

# DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCES AND HUMANITIES

UG PROGRAM (CBCS) – B.Sc. Microbiology

(2019–2022 Batch)

Course code	Name of the course	Objective and outcomes		Instruction hours / week			Credit(s)	Maximum Marks		
		PEO s	POs	L	T	P		CIA	ESE	Total
								40	60	100
SEMESTER-I										
19LSU101	Language – I	VII	e	4	0	0	4	40	60	100
19ENU101	English	VII	e	4	0	0	4	40	60	100
19MBU101	Introduction to Microbiology and Microbial Diversity	I	a	3	1	0	4	40	60	100
19MBU102	Bacteriology	I	g	4	0	0	4	40	60	100
19MBU103	Biochemistry - I	I	g	4	0	0	4	40	60	100
19MBU111	Basic Microbiology - Practical	VI	b	0	0	3	2	40	60	100
19MBU112	Bacteriology - Practical	VI	b	0	0	3	2	40	60	100
19MBU113	Basic Biochemistry - I- Practical	VI	b	0	0	4	2	40	60	100
	Semester total			19	1	10	26	320	480	800
SEMESTER-II										
19LSU201	Language –II	VII	E	4	0	0	4	40	60	100
19MBU201	Biochemistry – II	I	G	4	0	0	4	40	60	100
19MBU202	Microbial Physiology and Metabolism	II	G	4	0	0	4	40	60	100
19MBU203	Microbial genetics	IV	G	4	1	0	5	40	60	100
19MBU211	Biochemistry – II - Practical	VI	B	0	0	3	2	40	60	100
19MBU212	Microbial Physiology and Metabolism - Practical	VI	B	0	0	3	2	40	60	100
19MBU213	Microbial Genetics - Practical	VI	B	0	0	4	2	40	60	100
19AEC201	Environmental Studies	IV	F	3	0	0	3	40	60	100
	Semester total			19	1	10	26	320	480	800
SEMESTER – III										
19MBU301	Virology	I	g	4	0	0	4	40	60	100
19MBU302	Food and Dairy Microbiology	IV	h	4	0	0	4	40	60	100
19MBU303	Industrial Microbiology	IV	g	4	0	0	4	40	60	100
19MBU304A	Microbial Quality Control in Food and Pharmaceutical Industries	IV	h	3	0	0	3	40	60	100
19MBU304B	Microbial Diagnosis in Health Clinic									
19MBU311	Virology - Practical	VI	b	0	0	4	2	40	60	100
19MBU312	Food and Dairy Microbiology - Practical	IV	h	0	0	4	2	40	60	100
19MBU313	Industrial Microbiology - Practical	IV	g	0	0	4	2	40	60	100
19MBU314A	Microbial Quality Control in Food and Pharmaceutical Industries - Practical	III	b,h	0	0	3	1	40	60	100
19MBU314B	Microbial Diagnosis in Health Clinic -Practical									
	Semester total			15	0	15	22	320	480	800

SEMESTER – IV										
19MBU401	Immunology	I	h	4	0	0	4	40	60	100
19MBU402	Medical Microbiology	IV	j	4	0	0	4	40	60	100
19MBU403	Environmental Microbiology	I	g	4	0	0	4	40	60	100
19MBU404A	Biofertilizers and Biopesticides	IV	h,g,i	3	0	0	3	40	60	100
19MBU404B	Recombinant DNA Technology									
19MBU411	Immunology - Practical	I	h	0	0	4	2	40	60	100
19MBU412	Medical Microbiology - Practical	IV	j	0	0	4	2	40	60	100
19MBU413	Environmental Microbiology - Practical	I	b,g	0	0	4	2	40	60	100
19MBU414A	Biofertilizers and Biopesticides - Practical	IV	h,g,i	0	0	3	1	40	60	100
19MBU414B	Recombinant DNA Technology – Practical									
	<b>Semester total</b>			<b>15</b>	<b>0</b>	<b>15</b>	<b>22</b>	<b>320</b>	<b>480</b>	<b>800</b>
SEMESTER – V										
19MBU501A	Management of Human Microbial Diseases	I	J	4	0	0	4	40	60	100
19MBU501B	Microbiological Analysis of air and water	IV								
19MBU502A	Biomathematics and Biostatistics	V	c,d	4	0	0	4	40	60	100
19MBU502B	Bioinformatics	VII								
19MBU503A	Instrumentation and Biotechniques	IV	a,j	4	0	0	4	40	60	100
19MBU503B	Plant Pathology									
19MBU504A	Microbial Biotechnology	IV	G	3	0	0	3	40	60	100
19MBU504B	Inheritance Biology									
19MBU511A	Management of Human Microbial Diseases - Practical	I IV	J	0	0	4	2	40	60	100
19MBU511B	Microbiological Analysis of air and water - Practical									
19MBU512A	Biomathematics and Biostatistics - Practical	V VII	d	0	0	4	2	40	60	100
19MBU512B	Bioinformatics - Practical									
19MBU513A	Instrumentation and Biotechniques - Practical	IV	a,j	0	0	4	2	40	60	100
19MBU513B	Plant Pathology - Practical									
19MBU514A	Microbial Biotechnology - Practical	IV VI	G	0	0	3	1	40	60	100
19MBU514B	Inheritance Biology - Practical									
	<b>Semester total</b>			<b>15</b>	<b>0</b>	<b>15</b>	<b>22</b>	<b>320</b>	<b>480</b>	<b>800</b>
SEMESTER – VI										
19MBU601A	Mushroom Cultivation	III	h	4	0	0	4	40	60	100
19MBU601B	Food Fermentation Techniques									
19MBU602A	Biosafety and Intellectual Property Rights	V IV	a	4	0	0	4	40	60	100
19MBU602B	Microbes in Sustainable Agriculture and Development									
19MBU603A	Cell Biology	VI	b	3	0	0	3	40	60	100
19MBU603B	Molecular Biology									
19MBU611A	Mushroom Cultivation - Practical	III	h	0	0	4	2	40	60	100
19MBU611B	Food Fermentation Techniques - Practical									
19MBU612A	Biosafety and Intellectual Property Rights - Practical	V IV	a,i	0	0	4	2	40	60	100

19MBU612B	Microbes in Sustainable Agriculture and Development –Practical									
19MBU613A	Cell Biology - Practical	VI	b	0	0	3	1	40	60	100
19MBU613B	Molecular Biology - Practical									
19MBU691	Project	IV	b,g	0	0	8	6	40	60	100
ECA / NCC / NSS / Sports / General interest etc								Good		
	<b>Semester total</b>			<b>11</b>	<b>0</b>	<b>19</b>	<b>22</b>	<b>280</b>	<b>420</b>	<b>700</b>
	<b>COURSE TOTAL</b>			<b>94</b>	<b>2</b>	<b>84</b>	<b>140</b>	<b>1880</b>	<b>2820</b>	<b>4700</b>

\*Colour fonts highlights

Red colour : Entrepreneurship course

Green colour : Employability courses

Blue colour : Skill development courses

Ability Enhancement Courses (AEC)		
Semester	Course Code	Name of the Course
I	19LSU101	Language –I
	19ENU 101	English
II	19LSU201	Language –II
	19AEC201	Environmental Studies

Generic Elective Courses (GE) / Allied Courses		
Semester	Course Code	Name of the Course
I	19MBU103	Biochemistry – I
	19MBU113	Biochemistry –I - Practical
II	19MBU201	Biochemistry – II
	19MBU211	Biochemistry – II – Practical

Core Courses (CC)		
Semester	Course Code	Name of the Course
I	19MBU101	Introduction to Microbiology and Microbial Diversity
	19MBU102	Bacteriology
	19MBU111	Basic Microbiology – Practical
	19MBU112	Bacteriology – Practical
II	19MBU202	Microbial Physiology and Metabolism
	19MBU203	Microbial genetics
	19MBU212	Microbial Physiology and Metabolism - Practical
	19MBU213	Microbial Genetics – Practical
III	19MBU301	Virology
	19MBU302	Food and Dairy Microbiology
	19MBU303	Industrial Microbiology
	19MBU311	Virology - Practical
	19MBU312	Food and Dairy Microbiology – Practical
	19MBU313	Industrial Microbiology – Practical
IV	19MBU401	Immunology
	19MBU402	Medical Microbiology
	19MBU403	Environmental Microbiology

	19MBU411	Immunology - Practical
	19MBU412	Medical Microbiology - Practical
	19MBU413	Environmental Microbiology – Practical
<b>VI</b>	19MBU691	Project

<b>Skill Enhancement Courses(SEC)</b>		
<b>Semester</b>	<b>Course Code</b>	<b>Name of the Course</b>
<b>III</b>	19MBU304A	Microbial Quality Control in Food and Pharmaceutical Industries
	19MBU304B	Microbial Diagnosis in Health Clinic
<b>III</b>	19MBU314A	Microbial Quality Control in Food and Pharmaceutical Industries - Practical
	19MBU314B	Microbial Diagnosis in Health Clinic -Practical
<b>IV</b>	19MBU404A	Biofertilizers and Biopesticides
	19MBU404B	Recombinant DNA Technology
<b>IV</b>	19MBU414A	Biofertilizers and Biopesticides - Practical
	19MBU414B	Recombinant DNA Technology – Practical
<b>V</b>	19MBU501A	Management of Human Microbial Diseases
	19MBU501B	Microbiological Analysis of air and water
	19MBU502A	Biomathematics and Biostatistics
	19MBU502B	Bioinformatics
<b>V</b>	19MBU511A	Management of Human Microbial Diseases - Practical
	19MBU511B	Microbiological Analysis of air and water - Practical
	19MBU512A	Biomathematics and Biostatistics - Practical
	19MBU512B	Bioinformatics - Practical
<b>VI</b>	19MBU601A	Mushroom Cultivation
	19MBU601B	Food Fermentation Techniques
<b>VI</b>	19MBU611A	Mushroom Cultivation – Practical
	19MBU611B	Food Fermentation Techniques - Practical

<b>Discipline Specific Elective Courses (DSE)</b>		
<b>Semester</b>	<b>Course Code</b>	<b>Name of the Course</b>
<b>V</b>	19MBU503A	Instrumentation and Biotechniques
	19MBU503B	Plant Pathology
	19MBU504A	Microbial Biotechnology
	19MBU504B	Inheritance Biology
<b>V</b>	19MBU513A	Instrumentation and Biotechniques - Practical
	19MBU513B	Plant Pathology – Practical
	19MBU514A	Microbial Biotechnology – Practical
	19MBU514B	Inheritance Biology – Practical
<b>VI</b>	19MBU602A	Biosafety and Intellectual Property Rights
	19MBU602B	Microbes in Sustainable Agriculture and Development
	19MBU603A	Cell Biology
	19MBU603B	Molecular Biology
	19MBU612A	Biosafety and Intellectual Property Rights - Practical
	19MBU612B	Microbes in Sustainable Agriculture and Development -Practical
	19MBU613A	Cell Biology – Practical
	19MBU613B	Molecular Biology - Practical

# Undergraduate Programme – B.Sc Microbiology

## Programme Outcomes

**Programme Outcomes of UG Microbiology:** Students of all undergraduate microbiology degree Programmes at the time of graduation will be able to

- a. Scientific Knowledge: Microbiology majors able to make observations, develop hypotheses, and design and execute experiments using advanced methods. Able to discuss science and scientific methodology. They will have a good knowledge of Intellectual Property Rights.
- b. Laboratory Skills: Microbiology students will master the following laboratory skills: aseptic culture techniques, microscopy, use of appropriate methods to identify microorganisms and to use high laboratory equipments. They are able to practice safe microbiology, using appropriate protective and emergency procedures.
- c. Data analysis skills: Systematically collect, record, and analyze data, identify sources of error, interpret the results, and reach logical conclusions.
- d. Problem-Solving Skills: Microbiology students will be able to analyze and interpret results from a variety of microbiological methods, and apply these methods to analogous situations. Use mathematical and graphing skills and reasoning to solve problems in microbiology.
- e. Communication Skills: Microbiology majors will demonstrate competence in written and oral communication.
- f. Cooperation/Social Responsibility: Microbiology majors able to understand and appreciate the value of cooperating and working effectively with peers and be able to demonstrate a commitment to the process of developing such skills.
- g. Able to understand the importance of microorganisms in various industries such as pharmaceuticals, food, biofertilizers and biopesticides etc, Students will have a major knowledge on concepts of immunology, biotechnology, molecular biology, biochemistry, genetics. Able to explain the beneficial and harmful role of microorganisms in environment.

