methods- fermented and non-fermented products.

UNIT-IV

Flusy and sea food - Meat, Poultry and Egg - Pre-Processing; Processing and Preservation- Smoking, Canning, Drying, Cooling, Canning Pulsed Electric Field processing; Sea food - Types; Pre-Processing; Processing and Preservation- Dielectric, Ohmic and Infra-red heating.

UNIT-V

Dairy and oils - Dairy Processing- Milk Pre-Processing; Processing and Preservation - Separation, Homogenization, Pasteurization, Standardization, Sterilization (UHT), Evaporation (Spray Drying), Chilling, Freezing and Refrigeration. Oil seed Technology-Types; Pre-Processing; Processing & Preservation- Extraction of oils, meal concentrates and Value Addition.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Guide to Quality Management Systems for Food Industries.	Early R	Blackie Academic	1995
2.	Experiments in Food Process Engineering,	H. Pandey, H.K. Sharma, R.C. Chouhan, B.C. Sarkar and M.C. Bera	CBS Publishers and Distributors	2004
3.	Handbook of analysis and quality control for fruits and vegetables products	S. Ranganna,	Mcgraw Hill Pub. Co. New York.	2005
4.	Food Process Engineering: Theory and Laboratory Experiments,	S. K. Sharma, S.J. Mulvaney, and S.S.H. Rizvi	Wiley and Sons	2000

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1	New methods of Food Preservation, Food	Gould, G.G.	Blackie Academic & Professional, Chennai.	1996
2	Food Preservation Techniques Food Science and Processing Technology vol-2, Commercial processing and packaging, The complete Technology book on processing, dehydration, canning, preservation of fruits and vegetables, , Delhi	Peter zeuthena nd Leif Bogh-Sorensen,	Wood Head Publishing Ltd., Cambridge, England	2005
3		Mirdula Mirajkar, Sreelatha Menon	Kanishka publishers, New Delhi	2002
4		NIIR Board,	National Institute of Industrial Research	2005

Mapping with Programme Outcomes

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

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

SEMESTER III
Non-Major Elective Courses

NMEC - I	B.Sc. Biotechnology	2019 - 2020
Code: M19NBT01	NMEC - I - HEALTH AND HYGIENE	
Credit: 2		

Objectives

To focus on health, maintenance of body weight, dieting.

To knowledge about personal hygiene, food contamination, role of International control of health and WHO.

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 health and ecology of health	K1
CO2	Understand the concept of body weight, BMI and diet	K2
CO3	Describe the necessity of exercise, weight control and dieting	K3
CO4	Understand the basic knowledge about hygiene, food contamination, methods of disease transmission	K2
CO5	Understand the importance of eating, drinking, lightening, WHO	K2

UNIT-I

Health-definitions of health, dimensions of health, concept to fwellbeing, determinants of health, and ecology of health.

UNIT-II

Body weight and composition for Health and Sports – Ideal body weight, values and limitations of the BMI, composition of the body; Diet during training, dietary supplements for athletes.

UNIT-III

Exercise and Health related fitness-Health related fitness, physical activity for health benefits, types of exercise, effective weight control-dieting or exercise; weight reduction program for young athletes.

UNIT-IV

Hygiene-Meaning and importance; Hygienic practices of employees, personal hygiene and contamination of food products, methods of disease transmission.

UNIT-V

Drug Abuse and health laws – Hygiene of eating and drinking, Ventilation and lighting, Health laws for food safety and hygiene, International control of health, WHO, Health destroying habits and addictions - Pan, Ganja, Drinking, Smoking, Tea and Coffee.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Principles of food sanitation	Marriott, G. Norman	Van Nostrand Reinhold company, New York Wiley	1985
2.	Catering management-Anintegrated approach	Sethi,M. and Matha,S.,	EasternLtd., New Delhi.	
3.	Test book of preventive and social medicine	K. Park	15 th edition, MIS Banarsidas Bhano Publishers, Jabalpur	1997.

- | | | | | |
|----|--|---|---|------|
| 4. | Nutrition for Health, fitness and Sports | Melvin H. Williams | 7 th edition, MC Graw Hill international Edition | 2005 |
| 5. | Nutrition and Metabolism | Michael J.Gibney, Ian A Macdonald and Helen M.Roche | Blackwell Publishing company, Bangalore | 2008 |

Mapping with Programme Outcomes

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

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

SEMESTER III

NMEC-I	B.Sc. Biotechnology	2019 - 2020
Code: M19NBT02	NMEC - I - FOOD AND NUTRITION	
Credit: 2		

Objectives

To describe the basic aspects of nutrients and to understand the relationship between food, nutrition and health.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental concepts of sources, requirements, and deficiency for nutrition, carbohydrates, and dietary fiber	K1
CO2	Understand the concepts of sources, requirements, and deficiency diseases for proteins, lipids and essential fatty acids	K2
CO3	Understand the basic components of energy, total requirements and factors influencing basal metabolic rate	K3
CO4	Develop a deeper understanding and application of macro and micro-minerals with sources, requirements, and deficiency	K2
CO5	Understand the concept of sources, requirements, and deficiency diseases for fat and water soluble vitamins	K1

UNIT-I

Concept of Nutrition - Health, nutritional status and malnutrition.
Carbohydrates - Definition, composition, functions, maintenance of blood sugar levels, requirement, sources, digestion and absorption; Dietary fiber- Definition, classification, physiological effects and sources.

UNIT-II

Proteins - Definition, composition, nutritional classification of proteins and amino acids, functions, sources, requirements, digestion and absorption. Lipids - Definition, composition, functions, sources, requirements, digestion and absorption. Essential fatty acids – Definition, functions, sources and effects of deficiency.

UNIT-III

Energy - Definition, units of measurement, direct and indirect calorimetry; Determination of energy value of food, Total Energy requirement, Factors affecting physical activity, Factors affecting Basal Metabolic Rate.

UNIT-IV

Nutritional elements: Functions, sources, requirements and effects of deficiency- Calcium, Phosphorous, Iron, Iodine, Copper, Fluorine, Zinc, Sodium and Potassium.

UNIT-V

Fat soluble Vitamins –Vitamin A, D, E and K: Functions, requirements, sources and effects of deficiency. Water soluble Vitamins – Thiamine, riboflavin, niacin, ascorbic acid, folic acid, vitamin B6 and vitamin B12: Functions, requirements, sources and effects of deficiency.

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Text Book of Bio-Nutrition, Fundamental and Management	Paul. S	RBSA Publishers	2003
2.	Nutrition and Diet Therapy (6 th Edition)	Sue Rodwell Williams	C.V. Melskey Co.,	2000
3.	Text Book of Human Nutrition	Mahtab.S.Bamji, KamalaKrishnas wamyandG.N.VB rahmam	Oxford and IBH Publishing Company	2009

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Fundamentals of Foods and Nutrition (3 rd edition)	Sumathi R. Mudambi, Rajagopal, M.V	New Age International (P)Ltd, Publishers,	1997
2.	Nutrition Science(5 th edition) Normal Nutrition,	SrilakshmiB	New Age International (P)Ltd, Publishers	2016
3.	Curing diseases through diet (1 st edition)	Mangala Kango	CBS Publications	2005

Mapping with Programme Outcomes

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

S- Strong; **M-**Medium

SEMESTER IV
Non-Major Elective Courses

NMEC-II	B.Sc. Biotechnology	2019 - 2020
Code: M19NBT03	NMEC - II - ENTREPRENEURSHIP IN BIOTECHNOLOGY	
Credit: 2		

Objectives

To gain entrepreneurial skills in the field of mushroom cultivation, vermicomposting, hydroponics, aquaponics, home gardening, roof top gardening, sericulture and apiculture venture creation.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the scope and importance of entrepreneurship in biotechnology	K1
CO2	Learn the principles and methods of mushroom cultivation	K3
CO3	Understand the methods of vermicomposting	K3
CO4	Know the techniques of <i>Azolla</i> and <i>Spirulina</i> cultivation	K3
CO5	Understand the methods of hydroponics, home gardening, roof top gardening, sericulture and apiculture	K3

UNIT-I

Scope and importance of entrepreneurship; Introduction to bioentrepreneurship – types of bio-industries – biopharma, bioagri, bioservices and bioindustrial; innovation – types, out of box thinking; skills for successful entrepreneur – creativity, leadership, managerial, team building, decision making; opportunities for bioentrepreneurship.

UNIT-II

Introduction to mushroom fungi, nutritional value, edible and poisonous type, edible mushrooms -- Pleurotus, Volvariella and Agaricus, medicinal value of mushrooms. Preparation of culture, mother spawn production, multiplication of spawn, cultivation techniques, harvesting, packing and storage.

UNIT-III

Vermiculture and Vermicomposting: Introduction, Collection of wastes and their segregation and processing. Bed preparation for Anaerobic and Aerobic composting Earthworm collection and application on beds Vermicompost collection, Earthworms separation, Air drying of vermicompost, sieving and storing. Vermi-wash collection and processing.

UNIT-IV

Introduction to SCP production – Pond construction, Outdoor mass cultivation technology of *Spirulina*, Optimal conditions for mass cultivation, Development of *Spirulina* culture, Harvesting and Drying process of *Spirulina* biomass. *Azolla* Fodder- Introduction, Cultivation and harvesting methods. Advantages and nutritional values of *Azolla*.

UNIT-V

Farming – hydroponics and aquaponics, home gardening, roof top gardening. Sericulture – Introduction. Mulberry cultivation and silk worm rearing. Introduction to Apiculture. Honey Bee types and Life cycle. Bee keeping: Tools and Equipment. Queen rearing. Handling, Collection and preservation of honey. Honey Processing and marketing.

Note: Visiting the following production units and obtained enough trainings from the workshop units/fields such as, mushroom, *Spirulina* and *Azolla* cultivation, Honey bee keeping / Honey Processing / Honey Marketing, Hydroponics, roof gardening, vermicomposting and sericulture unit.