## **Programme Specific Outcomes (PSOs)**

h. Students will have a major knowledge on concepts of immunology, biotechnology, molecular biology, biochemistry, genetics. Able to explain the beneficial and harmful role of microorganisms in environment. Able to understand the importance of microorganisms in various industries such as pharmaceuticals, food, biofertilizers and biopesticides etc,

i Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.

j. Identify ways microorganisms' play an integral role in disease, and microbial and immunological methodologies are used in disease treatment and prevention.

## PROGRAMME EDUCATIONAL COURSE OBJECTIVES (PEOs)

**Programme Educational COURSE OBJECTIVES of UG Microbiology:** The major COURSE OBJECTIVES of the undergraduate course is

**PEO-I:** To impart knowledge on basic concepts of microbiology. To understand the beneficial and harmful role of microorganisms in the environment.

**PEO-II:** To understand the fundamentals of physiological reactions including metabolic pathways and biochemical reactions in microorganisms.

**PEO-III:** To develop human resource and entrepreneurs in Microbiology with the ability to independently start their own ventures or small biotech units in the field of biotechnology.

**PEO-IV:** Understand modern microbiology - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.

**PEO-V:** Become familiar with public policy, bio-safety, and intellectual property rights issues related to microbiology applications nationally and globally

**PEO-VI:** Gain experience with standard bioinstrumentations and molecular tools and approaches utilized: manipulate genes, gene products and organisms.

**PEO-VII:** To demonstrate the written and oral communication skill .To develop the problem solving and data interpretation skills.

POs	a	b	c	d	e	F	g	h	i	j
PEO I	X	X						X		X
PEO II	X	X						X	X	
PEO III	X	X		X			X	X		
PEO IV		X		X			X		X	
PEO V	X					X				X
PEO VI		X	X	X				X	X	X
PEO VII	X	X	X	X	X	X	X			

## பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

## பொதுநோக்கம்

- பொதுநோக்கம் என்பது கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள், 'பொதுநோக்கம்' என்பது கல்வியின் மூலக்கோள்.
- பொதுநோக்கம், கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள்.
- பொதுநோக்கம் என்பது கல்வியின் மூலக்கோள், 'பொதுநோக்கம்' ; 'பொதுநோக்கம்' என்பது கல்வியின் மூலக்கோள்.
- பொதுநோக்கம் என்பது கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள்.
- பொதுநோக்கம் என்பது கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள்.
- பொதுநோக்கம் என்பது கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள், கல்வியின் மூலக்கோள்.

## தாள்கள் வரிசையும் தேர்வுச் செயல்திட்டமும் பகுதி-I தமிழ்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
ஒன்று	I	4	3	40 / 60	100	4



**தமிழ் முதல் தாள்**  
(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)  
(For I-UG Science Degree Classes)

4-H,4-C

**அலகு - I : இக்கால இலக்கியம்: (10 மணிநேரம்)**

- |                                 |                           |
|---------------------------------|---------------------------|
| 1. மகாகவி பாரதியார்             | - பரம்பொருள் வாழ்த்து .   |
| 2. புரட்சிக்கவிஞன் பாரதிதாசன்   | - தமிழின் இனிமை.          |
| 3. கவிமணி தேசிக விநாயகம் பிள்ளை | - கோவில் வழிபாடு.         |
| 4. கவிக்கோ. அப்துல்ரகுமான்      | - பாருக்குள்ளே நல்ல நாடு. |
| 5. சிற்பி பாலசுப்பிரமணியன்      | - காலம்.                  |
| 6. கவிஞர் தாமரை                 | - தொலைந்து போனேன்.        |

**அலகு - II : அற இலக்கியம்: (8 மணிநேரம்)**

- ஒளவையார் - கொன்றை வேந்தன் (1- 50 பாடல்கள்)  
அன்னையும் பிதாவும் - புலையும் கொலையும் களவும் தவிர்
- வேதநாயகம்பிள்ளை - நீதிநூல் - (5 பாடல்கள்)  
சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவினும், வைத்தவர், ஈன்றவர்
- திருவள்ளுவர்- திருக்குறள்- பண்புடைமை, வினைத்திட்டம்
- முன்றுறையரையனார் - பழமொழி நானூறு 5 பாடல்கள்

உணற்கு இனிய, பரந்த திறலாரை, நெடியது காண்கிலாய், இனி யாரும், உரைசான்ற

**அலகு - III : சிற்றிலக்கியம்: (8 மணிநேரம்)**

- முக்கூடற் பள்ளு- 2 பாடல்கள் - சித்திரக் காலிவாலான் (நெல்வகைகள்)  
குற்றாலத் திரிகூட மால்வரை (மீன் வகைகள்)
- நந்தி கலம்பகம்- 5 பாடல்கள்- என்னையே புகழ்ந்தேன், பதிதொறு புயல்பொழி,  
இந்தப்புவிடில், அடிவிளக்கும் துகில், வானுறுமதியை
- மதுரைச் சொக்கநாதர் தமிழ்விடு தூது -தமிழின் சிறப்பு  
பாடியருள பத்துப்பாட்டும்-விளம்பக்கேள்.

**அலகு – IV : சிறுகதை:**

**(8 மணிநேரம்)**

- |                     |   |                 |
|---------------------|---|-----------------|
| 1. மகாமசானம்        | – | புதுமைப்பித்தன் |
| 2. அப்பாவின் வேஷ்டி | – | பிரபஞ்சன்       |
| 3. அந்நியர்கள்      | – | ஆர். சூடாமணி    |
| 4. இந்நாட்டுமன்னர்  | – | நாஞ்சில்நாடன்   |

**அலகு – V : மொழிப்பயிற்சி:**

**(6 மணிநேரம்)**

1. பொருத்தமான தமிழ்ச் சொற்களைப் பயன்படுத்துதல்
2. செய்யுள் பொருளுணர் திறன்
3. மொழிபெயர்ப்புப் பயிற்சிகள்
4. கடிதங்கள் மற்றும் விண்ணப்பங்கள் எழுதுதல்

**பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.**

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

19ENU101

ENGLISH

Semester – I  
4H –4C

Instruction Hours / week: L: 4 T: 0P: 0

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**Course Objectives:**

- To train students to acquire proficiency in English.
- To explore different genres of literature and learning grammar.
- To provide aesthetic pleasure through literature.
- To inculcate moral values through literature.
- To develop ethical values.
- To give basic grammar knowledge

**Course Outcome:**

1. Develop the knowledge of interpersonal skills.
2. Establish and maintain social relationships.
3. Genres of literature will give moral values of life.
4. Develop communication skills in business environment
5. Communication skills will get developed.
6. Develop to have language competence

**UNIT - I : PROSE**

1. Morals in the Indian Context - Francis Nicholas Chelliah
2. How Comic Books help us to relive our Childhood - Benoit Peeters
3. Let's Do What India Needs From Us -Dr.A.P.J. Abdul Kalam

**UNIT - II : POEM**

1. The Stolen Boat - William Wordsworth
2. Telephone Conversation- Wole Soyinka
3. A River - A.K. Ramanujan

**UNIT - III : SHORT STORIES**

1. Rapunzel - Brothers Grimm
2. The Ant and The Grasshopper- W. Somerset Maugham
3. The Nightingale and the Rose - Oscar Wilde.

**UNIT - IV: Drama**

1. The Merchant of Venice- Act 4-Scene 1
2. The Death Trap- Saki

**UNIT - V: Grammar and Composition**

GRAMMAR : 1. Tenses

2. Articles

3. Auxiliaries (Primary and Modal)

4. Tag Questions

Composition:

1. Reading to Comprehend
2. Letter Writing
3. Resume Writing
4. General Essay

**Prescribed Text:** Reminisce, Published by the Department of English, Karpagam Academy of Higher Education.

**Suggested Reading:** Hewings Martin, 1999 Advanced English Grammar, Cambridge University Press.

**COURSE OBJECTIVES**

- To provide a strong, fundamental foundation in microorganisms for advanced studies in biological sciences, particularly to improve their skills in microbiology field.
- To identify and understand the principle components of a light microscope
- To provide an overview of the biology of algae, ii) use the study of algae to provide a basis for understanding the evolutionary pathways to higher plants
- To explain why the study of fungi such as yeast and molds is within the discipline of microbiology
- To describe the unique characteristics of fungi
- To explain laboratory diagnosis, prevention and control of protozoa

**COURSE OUTCOMES**

1. After completion of this course paper, the students clearly understand the contributions of various scientists for development of microbiology field and skills associated with it.
2. This course will demonstrate the diversity of microbes and their applications.
3. Students will know about the various field of Microbiology
4. Students will know the role of microorganism in fermentation and spoilage
5. Able to understand the special features of algae, fungi and protozoa
6. Familiarize with morphologic criteria to differentiate the most common protozoan

**Unit I- History of microbiology**

Development of microbiology as a discipline, spontaneous generation vs biogenesis. Contribution of Anton von Leewenhoek, Golden era of Microbiology Louis Pasteur, Robert Koch, Joseph Lister, Alexander Flemming. Role of microorganism in fermentation, Germ theory of disease, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Ellie Metchnikoff, Edward Jenner. Microscopy. Application in industries, Application in medicine, Application in agriculture, Application in biotechnology, Application in biology.

**Unit II- Classification of microorganisms**

Bergey's Manual, Binomial Nomenclature and Universal Phylogenetic tree. Classification system: Phenetic and Phylogenetic, Whittaker's Five Kingdom and Carl Woese's three kingdom classification system and their utility. Difference between prokaryotic and eukaryotic microorganism. Major diversity of microbial life. General characteristics of Bacteria, Bacterial ultra-structure and Nutrients. **General characteristics of Actinobacteria.**

**Unit III- Algae**

General characteristics of algae including algal cell ultra-structure. Classification of algae- Chlamydomonas, Volvox, Diatoms, red algae and brown algae. **Algal cell cultivation and preservation.** Application of Algae in agriculture, industry, environment and food.

**Unit IV-Fungi**

General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure. Economic importance of fungi .Classification of fungi.

## Unit V- Parasites

General characteristics, special references with *Entamoeba histolytica*, *Trichomonas*, *Giardia* and *Plasmodium*. Classification and general properties of viruses.

### SUGGESTED READINGS

1. Tortora, G.J., Funke, B.R., and Case CL. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.
2. Madigan, M.T., Martinko J.M., Dunlap, P.V., and Clark, D.P. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.
3. Cappuccino, J., and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9<sup>th</sup> edition. Pearson Education Limited.
4. Wiley, J.M., Sherwood, L.M., and Woolverton, C.J. (2013) Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill International.
5. Atlas, R.M. (1997). Principles of Microbiology. 2<sup>nd</sup> edition. W.M.T. Brown Publishers.
6. Pelczar, M.J., Chan, E.C.S., and Krieg, N.R. (1993). Microbiology. 5<sup>th</sup> edition. McGraw Hill Book Company.
7. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R. (2005). General Microbiology. 5<sup>th</sup> edition. McMillan.
8. Duby, R.C. (2014) Textbook of Microbiology. 5<sup>th</sup> edition. S. Chand Publishing.
9. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology. (10<sup>th</sup> Ed). McGraw-Hill Higher Education, United States.

**COURSE OBJECTIVES**

- To provide a strong base in the fundamentals of bacteria that improves their chances in employability.
- To learn techniques and methods used in the cultivation and isolation of bacteria.
- To learn various physical and chemical means of sterilization
- To prepare the specimen and identify the morphology of the bacteria
- To know about the culture media
- To obtain with the knowledge about the habitat and characteristics of various physiological groups of bacteria and archaea in detail.

**COURSE OUTCOME**

After completion of this course candidate able to:

1. Understand the basic microbial structure and function and this course provide an understanding of the concepts of bacteriology which is one of the basic requirements for their employability
2. Understand the structural similarities and differences among various physiological groups of bacteria and archaea
3. Demonstrate theory and practical skills in staining procedures
4. Understand various Culture media and their applications
5. Understand various physical and chemical means of sterilization
6. Know General bacteriology and microbial techniques for isolation of pure culture of bacteria

**Unit I- Structure of bacteria**

Cell shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili. Cell-wall structure and composition of Gram-positive, Gram-negative and archae cell wall. Action of antibiotics and enzymes on the cell wall (sphaeroplasts, protoplasts, and L-forms). Cell Membrane- Structure, function and chemical composition of bacterial and Archaeal cell membranes. Cell organelles. Endospore: Structure, formation, stages of sporulation.

**Unit II – Microscopic staining**

Staining-principle and types of staining (Simple and Differential). Pure culture technique- microbial preservation- cultivation of anaerobic bacteria.

**Unit III- Media and Sterilization**

Culture media-types, composition. Sterilization technique-Physical and Chemical methods of microbial control-types and mode of action. Bacterial growth curve-bacterial motility and cell count technique. Calculation of generation time and specific growth rate.

**Unit IV- Microbial classification**

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and Archae bacteria.

## **Unit V- Archae, bacteria and Eubacteria**

Archae bacteria and Eubacteria- General characteristics, Classification (Overview), metabolism and ecological significance. Gram Positive and Gram Negative (Low G+C and High G+C)-General characteristics with suitable examples. Cyanobacteria: An Introduction.

### **SUGGESTED READINGS**

1. Pelczar, J.r M.J., Chan, ECS., and Krieg, N.R. (2004). Microbiology. 5<sup>th</sup> edition. Tata McGrawHill.
2. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2013). Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill HigherEducation.
3. Madigan, M.T., and Martinko, J.M. (2014). Brock Biology of Micro-organisms. 14<sup>th</sup> edition. Parker J. Prentice Hall International, Inc.
4. Tortora, G.J., Funke, B.R., and Case, C.L. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.
5. Black, J.G. (2008). Microbiology: Principles and Explorations. 7<sup>th</sup> edition. PrenticeHall
6. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R. (2005). General Microbiology. 5<sup>th</sup> edition. McMillan.
7. Atlas, R.M. (1997). Principles of Microbiology. 2<sup>nd</sup> edition. W.M.T. Brown Publishers.
8. Cappuccino, J., and Sherman. N. (2010). Microbiology: A Laboratory Manual. 9<sup>th</sup> edition. Pearson Education Limited
9. Srivastava, S., and Srivastava, P.S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.



Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES**

- To provide the knowledge on basics of biochemistry and its applications and to highlight the technical skill.
- To describe the classification and functions of lipids.
- To summarize the structure and classification of enzymes
- To state the Structure and types of DNA
- To analyse the functions and properties of phosphoglycerides
- To understand about storage and structural polysaccharides.

**COURSE OUTCOME (CO'S)****Upon completion of this course students will be able to**

1. Understand the structures of enzymes, proteins, carbohydrates and fats
2. Understand the functions of biomolecules
3. Analyze the process of metabolism
4. Understand of nucleic acids and their importance to combine and analyses information.
5. Structure and classification of enzymes, specificity of enzymes
6. Summarize the DNA & RNA structure and base pairing schemes

**Unit I- Carbohydrates**

Monosaccharides-families, stereo isomerism, epimers, Mutarotation and anomers. Forms of glucose and fructose, Fischer and Haworth projection. Sugar derivatives. Disaccharides- occurrence, concept of reducing and non-reducing sugars and Haworth projections. Polysaccharides-storage and structural polysaccharides.

**Unit II- Lipids**

Classification and functions of lipids. Storage lipids- structure and function of fatty acids. Triacylglycerols. Saponification. Structural lipids- structure, functions and properties of phosphoglycerides and sphingolipids.

**Unit III- Proteins**

Classification and functions of proteins and amino acids, Structure of amino acids and concept of zwitterion. Ninhydrin reaction. Natural modifications of amino acids in proteins. Non protein amino acids, Primary and Secondary structure of proteins- alpha helix, beta pleated sheet. Tertiary and quaternary structures of proteins. Human haemoglobin structure.

**Unit IV- Enzymes**

Structure and classification of enzymes, specificity of enzymes. Michaelis-Menten equation,  $K_m$ ,  $V_{max}$ , isoenzymes. Allosteric enzyme and its mechanism. Multienzyme complex. Enzyme inhibition.

## **Unit V- Nucleic Acids**

Nucleic Acids-Purines &Pyrimidinesnucleotides, RNA, & DNA base pairing schemes, types of RNA: mRNA, rRNA, tRNA, Secondary structure of DNA, Watson and Crick model.

### **SUGGESTED READINGS**

1. Campbell, M.K. (2012) Biochemistry, 7<sup>th</sup> edition. Published by CengageLearning.
2. Campbell, P.N., and Smith, A.D., (2011) Biochemistry Illustrated, 4<sup>th</sup> edition. Published by ChurchillLivingstone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2<sup>nd</sup> edition. W.H.Freeman.
4. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company.  
Nelson, D.L and Cox, M.M. (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> edition. W.H. Freeman andCompany.
5. Willey, M.J., Sherwood, L.M., &Woolverton, C. J. (2013) Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGrawHill.

19MBU111

BASIC MICROBIOLOGY-PRACTICAL

Semester – I  
(3H –2C)

Instruction Hours / week: L: 0 T: 0P: 3

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**To develop **skills** related to

- Isolation and culture techniques of bacteria
- The external feature of bacteria and colony characteristics. Various staining techniques
- Sterilization of heat sensitive materials
- Counting of microorganism in the environment
- Isolation of parasites from edible fruits.
- Biosafety measures.

**COURSE OUTCOME (CO'S)**

1. This practical paper will build the student to describe and distinguish the bacterial colonies.
2. They also will create knowledge on preparing permanent temporary mounts for fungi, protozoan's and algae.
3. Students will be able to understand the parasites and its nature.
4. They can be able to handle the pathogens safely.
5. Students able to describe the *Spirogyra*, *Chlamydomonas* and *Volvox*
6. Students able to handle the instruments in the microbiology laboratory

**EXPERIMENTS**

1. Microbiology Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility.
5. Demonstration of the presence of micro flora in the environment by exposing nutrient agar plates to air.
6. Temporary mounts Lacto phenol cotton blue mount – *Rhizopus*, *Penicillium*, *Aspergillus*.
7. Study of *Spirogyra* and *Chlamydomonas*, *Volvox* using temporary mounts.
8. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*.

**SUGGESTED READINGS**

1. Tortora, G.J., Funke, B.R., and Case, C.L. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.
2. Madigan, M.T., Martinko, J.M., Dunlap, P.V., and Clark, D.P. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International edition.
3. Cappuccino, J., and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9<sup>th</sup> edition. Pearson Education Limited.
4. Wiley, J.M., Sherwood, L.M., and Woolverton, C.J. (2013) Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill International.
5. Atlas, R.M. (1997). Principles of Microbiology. 2<sup>nd</sup> edition. W.M.T. Brown Publishers.
6. Pelczar, M.J., Chan, E.C.S., and Krieg, N.R. (1993). Microbiology. 5<sup>th</sup> edition. McGraw Hill Book Company.
7. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R., (2005). General Microbiology. 5<sup>th</sup> edition. McMillan.

19MBU112

BACTERIOLOGY-PRACTICAL

Semester – I  
(3H – 2C)

Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To provide a strong base in the fundamentals of bacteria.
- To learn techniques and methods used in the cultivation and isolation of bacteria.
- To develop skills related to preservation of bacterial cultures.
- To learn about bacterial specialized structure using staining methods
- To learn the bacterial special structure capsule and spore
- To measure the bacterial size

**COURSE OUTCOME**

After Completion of this course candidate can able to demonstrate:

1. Theory and practical skills in staining procedures
2. Various Culture media and their applications
3. Various microbial culture techniques to obtain isolation of pure cultures of bacteria
4. Bacterial endospore and capsule
5. Able to analyze the Bacterial size
6. Able explain the bacterial motility and flagella

**EXPERIMENTS**

1. Preparation of different media: synthetic media BG-11, Complex media - Nutrient agar, McConkey agar, EMB agar.
2. Micrometry.
3. Haemocytometer
4. Motility by hanging drop method.
5. Simple staining
6. Negative staining
7. Gram's staining
8. Acid fast staining – demonstration permanent slide only.
9. Capsule staining
10. Endospore staining.
11. Isolation of pure cultures of bacteria by streaking method - Quadrant, Continuous and T-streaking.
12. Preservation of bacterial cultures by various techniques - Agar slants and deeps - Mineral Oil, Glycerol stocks
13. Estimation of Colony Forming Unit (CFU) count by spread plate method/pour plate method.

**SUGGESTED READINGS**

1. Pelczar Jr, M.J., Chan, E.C.S., and Krieg, N.R. (2004). Microbiology. 5<sup>th</sup> edition. Tata McGraw Hill.
2. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2013). Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.
3. Madigan, M.T., and Martinko, J.M. (2014). Brock Biology of Micro-organisms. 14<sup>th</sup> edition. Parker J. Prentice Hall International, Inc.
4. Tortora, G.J., Funke, B.R., and Case, C.L. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.