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	The Practice of Entrepreneurship	G.G. Meredith, R.E.Nelson and P.A. Neek,	ILO, New Delhi	1982
2.	Management of Small Scale Enterprises,	Vasant Desai,	Himalaya Publishing House	2004
3.	Entrepreneurship: Successfully	Bruce R Barringer and R Duane Ireland,	Launching New Ventures, 3rd ed., Pearson Edu.,	2013
4.	Mushrooms Cultivation, Marketing and Consumption	Manjit Singh Bhuvnesh Vijay Shwet Kamal G.C. Wakchaure	Directorate of Mushroom Research (Indian Council of Agricultural Research) Chambaghat, Solan – 173213 (HP)	2011
5.	Yuvagreen Azolla Bed for Azolla Cultivation	Yuvagreen	Daya Publishing House, New Delhi	2008
6.	Hydroponics: Hydroponics Gardening Guide - from Beginner	Thomas Thatcher	Breakthrough Publishing, USA	2016
7.	Roof Terrace Gardening	Michele Osborne	Aquamarine; New edition edition, India	2012

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Enterprise for life scientists: Developing innovation and	Adams, D. J., & Sparrow, J.	Bloxham: Scion	2008

- entrepreneurship in the biosciences.
2. Biotechnology entrepreneurship: Starting, managing, and Leading biotech companies. Shimasaki, C. D. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier. 2014
 3. Honey Bee Biology and Beekeeping, Dewey M. Caron Revised Edition. Wicwas Press, Kalamazoo 2013
 4. The Complete Step-by-step Book of Beekeeping: A Practical Guide to Beekeeping, from Setting up a Colony to Hive Management and Harvesting the Honey. David Cramp Lorenz Books. London. 2012
 5. Mushroom Cultivation in India B .C. Suman and V.P Sharma Daya Publishing House, New Delhi 2007
 6. Azolla a super organism Rich Mark Constantino Kindle Edition, Amazon Asia-Pacific Holdings Private Limited 2009
 7. An Introduction to Sericulture M. Madan Mohan Rao BS Publications, New Delhi 2019
 8. Nutraceutical Spirulina : Commercial Cultivation Using Rural Technology in India Pushpa Srivastava Aavishkar Publishers, Distributors, Jaipur; First edition 2017
 9. Hydroponics for the Home Grower Howard M. Resh CRC Press; 1 edition USA 2015

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
C01	M	M	S	S	S
C02	S	M	M	S	S
C03	M	S	M	S	S
C04	S	S	S	M	S
C05	S	M	S	M	M

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

SEMESTER IV

NMEC-II	B.Sc. Biotechnology	2019 - 2020
Code: M19NBT04	NMEC-II - AGRICULTURAL BIOTECHNOLOGY	
Credit: 2		

Objectives

To introduce the principles, practices and application of agricultural biotechnology.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the fundamental principles of crop improvement, hybridization and plant breeding, micro-propagation and plant tissue culture technique	K1 & K3
CO2	Understand the mechanism of biological nitrogen fixation, production of bio-fertilizers and applications	K2
CO3	Knowledge about microbes based bio-fertilizers and bio-pesticides	K3
CO4	Develop a deeper understanding of biodiversity and biosafety	K1
CO5	Understand the role of Transgenic plants in quality modifications, and its current status	K1

UNIT-I

Introduction to Agricultural biotechnology. Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation.

UNIT-II

Mechanism of biological nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza. Use of plant growth regulators in agriculture and horticulture.

UNIT-III

Microbes based Biofertilizers: Azolla and Anabena, Rhizobium, Azotobacter, Azospirillum, Mycorrhiza. Biopesticide – Trichoderma, BT and NPV.

UNIT-IV

Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop genetic resources. Convention on Biological Diversity (CBD) and Cartagena protocol on Biosafety. Conservation strategies for seed gene bank; Impact of GE crops on Biodiversity.

UNIT-V

Transgenic plants in quality modifications–Starch, Oil, Protein, and Golden Rice. Current status of transgenics, Biosafety norms and controlled field trails and release of transgenic (GMO).

TEXT BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Environmental microbiology Handbook on	Grant W.D. and Long P.E Stuart J.	Springer	1981
2.	Agriculture, Biotechnology and development	Smyth, Peter W.B. Phillips, David Castle	Edward Elgar Publishing Inc.	2014

REFERENCE BOOKS:

S. No.	Title of the Book	Author	Publishing Company	Year of Publication
1.	Agricultural Biotechnology	Kumar HD	Daya Publishing house	2005
2.	Agricultural Biotechnology	Rajmohanjoshi	Isha Books, Delhi	2006
3.	Text book of Agricultural Biotechnology	AhindraNag	PHI Learning Private Limited, New Delhi	2008

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
C01	S	S	S	M	M
C02	S	M	S	M	M
C03	S	S	S	S	S
C04	S	M	M	M	M
C05	M	M	S	S	M

S- Strong; **M-**Medium