5. Black, J.G. (2008). Microbiology: Principles and Explorations. 7<sup>th</sup> edition. PrenticeHall
6. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R. (2005). General Microbiology. 5<sup>th</sup> edition. McMillan.
7. Atlas, R.M. (1997). Principles of Microbiology. 2<sup>nd</sup> edition. W.M.T. Brown Publishers.
8. Cappucino, J., and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9<sup>th</sup> edition. Pearson Education Limited
9. Srivastava, S., and Srivastava, P.S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.

19MBU113

BIOCHEMISTRY- I - PRACTICAL

Semester – I  
(4H –2C)

Instruction Hours / week: L: 0 T: 0P:4

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- To familiarize the students with the basic cellular processes at molecular level
- To make students familiar with practical techniques used for studying biochemical structure and analysis of biochemical methods.
- To expertise in Qualitative/Quantitative tests of carbohydrates, reducing sugars, Protein and lipids
- To study the protein secondary and tertiary structures
- To study the effect of temperature, pH and heavy metals on enzyme activity.
- To gain the knowledge on vitamin estimation

**COURSE OUTCOME****Upon the completion this course student will acquire**

1. The practical knowledge and the skills associated about various techniques used in Biochemistry.
2. The skill in qualitative and quantity analysis of carbohydrates, protein and lipid
3. An understanding in protein secondary and tertiary structures
4. An insight in enzyme activity and its physical factors influence the activity
5. Knowledge on vitamin estimation
6. Cognitive skill and students able to solve the numerical problems

**EXPERIMENTS**

- 1 Properties of water, concept of pH and buffers, preparation of buffers and numerical problems to explain the concepts.
- 2 Numerical problems on calculations of standard free energy change and equilibrium constant.
- 3 Standard free energy change of coupled reactions.
- 4 Qualitative/Quantitative tests for carbohydrates, reducing sugars, and non-reducing sugars.
- 5 Qualitative / Quantitative tests for lipids and proteins.
- 6 Study of protein secondary and tertiary structures with the help of models.
- 7 Study of enzyme kinetics– calculation of Vmax, Km, Kat values.
- 8 Study effect of temperature, Ph and heavy metals on enzyme activity.
- 9 Estimation of any one vitamin.

**SUGGESTED READING**

1. Campbell.,M.K.(2012)Biochemistry,7<sup>th</sup> edition.Published by Cengage Learning.
2. Campbell,P.N.,and Smith,A.D.(2011)Biochemistry Illustrated,4<sup>th</sup> edition.Published by Churchill Livingstone.
3. Tymoczko,J.L.,Berg,J.M.,and Stryer,L.(2012)Biochemistry:A short course,2<sup>nd</sup> edition.
4. Berg,J.M.,Tymoczko,J.L.,and Stryer,L.(2011)Biochemistry,W.H.Freeman and Company.
5. Nelson,D.L.,and Cox,MM..(2008)Lehninger Principles of Biochemistry,5<sup>th</sup> Edition.W.H.Freeman and Company.
6. Willey,M.J.,Herwood,L.M.& Woolverton,C.J.(2013)Prescott,Harley and Klein's Microbiology 9<sup>th</sup> Edition. McGraw Hill
7. Voet,D.,and Voet,J.G.(2004)Biochemistry 3<sup>rd</sup> edition, John Wiley and Sons.

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சாத்தனார், மற்றுஅதன் தன் உடம்பினை, இவன் உயிர் பெற்ற றெழில், பாய்த்திய பின் திருமூலராய், வெய்ய சுடர் கதிரவனும், அங்கவளும், பித்து உற்ற மையல் அன்று, இந்த நிலைமையில், ஆவடு தண்துறை, ஊன்உடம்பில், முன்னிய அப்பொருள்.

**2. வைணவம் – ஆண்டாள் நாச்சியார் திருப்பாவை: (11 பாடல்கள்):**மார்கழித்திங்கள், வையத்து வாழ்வீர்காள், ஓங்கி உலகளந்த, ஆழி மழைக்கண்ணா, மாயனை மன்னுவட மதுரை, சிற்றம் சிறுகாலே, ஒருத்தி மகனாய், மாலே மணிவண்ணா, கூடாரை வெல்லும், கறவைகள் பின்சென்று, வங்கக்கடல் கடைந்த.

**அலகு – II :சங்கஇலக்கியம்**

**(14 மணிநேரம்)**

சங்க இலக்கியங்கள் -அறிமுகம்

**அ).எட்டுத்தொகை**

**நற்றிணை:**கொண்டல் மாமழை – குறிஞ்சி – தலைவன் - 140

**குறுந்தொகை :** வாரார் ஆயினும், வரினும் –முல்லை– தலைவி - 110

**ஐங்குறுநூறு :** மருதம் –தோழி -வேட்கைப்பத்து: வாழிஆதன் வாழி அவனி - 6

**பதிற்றுப்பத்து:** சிதைந்தது மன்ற - 27

**பரிபாடல்:** பரிபாடல் திரட்டு-வையை –10: மலைவரை மாலை-கரை நண்ணி 10:1-25, ஆங்க அணிநிலை மாடத்து-நீகானும் போன்ம் 10: 41-55, இலம்படு புலவர் - ஏத்தினர் தொழுவே 10: 126-130.

**கலித்தொகை:** பாலைக்கலி- செவிலி – எறித்தரு கதிர்தாங்கி-9

**அகநானூறு:** அன்னை அறியினும் அறிக – தோழி - நெய்தல் - 110

**புறநானூறு :** யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192

**ஆ).பத்துப்பாட்டு: நெடுநல்வாடை - கார்காலச் சிறப்பு :** வையகம் பனிப்ப -1-70

**அலகு - III :காப்பியம்**

**(6 மணிநேரம்)**

**(அ). சிலப்பதிகாரம்:**

**மங்கல வாழ்த்துப் பாடல்:** (21-29)- நாக நீள் நகரொடு-கண்ணகி என்பாண் மன்னோ .

**வழக்குரை காதை,** (48-56) - நீர்வார் கண்ணை-புகா ரென்பதியே .

**வஞ்சின மாலை:** (5-34) - வன்னிமரமும் – பிறந்த பதிப் பிறந்தேன்.

**நடுகற் காதை:** (207-234) - அருத்திற லரசர் – மன்னவ ரேறென்.,

**வாழ்த்துக்காதை:** (9) - என்னேயிஃ தென்னே – மீவிசும்பிற் றோன்றுமால்.

**(ஆ). மணிமேகலை:**

**பசியின் கொடுமை: பாத்திரம் பெற்ற காதை:**

‘போதி நீழல்’ - ‘பெருகியதன்றோ’ , ‘ஆற்றுநர்க்களிப்போர்’ - ‘நல்லறம் கண்டனை’ (73-98).

**சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை:**மாவண் கிள்ளிக்கு காவலன் உரைத்தவை:

‘பைஞ்சேறு மெழுகாப் பசும்பொன் மண்டபத்து - அரவோர்க் காக்கினன் அரசாள் வேந்தன்’ (116-163).

**அலகு – IV : கட்டுரைகள்**

**(8 மணிநேரம்)**



1. தமிழிசை இயக்கம் – பேரா. க. வெள்ளைவாரணர்
2. தனிப்பாடல்கள் - பேரா. வ. சுப. மாணிக்கனார்
3. கலைச்சிறப்பு - முத்தமிழ்க் காவலர் கி.ஆ.பெ. விசுவநாதம்
4. காளத்திவேடனும் கங்கைவேடனும் –சொல்லின்செல்வர் ரா.பி.சேதுப்பிள்ளை
5. ஏட்டில் இல்லாத இலக்கியம் – ஒளவை துரைசாமி

**அலகு- V :மொழிப்பயிற்சி (5 மணிநேரம்)**

**(பேச்சுப்பயிற்சி & படைப்பாக்கப் பயிற்சி)**

படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடைஎழுதுதல், நேர்காணல்)மொழிபெயர்ப்பு

**பாடநூல்:கற்பகச்சோலை – தமிழ்ஏடு.**

கற்பகம்உயர்கல்வி கலைக்கழகத்தமிழ்த்துறைவெளியீடு.

19MBU201

BIOCHEMISTRY - II

Semester – I  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0P:0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES**

- To provide the informative understanding on Advances in Biochemistry and its applications.
- It serves as good research knowledge on various metabolic pathways that prevails inside the human body.
- To understand the free energy and standard free energy
- To gain the knowledge on carbohydrate metabolism
- To provide an advanced understanding of the principle concept of biochemical compounds
- To know about genetic information storage in cell.

**COURSEOUTCOME (CO'S)**

1. A candidate can able to understand metabolic pathways of carbohydrates, proteins, Lipids and Nucleic acid that improve their skills.
2. This course will provide clear understanding about the Biological oxidation.
3. Students able to categorize the biochemical compounds
4. Students able to demonstrate the carbohydrate, protein and nucleic acid
5. Students able to comment on metabolism of carbohydrate, protein and lipid.
6. Students will analyze structural functional relationships of genes and proteins from bacteria to eukaryotes.

**Unit I- Introduction to metabolism**

Anabolism and catabolism - Definition. Bioenergetics - Thermodynamics principles, Concepts of free energy, Standard free energy, Mitochondrial Electron Transport Chain: electron carriers, chemiosmotic theory and ATP production, High Energy phosphate compounds.

**Unit II- Carbohydrate metabolism**

Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis, HMP shunt, Gluconeogenesis, Glucuronic acid pathway.

**Unit III- Lipid metabolism**

Fatty acid oxidation –  $\alpha$ ,  $\beta$ ,  $\omega$  oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of cholesterol, triglycerides and ketone bodies.

**Unit IV- Protein metabolism**

Synthesis of Aliphatic and aromatic amino acids. Degradation of proteins: Deamination, Transamination and Decarboxylation, Urea cycle.

**Unit V- Nucleic acid metabolism and Biological oxidation**

Biosynthesis and degradation of purine and pyrimidine nucleotides. Integrated Carbohydrate, Protein and lipid metabolism.

**SUGGESTED READINGS**

1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
2. Lehninger's Principles of Biochemistry (2000) by Nelson, David I. and Cox, M.M. Macmillan /Worth, NY.
3. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24<sup>th</sup> edition, Prentice Hall International. Inc.
4. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W.C. Brown Publishers, 1995.
5. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H. Freeman and company.
6. Biochemistry, Lubert Stryer, 4th edition, W.H. Freeman & Co, 1995.
7. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY.

19MBU202

MICROBIAL PHYSIOLOGY AND METABOLISM

Semester – II  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0P: 0

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- It gives brief description on the microbial metabolism and its energetic
- It deals with the various aerobic and an aerobic process through which the organisms obtain and utilize the energy for their growth and to produce industrially important products that helps the students to become better entrepreneurs
- Explains photosynthesis and photosynthetic bacteria
- To study the structure, function, energy metabolism, growth and regulatory mechanisms of microorganisms.
- The students will learn about the metabolic diversity exhibited by microorganisms
- The students will learn about regulatory networks that support their survival and growth of the microorganism.

**COURSE OUTCOME (CO'S)**

1. The students will be able to understand and predict the various metabolic reactions in microbial cell.
2. This will make them predict the intermediate products which can be employed in industrial production processes.
3. Students will understand the growth, nutrition and environmental factors
4. Students able to assess the prokaryotes by observing the biochemical reaction
5. This course will support them to interpret the fermentation using microbes
6. Able to summarize the nutrients uptake system in the prokaryotes

**Unit I- Microbial nutrition**

Microbial nutrition–nutrient requirements, Nutritional groups of microorganisms.Uptake of nutrients by cell – Passive, Facilitated diffusion, Active transport, Group translocation and Iron uptake.

**Unit II- Microbial growth**

Different phases of growth curve - generation time.Measurement of microbial growth. Batch, Continuous and Synchronous culture, Diauxic growth, Influence of environmental factors on growth (Temperature, pH, solute, water activity, oxygen and pressure).

**Unit III- Carbohydrate metabolism**

Carbohydrate metabolism – EMP, ED, Pentose phosphate pathway, TCA cycle, Aerobic respiration, oxidative phosphorylation, electron transport chain (Prokaryotic and Eukaryotic), substrate level phosphorylation.Anaerobic respiration.Uncouplers and inhibitors.

**Unit IV- Anaerobic respiration**

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

**Unit V- Cyanobacteria**

Photosynthesis – bacteria and cyanobacteria, photosynthetic pigments – oxygenic (cyanobacterial) and Anoxygenic (Purple, green bacteria) photosynthesis.Nitrogen metabolism-overview of nitrogen cycle.

**SUGGESTED READINGS**

1. Madigan, M.T., and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Prentice Hall International Inc.
2. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology.(10<sup>th</sup> Ed).McGrawHillHigherEducation.

3. Moat, A.G., and Foster, J.W. (2002). Microbial Physiology. 4<sup>th</sup> edition. John Wiley & Sons.
4. Reddy, S.R., and Reddy, M. (2005). Microbial Physiology. Scientific PublishersIndia.
5. Gottschalk, G. (1986). Bacterial Metabolism. 2<sup>nd</sup> edition. SpringerVerlag.
6. Stanier, R.Y., Ingrahm, J.I., Wheelis, M.L., and Painter, P.R. (1987). General Microbiology. 5<sup>th</sup> edition, McMillan Press.
7. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2013). Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill HigherEducation.

19MBU203

MICROBIAL GENETICS

Semester – II  
(5H –5C)

Instruction Hours / week: L: 4 T: 1 P: 0

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To focus on the basic principles of genetics incorporating the concepts of classical, molecular and population genetics.
- Compilation is required for recent advances in genetic principles for strong foundation in Biotechnology that improve their chances of employability in biotechnological industries
- To explain the mutagen and process of mutation
- To explain about DNA as a genetic material
- To paraphrase the genetic material structure and model
- To explain the concept of recombination, linkage mapping and elucidate the gene transfer mechanisms in prokaryotes and eukaryotes

**COURSE OUTCOME (CO'S)**

1. This course provided candidates with basic knowledge and understanding of Molecular Biology with special reference to microbial genome.
2. Students undertaking this course will be able to describe the nature of molecular world and its application in modern Microbiological sectors.
3. Students able to understand the properties, structure and function of genes in microorganism at the molecular level
4. Describe the importance of genetic code and operon concept
5. Discuss the molecular mechanisms underlying mutations and repair mechanisms
6. Able to summarize the concept of recombination, linkage mapping and elucidate the gene transfer mechanisms in prokaryotes and eukaryotes

**Unit I- History of genetics**

Concept of Genetics, Mendelian principles, DNA as a genetic material, Experimental evidence Chromosomal theory of inheritance. DNA structure, models of DNA, RNA structure and types.

**Unit II- Plasmids**

Types of plasmids- replication, partitioning, host range, plasmid-incompatibility, amplification, curing and application.

**Unit III- Genetic code**

DNA replication, transcription, translation, Genetic code- Operon concept-Lactose, tryptophan. Genetic recombination in bacteria- Conjugation, Transformation-Transduction and its types. Gene Mapping techniques-gene and chromosome walking.

**Unit IV- Mutations**

Mutations and mutagenesis, types of mutations and mutagens. Identification of mutants- Ames test.

**Unit V- Transposons**

Transposons-definition, types of Transposons, mechanism of transposition and application. Mu transposon elements and eukaryotic transposable elements. Applications.

### **SUGGESTED READINGS**

1. Klug, W.S., Cummings, M.R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10<sup>th</sup> edition, BenjaminCummings.
2. Krebs, J., Goldstein, E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3<sup>rd</sup> edition, Jones and Bartlett Learning.
3. Pierce, B.A. (2011) Genetics: A Conceptual Approach, 4<sup>th</sup> edition, Macmillan Higher Education Learning.
4. Watson, J.D., Baker, T.A., Bell, S.P., et al. (2008) Molecular Biology of the Gene, 6<sup>th</sup> edition, BenjaminCummings.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. 8<sup>th</sup> edition, Wiley-India.
6. Russell, P.J. (2009). *iGenetics- A Molecular Approach*. 3<sup>rd</sup> edition, BenjaminCummings.
7. Sambrook, J., and Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual. 4<sup>th</sup> edition, Cold Spring Harbour Laboratorypress.
8. Maloy, S.R, Cronan, J.E., and Friefelder, D. (2004) Microbial Genetics 2<sup>nd</sup> edition, Jones and Barlett Publishers.

19MBU211

BASIC BIOCHEMISTRY - PRACTICAL II

Semester – II

(4H –2C)

Instruction Hours / week: L: 0 T: 0P:4

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- To familiarize the students with the some basic analytical techniques in Biochemistry that improve their **skills** associated with laboratory techniques
- To gain knowledge with these techniques used for purification
- To know principle behind the compound purification
- To measure the protein using standard method
- To analyze the lipid using routine test
- To determine the physical factors and substrate concentration of protein

**COURSE OUTCOME**

1. Students will get practical knowledge about various techniques used in Biochemistry.
2. Students will evaluate the protein and cholesterol
3. Able to purify the compounds using chromatography
4. Students able to separate the amino acid and sugar using thin layer chromatography
5. Able to discuss about biochemical compound and its estimation using standard method
6. Students able to separate the plant pigments

**EXPERIMENTS**

1. Separation of sugar by paper chromatography
2. Separation of amino acid by thin layer chromatography
3. Separation of plant pigments by thin layer / column chromatography
4. Estimation of Protein by Lowry's method
5. Estimation of Cholesterol by Zak's method
6. Estimation of Phosphorus by Fiske Subbarow method
7. Determination of effect of pH, temperature and substrate concentration of Salivary Amylase

**SUGGESTED READING**

1. Biochemical Methods 1992, by S.Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi
2. Laboratory Manual in Biochemistry, 1981. J.Jayaraman, New Age International publishers, New Delhi



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**19MBU212 MICROBIAL PHYSIOLOGY AND METABOLISM–PRACTICAL** **Semester – II**  
**(3H –2C)**

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**Instruction Hours / week: L: 0 T: 0P: 3****Marks: Internal: 40 External: 60 Total:100****End Semester Exam: 6 Hours****COURSE OBJECTIVES**

- To enhance the students' knowledge on various aspects of microbial physiology like growth, extremophiles studies and chemical characterization of microbes.
- To improve their **skills** in handling microorganisms
- To analyze the growth condition of the bacteria.
- To facilitate the students to deal with the bacterial strain
- To demonstrate the fermentation technique
- To demonstrate the generation time and thermal death time of bacteria

**COURSE OUTCOME****Upon successful completion of this practical course**

1. The students will be able to analyze the bacteria growth and growth condition
2. Able to identify the various factors for optimal growth of *E.coli*.
3. Understand the basic microbial structure and functions of various physiological groups of prokaryotes.
4. Able to utilize the various Culture media in the proper physical condition for fermentation
5. Able to explain the microbial metabolism – Autotrophy and heterotrophy modes of nutrition
6. Students able to understand the physical and chemical growth requirements of bacteria and thermal death time of bacteria.

**EXPERIMENTS**

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E.coli*
4. Effect of pH and **aeration on growth of *E.coli***
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E.coli*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E.coli*.

**SUGGESTED READINGS**

1. Madigan, M.T., and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Prentice Hall International Inc.
2. Moat, A.G., and Foster, J.W. (2002). Microbial Physiology. 4<sup>th</sup> edition. John Wiley & Sons
3. Reddy, S.R., and Reddy, S.M. (2005). Microbial Physiology. Scientific Publishers India
4. Stanier, R.Y., Ingraham, J.I., Wheelis, M.L., and Painter, P.R. (1987). General Microbiology. 5<sup>th</sup> edition, McMillan Press.
5. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2013). Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.

19MBU213

MICROBIAL GENETICS - PRACTICAL

Semester – II  
(4H –2C)

Instruction Hours / week: L: 0 T: 0P:4

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 6Hours

**COURSE OBJECTIVES**

- To focus on the basic principles of genetics incorporating the concepts of classical, molecular and population genetics.
- Compilation is required for recent advances in genetic principles for strong foundation in Biotechnology that improve their chances of employability in biotechnological industries
- To study the effect of chemical and physical mutagens on prokaryotic cell
- To isolate the extra chromosomal from bacteria
- To Interpret the DNA quantity and purity
- To identify the mutant strains using appropriate techniques

**COURSE OUTCOME (CO'S)**

1. Students undertaking this practical shall be able to describe the key concept in the basic Microbial Genetics
2. Effectively understand the implication of mutation and its characteristics.
3. Further, the experiments would allow students to recall and relate the information gained from Microbial Genetics theory paper and [skills](#) associated with it
- 4.Students able demonstrate the gene transfer techniques
- 5.Students can estimate the genetic materials
- 6.Able to distinguish the plasmid and Genomic DNA

**EXPERIMENTS**

1. Preparation of Master and Replica Plates.
2. Study the effect of chemical (HNO<sub>2</sub>) and physical (UV) mutagens on bacterial cells.
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
4. Isolation of Plasmid DNA from *E.coli*.
5. Estimation of DNA
6. Study different conformations of plasmid DNA through Agarose gelelectrophoresis.
7. Demonstration of Bacterial Conjugation.
8. Demonstration of bacterial transformation and transduction.
9. Demonstration of AME Test.

**SUGGESTED READINGS**

1. Klug, W.S., Cummings, M.R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10<sup>th</sup> edition, Benjamin Cummings
2. Krebs, J., Goldstein, E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3<sup>rd</sup> edition, Jones and Bartlett Learning.
3. Pierce, B.A. (2011) Genetics: A Conceptual Approach, 4<sup>th</sup> edition, Macmillan Higher Education Learning.
4. Watson, J.D., Baker, T.A., Bell, S.P., et al. (2008) Molecular Biology of the Gene, 6<sup>th</sup> edition, Benjamin Cummings.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. 8<sup>th</sup> edition, Wiley-India.
6. Sambrook, J., and Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual. 4<sup>th</sup> edition, Cold

Spring Harbour Laboratorypress.

7. Maloy, S.R., Cronan, J.E., and Friefelder, D. (2004) Microbial Genetics 2<sup>nd</sup> edition, Jones and Barlett Publishers.
8. Peter J. Russell, i Genetics – A molecular approach, 7<sup>th</sup> edition, 2010. Pearson Benjamin Cummings Publishers, Boston,USA.
9. David Freifelder, Microbial Genetics. Narosa Publishing House, 10<sup>th</sup> edition, 2004. New Delhi,India.

19AEC201

ENVIRONMENTAL STUDIES

Semester – II  
(3H –3C)

Instruction Hours / week: L: 3 T: 0P: 0

Marks: Internal: 40 External: 60 Total:100

End Semester Exam: 3Hours

**Course Objectives**

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.
- To Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.
- To create awareness among the students to know about various renewable and nonrenewable resources of the region, enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislation, etc.)
- To make appropriate judgments and decisions for the protection and **skills** associated with improvement of the earth.

**Course Outcomes (COs)**

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

**Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS**

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

**Unit II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES**

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

**Unit III - BIODIVERSITY AND ITS CONSERVATION**

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

## **Unit IV - ENVIRONMENTAL POLLUTION**

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies.

## **Unit V - SOCIAL ISSUES AND THE ENVIRONMENT**

Concept of sustainability and sustainable development. Water conservation - Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

### **Suggested Readings**

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidyaapeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc., New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand & Company Pvt. Ltd., New Delhi.
6. Odum, E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
10. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2<sup>nd</sup> ed.). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology). S.Chand and Company Ltd, New Delhi.
12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

**Instruction Hours / week: L: 4 T: 0P: 0      Marks: Internal: 40 External: 60 Total:100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To study general aspects of viral morphology and classification, replication, interactions and immunity to viruses
- To discuss the application of various immunological and molecular diagnostic tools.
- To explain the students about the virus classification
- To distinguish the architecture of viruses and their features
- To Know the methods used in studying viruses
- Discern the replication strategies of representative viruses from the seven Baltimore classes

**COURSE OUTCOME (CO'S)**

1. This paper will have clear understanding the role of various in plant, animal and human disease
2. Candidate able to understand their **skill** based various mechanisms to enter and escape from host.
3. Comprehend the intricate interaction between viruses and host cells
4. Understand the interactions between viruses and the host immune system
5. It will explain the terms Oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis.
6. Explain vaccine strategies and mechanisms of antiviral drugs and interferons

**Unit I- History of viruses**

History of viruses. Structure, Classification, nomenclature of viruses. Isolation, purification and cultivation of viruses. Viral assay. Concept of viroids, virusoids, satellite viruses, Virophage and Prions.

**Unit II- Bacteriophages**

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

**Unit III- Transmission of virus**

Modes of viral transmission, Salient features of viral Nucleic acid-unusual bases, overlapping genes, splicing genes, terminal redundancy, cohesive ends, capping and tailing. Viral genome organization.

**Unit IV- Viral multiplication and replication**

Viral multiplication and replication-Interaction, and entry, assembly, maturation and release of virions. Oncogenic viruses and its types, mechanism. Viral replication strategies as per Baltimore classification. Prevention and control of viral diseases.

**Unit V- Antiviral compounds**

Antiviral compounds and their mode of action. Interferon and their mode of action. General principles of viral vaccination. Immunization schedule. Use of viral vectors in cloning and expression, gene therapy and phage display.

**SUGGESTED READINGS**

- Dimmock, N.J., Easton., A.L., Leppard, K.N. (2007). Introduction to Modern Virology. 6<sup>th</sup> edition, Blackwell Publishing Ltd.
2. Carter J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint, S.J., Enquist, L.W., Krug, R.M., Racaniello, V.R., Skalka, A.M. (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2<sup>nd</sup> edition. ASM press Washington DC.
4. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3<sup>rd</sup> edition. Prentice Hall publication, New Jersey.
5. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2<sup>nd</sup> edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayud, M.V. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos, L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.



19MBU302

FOOD AND DAIRY MICROBIOLOGY

Semester – III  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To encode the employability importance of the role of microorganisms in food industries both in beneficial and harmful ways.
- This course aims to provide instruction in the general principles of food microbiology.
- Hands on practicals complimented with an industry-based project, give a real-world perspective to microbiological challenges faced by the food industry.
- The course covers the microbiology of food preservation and food commodities; principles and methods for the microbiological examination of foods and microbiological quality control.
- To develop an understanding of the major principles of and current issues in the several topical areas that collectively constitute Food Microbiology
- It will help the students to understand the dairy Technology.

**COURSE OUTCOME**

1. Provides job-oriented information about the role of microorganisms in many foods, and beverage industries both in production and spoilage processes.
2. Develop job-based output on industrial based technologies on Food microbiology.
3. It will explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.
4. Discuss the microbiology of different types of food commodities.
5. Students are able to identify the pathogens from spoiled food
6. Explain why the microbiological quality control programmes are necessary in food production.

**Unit I**

Natural flora and source of contamination of foods in general. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Microbial spoilage of various foods – Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

**Unit II**

Principles of food preservation. Physical methods of food preservation: temperature (low, high, canning, and drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, nitrite and nitrates, antibiotics and bacteriocins, sterilization of dry heat, moist heat, chemical, physical and radiation.

**Unit III**

Fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese. Other fermented foods: Idly, sauerkraut, soy sauce and tampeh. Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

**Unit IV**

Causative agents, foods involved, symptoms and preventive measures of the following diseases, Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins. Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis, Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*, fungal diseases.

**Unit V**

Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology. HACCP, FSSAI (ISO 9001:2008) Indices of food sanitary quality (record maintenance and standards) and sanitizers.



## **SUGGESTED READINGS**

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7<sup>th</sup> edition, CBS Publishers and Distributors, Delhi, India.
2. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3<sup>rd</sup> edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
3. Adams MR and Moss MO. (1995). Food Microbiology. 4<sup>th</sup> edition, New Age International (P) Limited Publishers, New Delhi, India.
4. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
5. Banwart JM. (1987). Basic Food Microbiology. 1<sup>st</sup> edition. CBS Publishers and Distributors, Delhi, India.
6. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
7. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To encompasses the employability use of microorganisms in the manufacture of food or industrial products.
- The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
- This course covers the principles of various processes associated with the production and recovery of different bio-products derived from microorganisms.
- The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.
- It will make the students to explore their practical skills in entrepreneurial activities.
- It will deliver the large scale production of microbial products techniques in advanced level.

**COURSE OUTCOME**

1. Provides knowledge in the large scale production of industrial product, providing the trends to cater the needs of industry.
2. This will help the students to enhance their employment knowledge on microbiology based commercial products.
3. The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
4. This course covers the principles of various processes associated with the production
5. Students are able recover the different bio-products from microorganisms.
6. The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.

**Unit I**

Brief history and developments in industrial microbiology. Sources of industrially important microbes and methods for their isolation, primary and secondary screening methods. Strain improvement method (protoplast fusion, mutation and recombinant DNA technology).

**Unit II** Preservation and maintenance of industrial strains. Media formulation (molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates).

**Unit III**

Types of fermentation processes – Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations. Components of a typical bio-reactor, Types of bioreactors – Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration.

**Unit IV**

Separation of cells – filtration and centrifugation. Cell disruption – physical, chemical and enzymatic methods. Product separation – solvent extraction and precipitation. Lyophilization and spray drying. Methods of immobilization, advantages and applications of immobilization.

**Unit V**

Microbial production of industrial products-Citric acid, Ethanol, Penicillin, Glutamic acid, Vitamin B<sub>12</sub>, Enzymes (DHA, amylase, protease, lipase, chitinase) Wine, Beer, probiotics (*Lactobacillus*, *Bacillus* and yeast) (micro-organisms involved, media, fermentation conditions, downstream processing and uses).

## **SUGGESTED READINGS**

1. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2<sup>nd</sup> edition. Panima Publishing Co. New Delhi.
3. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1<sup>st</sup> edition. Bios Scientific Publishers Limited. USA
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1<sup>st</sup> edition. W.H. Freeman and Company
5. Casida LE. (1991). Industrial Microbiology. 1<sup>st</sup> edition. Wiley Eastern Limited.
6. Patel A.H. (1996). Industrial Microbiology. 1<sup>st</sup> edition, Macmillan India Limited.
7. Waites M.J., Morgan N.L., Rockey J.S. and Higon G. (2001). Industrial Microbiology: An Introduction. 1<sup>st</sup> edition. Wiley – Blackwell.

19MBU304A

Semester – III  
(3H – 3C)**MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To make the students better to understand the aspects of skilled manufacturing practices, kinds of pathogenic microorganisms in food and quality control in food and pharmaceutical industries.
- Develop industry oriented skills on developing drugs and food.
- To make the students to understand the food quality systems and advancement universally.
- It will explain the students about all kinds of bio safety levels in laboratories.
- To train the students to be competent working professionals in the food industry and pharmaceutical industry.
- To help the students to explain the production of quality food by imparting better nutritional, sanitation & hygiene concepts.

**COURSE OUTCOME**

1. Imparts skilled knowledge on good manufacturing practices and food spoilage of different types of foods.
2. Develop skills on Food and drug based microbiological analysis.
3. To encourage students to the entrepreneurs and develop the capacity for setting up small scale enterprises with respect to food and pharmaceuticals within the country.
4. To organize functions for creating awareness about the importance of safe processed nutritious food.
5. To provide diagnostic analysis of food and pharmaceutical products.
6. The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.

**Unit I**

Good laboratory practices – Good microbiological practices. Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration.

**Unit II**

Sampling procedures for food, water, and air Culture and microscopic methods – Standard plate count, membrane filtration, most probable numbers, direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel, lot agglutination precipitation sterility testing for pharmaceutical products. Molecular methods – Nucleic acid probes, PCR based detection, biosensors.

**Unit III**

Enrichment culture technique, Detection of specific microorganisms – on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, MacConkey Agar, Saboraud Agar.

**Unit IV**

Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

**Unit V**

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different

### **SUGGESTED READINGS**

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3<sup>rd</sup> edition, Academic Press
2. Garg N, Garg KL and Mukerji KG (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7<sup>th</sup> edition. Springer.
4. Baird RM, Hodges NA and Denyer SP (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

### COURSE OBJECTIVES

- To provide an employment understanding of the natural history of infectious diseases in order to deal with the etiology, laboratory diagnosis, treatment and control of infections in the community.
- This course is aimed to Identify the species of pathogenic bacteria and fungi
- Determine the modes of transmission of infectious diseases and pathogenesis
- Know of the theoretical foundations for the differentiation of the major pathogenic groups
- To Determine the antimicrobials to be used in the sensitivity testing of different types of pathogens.
- Analyze and solve case studies involving bacterial and fungal agents

### COURSE OUTCOME

1. Provides employment knowledge to identify the common infectious agents with the help of laboratory procedures and use antimicrobial sensitivity tests to select suitable antimicrobial agents.
2. It describes the basic mechanisms of pathogenesis of infectious diseases.
3. It explains the basic principles of diagnosis, antimicrobial treatment, prevention and control of infectious diseases in the hospital and community.
4. It help the students to understand the host immune system and explain the host response to infection
5. Understand and interpret basic laboratory tests for the diagnosis of infectious diseases.
6. Apply the principles of molecular and immunological techniques for the diagnosis of infectious diseases.

#### Unit I

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

#### Unit II

How to collect clinical samples (oral cavity, throat swab, tissue sample, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

#### Unit III

Examination of sample by staining – Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, distinct colony properties of various bacterial pathogens.

#### Unit IV

Serological Methods - Agglutination, ELISA, immune fluorescence, Nucleic acid based methods – PCR, Nucleic acid probes, Typhoid, HBV, HCV, HIV and Denque.

#### Unit V

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method (Kirby Bauer Method) Determination of minimal inhibitory concentration (MIC) of an antibiotic by broth dilution method (LC<sub>50</sub>, LC<sub>90</sub>).

### SUGGESTED READINGS

1. Ananthanarayan R and Paniker CKJ (2009). Textbook of Microbiology, 8<sup>th</sup> edition, Universities Press Private Ltd.

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication.
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology. 2<sup>nd</sup> edition, Elsevier India Pvt Ltd.
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13<sup>th</sup> edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14<sup>th</sup> edition, Elsevier.

19MBU311

VIROLOGY-PRACTICAL

Semester – II  
(4H –4C)

Instruction Hours / week: L: 0 T: 0P:4

Marks: Internal:40 External: 60 Total:100

End Semester Exam: 6 Hours

**COURSE OBJECTIVES**

- Describe the structure and replication strategies of the individual viruses discussed, including the processes of entry into cells, control of gene transcription.
- Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
- Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.
- To study general aspects of viral morphology and classification.
- Cultivation of viruses and various methods of propagation.
- To discuss the application of various immunological and molecular diagnostic tools.

**COURSE OUTCOME (CO'S)**

1. Upon paper completion, students will have skill based knowledge on structure of plants, animal, bacteria and viruses.
2. This paper also enables the student on isolation, propagation of various viruses.
3. It will help the students to understand the plant and animal viruses.
4. Students can distinguish the viruses According to their characteristic features.
5. It will explain the research activities involved in virology studies.
6. Skill based viral analysis can be performed in medical research.

**EXPERIMENTS**

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs –Demonstration.
2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs – Demonstration.
3. Study of the structure of important bacterial viruses ( $\phi$ X174, T4, $\lambda$ ) using electron micrograph – Demonstration.
4. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
5. Studying isolation and propagation of animal viruses by chick embryo technique
6. Study of cytopathic effects of viruses using photographs
7. Perform local lesion technique for assaying plant viruses.

**SUGGESTED READING**

1. Dimmock, N.J., Easton, A.L., Leppard, K.N. (2007). Introduction to Modern Virology. 6<sup>th</sup> edition, Blackwell Publishing Ltd.
2. Carter, J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint, S.J., Enquist, L.W., Krug, R.M., Racaniello, V.R., Skalka, A.M. (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2<sup>nd</sup> edition. ASM press Washington DC.
4. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3<sup>rd</sup> edition. Prentice Hall publication, New Jersey.
5. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2<sup>nd</sup> edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu, M.V. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos, L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg, J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.



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**Semester – III**

**19MBU312 FOOD AND DAIRY MICROBIOLOGY – PRACTICAL (4H – 2C)**

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**Instruction Hours / week: L: 0 T: 0 P: 4    Marks: Internal: 40    External: 60 Total: 100**  
**End Semester Exam: 9 Hours**

**COURSE OBJECTIVES**

- To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.
- To obtain a good **entrepreneurial** understanding of food and dairy products and become qualified as microbiologist in food and dairy industries.
- Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
- To know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
- Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries.

**COURSE OUTCOME**

1. Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.
2. It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.
3. To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
4. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation
5. Students can able to understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food
6. Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

**EXPERIMENTS**

1. MBRT of milk samples
2. Standard plate count of milk sample.
3. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
4. Isolation of food borne bacteria from food products.
5. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
6. Isolation of spoilage microorganisms from bread.
7. Preparation of yogurt.

**SUGGESTED READINGS**

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7<sup>th</sup> edition, CBS Publishers and Distributors, Delhi, India.
2. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3<sup>rd</sup> edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
3. Adams MR and Moss MO. (1995). Food Microbiology. 4<sup>th</sup> edition, New Age International (P) Limited Publishers, New Delhi, India.
4. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.

5. Banwart JM. (1987). Basic Food Microbiology. 1<sup>st</sup> edition. CBS Publishers and Distributors, Delhi, India.
6. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
7. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.

19MBU313

INDUSTRIAL MICROBIOLOGY – PRACTICAL

Semester – III  
(4H – 2C)

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 9 Hours

**COURSE OBJECTIVES**

- To encompass the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in manufacture of industrial products
- Know how to source for microorganisms of industrial importance from the environment
- Know about design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air.

**COURSE OUTCOME**

1. Provides knowledge in the large scale production of industrial product, and teaches the modern employment trends to cater the needs of industry.
2. Students will differentiate the types of fermentation processes
3. Understand the biochemistry of various fermentations
4. Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms
5. Comprehend the techniques and the underlying principles in downstream processing
6. Students can able to explore the practical skills in research activities.

**EXPERIMENTS**

1. Study of different parts of fermenter
2. Study the growth curve: *Haemocytometer; Glycol stock and stability of vials at different time*
3. Microbial fermentation – Production and estimation (qualitative and quantitative) of
  - a) Enzymes : Amylase, Protease and DHA
  - b) Amino acid : Glutamic acid
  - c) Organic acid : Citric acid
  - d) Alcohol : Ethanol
4. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.
5. *Assess quality of probiotics in tablets and nutritional supplements*; stability of vials at different time

**SUGGESTED READINGS**

1. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2<sup>nd</sup> edition. Panima Publishing Co. New Delhi.
3. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1<sup>st</sup> edition. Bios Scientific Publishers Limited. USA.
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1<sup>st</sup> edition. W.H. Freeman and Company.
5. Casida LE. (1991). Industrial Microbiology. 1<sup>st</sup> edition. Wiley Eastern Limited.
6. Patel A.H. (1996). Industrial Microbiology. 1<sup>st</sup> edition, Macmillan India Limited.

7. Waites M.J., Morgan N.L., Rockey J.S. and Higon G. (2001). Industrial Microbiology: An Introduction. 1<sup>st</sup> edition. Wiley – Blackwell.

19MBU314A

Semester – III  
(3H – 1C)**MICROBIAL QUALITY CONTROL IN FOOD AND  
PHARMACEUTICAL INDUSTRIES – PRACTICAL****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVE**

- To make the students better to understand the aspects of skilled manufacturing practices, kinds of pathogenic microorganisms in food and quality control in food and pharmaceutical industries.
- Quality systems such as investigations, document management systems, Standard Operating Procedures (SOP), change management system, recall management and inspection management
- Food safety systems including hazard analysis critical control points and preventative control plans
- Principles of enumeration and identification of micro-organisms, using both traditional and rapid methods as well as the pharmacopoeial methods for the detection of specified organisms.
- To gain theoretical and practical knowledge on food and pharma industries.
- To encourage students to the entrepreneurs and develop the capacity for setting up small scale enterprises with respect to food within the country.

**COURSE OUTCOME**

1. This paper imparts skilled knowledge on good manufacturing practices and food spoilage of different types of foods.
2. Students can develop their entrepreneurial skills in food and pharma sectors.
3. Good Manufacturing Practices (GMP) and associated guidelines for drugs, natural health products, cannabis and food
4. Good documentation Practices (GDP) and Data Integrity (DI)
5. Validation for equipment, methods, cleaning and process
6. Quality systems such as investigations, document management systems, Standard Operating Procedures (SOP), change management system, recall management and inspection management.

**EXPERIMENTS**

1. Good manufacturing practices.
2. Most probable number test.
3. Isolation of pathogens from food samples.
4. Methylene blue reduction test.
5. Enumeration of microbial population from pharmaceutical samples.

**SUGGESTED READINGS**

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3<sup>rd</sup> edition, Academic Press.
2. Garg N, Garg KL and Mukerji KG (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7<sup>th</sup> edition. Springer.
4. Baird RM, Hodges NA and Denyer SP (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

**MICROBIAL DIAGNOSIS IN HEALTH CLINIC - PRACTICAL****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To provide employment oriented understanding of the natural history of infectious diseases in order to deal with the etiology, laboratory diagnosis, treatment and control of infections in the community.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

**COURSE OUTCOME**

- Acquire knowledge to identify the common infectious agents with the help of laboratory procedures and use antimicrobial sensitivity tests to select suitable antimicrobial agents on the basis of employment.
- Helps to understand the use of lab animals in medical field.
- Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
- Explain the methods of microorganism's control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.
- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.
- It will help the students to understand the general bacteriology and microbial techniques for isolation of pure cultures of Microorganisms.

**EXPERIMENTS**

1. Collection and processing of clinical specimen – Sputum.
2. Collection and processing of clinical specimen – Urine.
3. Collection and processing of clinical specimen – Blood.
4. Collection and processing of clinical specimen – Stool.
5. Antibiotic sensitivity testing by Kirby-Bauer method
6. Determination of minimal inhibitory concentration.

**SUGGESTED READINGS**

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
2. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14th edition, Elsevier.
3. Greenwood D, Slack R, Barer M, and Irving W. (2012). Medical Microbiology, 18<sup>th</sup> Edition. Churchill Livingstone.
4. Ryan KJ and Ray CG. (2014). Sherris Medical Microbiology, 6<sup>th</sup> Edition. McGraw-Hill Professional.

19MBU401

IMMUNOLOGY

Semester – IV  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To strengthen the knowledge of students in immunodiagnostics.
- To learn the latest trends in immunology.
- Rapid diagnosis and Immune reaction.
- To provide overview of immune system, antigen antibody structure and interactions.
- To develop understanding of innate and adaptive immunity along with major cells and molecules involved.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction

**COURSE OUTCOME**

1. Introducing the employment aspect of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. Students can able to perform basic immunological assays.
6. It will distinguish fundamental knowledge on immunology and its advancement

**Unit I**

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology – Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa. Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

**Unit II**

Antigens – Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. Antibodies – Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies.

**Unit III**

MHC – Organization of MHC locus; Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways). Complement system – Components of the Complement system; Activation pathways (Classical, Alternative); Biological consequences of complement Activation

#### **Unit IV**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co-stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance. Types of Autoimmunity and Hypersensitivity with examples; Immuno deficiencies – Animal models (Nude and SCID mice), DiGeorge syndrome, Chediak-Higashi syndrome. Transplantation immunology, Graft versus host reaction, Types of tumors, tumor Antigens, causes and therapy for cancers.

#### **Unit V**

Principles of precipitation, agglutination, complement fixation, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy.

#### **SUGGESTED READINGS**

1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6<sup>th</sup> edition. W.H. Freeman and Company, New York.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11<sup>th</sup> edition Wiley-Blackwell Scientific Publication, Oxford.
3. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7<sup>th</sup> edition Garland Science Publishers, New York.
4. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6<sup>th</sup> edition, Saunders Publication, Philadelphia.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2<sup>nd</sup> edition Churchill Livingstone Publishers, Edinburgh.



19MBU402

MEDICAL MICROBIOLOGY

Semester – IV  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To introduce the skill-oriented knowledge of the medically important microorganisms, microbial morphology with the main focuses being the characterization, isolation and identification of different microorganism.
- Develop understanding about immune system, antigen antibody interactions.
- Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
- To develop understanding about microbial infections and manifestations.
- Gain knowledge on microbial infections and its prophylaxis.
- To understand the microbial host interactions in life science.

**COURSE OUTCOME**

1. It provides the ability to characterize, isolate and identify different microbes.
2. It includes a detailed study of characterization, etiology, pathogenicity, clinical systems, and laboratory diagnosis of disease causing Microorganisms.
3. Upon completion, students gained the knowledge of most common medically important organism and the infections they cause.
4. Different approaches, techniques and tools used to identify pathogens and control them.
5. Diagnostic approaches for microbial pathogens
6. Developing efficient vaccines and new drugs

**Unit I**

Normal micro flora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Definitions – Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS. Collection, transport and culturing of clinical samples – Sputum, Stool and Urine.

**Unit II**

List of diseases of various organ systems and their causative agents. The following diseases in detail with symptoms, mode of transmission, prophylaxis and control. Respiratory pathogens: *Streptococcus pyogenes*, *Haemophilus influenzae*, *Mycobacterium tuberculosis*. Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*. Others: *Staphylococcus aureus*, *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum*.

**Unit III**

The detailed study of following diseases – Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis of Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

#### **Unit IV**

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention. Cutaneous mycoses: Tinea pedis (Athlete's foot). Systemic mycoses: Histoplasmosis. Opportunistic mycoses: Candidiasis. The detailed study of following diseases – Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis of Amoebiasis, Giardiasis, Elephantiasis, Taeniasis, Malaria, Kala-azar.

#### **Unit V**

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Antibiotic resistance - MDR, XDR, MRSA, NDM-1 – resistance mechanisms. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine.

#### **SUGGESTED READINGS**

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication.
2. Greenwood D, Slack R, Barer M, and Irving W. (2012). Medical Microbiology, 18<sup>th</sup> Edition. Churchill Livingstone.
3. Ryan KJ and Ray CG. (2014). Sherris Medical Microbiology, 6<sup>th</sup> Edition. McGraw-Hill Professional.
4. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8<sup>th</sup> edition, University Press Publication.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.
6. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007). Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.

**Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To educate students about Environmental monitoring and environmental aspects of microbes.
- To impart a skill-based knowledge on Microbes and environment and ecological importance.
- The students will develop set of skills to recognise the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.
- Learning the basic principles of environment microbiology and be able to apply these principles to understanding and solving problems in current environmental and agricultural issues.
- Familiarize students with general principles and subject knowledge in the field of environment and agricultural microbiology.
- To make students aware with current research in environmental and agricultural microbiology

**COURSE OUTCOME**

1. It provides a comprehensive overview of biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.
2. Students will get the basic knowledge how to prepare and perform sampling and microbial analyses for the environmental studies.
3. Critically discuss the need for environmental microbiology and agricultural microbiology and explain their limitations.
4. Clarify application of microorganisms in varied fields of agricultural and environmental microbiology like bioremediation, biofertilizers and waste water treatment.
5. Analyse various aspects of N<sub>2</sub> fixation, Phosphate solubilization, PGPR, biodegradation and bioremediation mechanisms provided by microbes.
6. Describe role of microorganism in recycling soil nutrients, biodegradation of complex plant polymers, sustaining and improving plant growth through improving nutrient availability.

**Unit I**

Structure and function of ecosystems (Definition and concept). Types of Environment-Terrestrial, Aquatic and extreme habitats. Environmental factors affecting microbial growth. Microbial succession in decomposition of plant organic matter.

**Unit II**

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

**Unit III**

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle. Other elemental cycles: Iron and manganese

**Unit IV**

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill and incineration). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

## Unit V

Principles and biodegradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (heavy metals-chelation) matter, biosurfactants. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) MPN test (b) Membrane filter technique. GMO and their impact.

### SUGGESTED READINGS

1. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press
2. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1<sup>st</sup> edition, Springer, New York
3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
4. Subba Rao NS. (1999). Soil Microbiology. 4<sup>th</sup> edition. Oxford & IBH Publishing Co. New Delhi.
5. Barton LL & Northup DE (2011). Microbial Ecology. 1<sup>st</sup> edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
6. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
7. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
8. Martin A. (1977). An Introduction to Soil Microbiology. 2<sup>nd</sup> edition. John Wiley & Sons Inc. New York & London.
9. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
10. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson/ Benjamin Cummings.

19MBU404A

BIOFERTILIZERS AND BIOPESTICIDES

Semester – IV  
(3H – 3C)

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To demonstrate the techno-economic viability of the biofertilizers / biopesticides to farmers through field demonstration at farmer's field & by know-how training.
- To study about the biofertilizers in increasing soil fertility and usage of Biopesticides for plant disease.
- To prepare literature and promulgate in local language through booklets / documents etc. about; the benefits of biofertilizers for farming in villages through trained beneficiaries/ cultivators as multiplier impact.
- To demonstrate the effectiveness of biofertilizer cultural practices in the farmers fields for enhanced crop productivity through bioreclamation of waste/ marginal land
- To raise the rural/tribal economy & living standard of the lowly of the lowest backward farming community especially SC & ST and marginal farmers.
- To create self-employment opportunities to weaker underprivileged SC & ST and marginal farmers

**COURSE OUTCOME**

1. This course has been designed to provide the student knowledge about eco friendly product which play a crucial role in determining its future use and applications in environmental management.
2. Provides detailed entrepreneurial idea about biofertilizer production and plant disease.
3. To produce and impart training of ecofriendly agricultural inputs so as to nullify the ill effects of chemical fertilizers.
4. To demonstrate the know-how technology pertinent to microbiological and physico-chemical analyses of soil samples and their assessment.
5. To demonstrate the low cost media preparation and cultural practices in biofertilizer / biopesticide production.
6. Students can able to develop fundamental aspects of to seed/seed material/seedlings/soil/waste matter/crop residues in order to increase the population

**Unit I**

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N<sub>2</sub> fixers: *Rhizobium* – Isolation, characteristics, types, inoculum production and field application, legume/pulses plants. *Frankia* – Isolation and characteristics, Alnus, Casuarina plants, non-leguminous crop symbiosis. Cyanobacteria, *Azolla* – Isolation, characterization, mass multiplication, their role in rice cultivation, crop response and field application. **Soil nutrients and plant growth**

**Unit II**

Free living *Azospirillum*, *Azotobacter* – isolation, characteristics, mass production and field application. Nitrogen cycle. **Zinc solubilizer and potash solubilizing microbes**

**Unit III**

Phosphate potash and zinc solubilizing microbes – Isolation, characterization, mass production, field application. Role of phosphate and zinc in plant growth and yield

#### Unit IV

**Introduction of mycorrhizae**, Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass production of VAM, field applications of Ectomycorrhizae and VAM. Entomopathogenic fungi

#### Unit V

General account of microbes used as bio-insecticides and their advantages over synthetic pesticides, **bio nematicide**, *Bacillus thuringiensis*, *Pseudomonas*, *Bacillus*, *Streptomyces*- production, Field applications, Viruses – cultivation and field applications.

#### SUGGESTED READINGS

1. Kannaiyan, S. (2003). Bioethnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. *et. al.* (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. New Delhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG.
6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

19MBU404B

## RECOMBINANT DNA TECHNOLOGY

Semester – IV  
(3H – 3C)

Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

## COURSE OBJECTIVES

- To learn the basic tools in recombinant technology
- To understand the various concepts of cloning vectors and cloning strategies
- To emphasize the knowledge in biotechnology and techniques.
- To familiarize the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
- A sound knowledge on procedural repertoire allows students to innovatively apply these in basic and applied fields of biological research.
- This course offers theoretical bases to properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant transformants

## COURSE OUTCOME

1. Imparts the entrepreneurial concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.
2. Understand the difference between old biotechnology and modern biotechnology.
3. Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic sciences.
4. Explain the general principles of generating transgenic plants, animals and microbes.
5. Technical know-how on versatile techniques in recombinant DNA technology.
6. An understanding on application of genetic engineering techniques in basic and applied experimental biology

## Unit I

Milestones in genetic engineering and Biotechnology cloning Tools; Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases

## Unit II

Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs. Use of linkers and adaptors. Expression vectors: *E.coli* lac and T7 promoter-based vectors, yeast YIp, YE<sub>p</sub> and YC<sub>p</sub> vectors, Baculovirus based vectors, mammalian SV40-based expression vectors

## Unit III

Transformation of DNA: Chemical method, Electroporation. Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral- mediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

## Unit IV

PCR: Basics of PCR, RT-PCR, Real-Time PCR (Quantitative). Sanger's method of DNA Sequencing: traditional and automated sequencing. Primer walking and shotgun sequencing

## Unit V

Construction of Genomic and cDNA libraries, screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis. **CRISPR tool.**

### SUGGESTED READINGS

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3<sup>rd</sup> edition. Cold Spring Harbor Laboratory Press.
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education.
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.



19MBU411

IMMUNOLOGY – PRACTICAL

Semester – IV  
(4H – 2C)

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 6 Hours

**COURSE OBJECTIVES**

- To strengthen the knowledge of students in immunodiagnostics on skill basis.
- To learn the latest trends in immunology.
- Rapid diagnosis and Immune reaction.
- To provide overview of immune system, antigen antibody structure and interactions.
- To develop understanding of innate and adaptive immunity along with major cells and molecules involved.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction

**COURSE OUTCOME**

1. Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. After course completion, students can apply the knowledge in further studies and higher education.
6. Knows the concepts of advanced immunological assays

**EXPERIMENTS**

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.s
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum and plasma from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOT ELISA.
7. Perform immunoelectrophoresis.

**SUGGESTED READINGS**

1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6<sup>th</sup> edition, W.H. Freeman and Company, New York.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11<sup>th</sup> edition, Wiley- Blackwell Scientific Publication, Oxford.
3. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7<sup>th</sup> edition, Garland Science Publishers, New York.
4. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6<sup>th</sup> edition, Saunders Publication, Philadelphia.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2<sup>nd</sup> edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6<sup>th</sup> edition. Wiley Blackwell Publication.

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 9 Hours

**COURSE OBJECTIVES**

- To introduce the knowledge of the medically important microorganisms, microbial morphology with the main focuses being the characterization, isolation and identification of different microorganism.
- The aim of Medical Microbiology course is to introduce basic principles and application relevance of clinical disease for students who are in preparation for physicians.
- The content of rigorous course includes many etiological agents responsible for global infectious diseases.
- It covers all biology of bacteria, viruses and other pathogens related with infectious diseases in humans.
- The course will provide the conceptual basis for understanding pathogenic microorganisms and particularly address the fundamental mechanisms of their pathogenicity.
- It will develop the basic skills on handling clinical pathogens

**COURSE OUTCOME**

1. It provides the entrepreneurial ability to characterize, isolate and identify different microbes.
2. It includes a detailed study of characterization, etiology, pathogenicity, clinical systems, and laboratory diagnosis of disease-causing Microorganisms.
3. It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
4. Comprehend the various methods for identification of unknown microorganisms.
5. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
6. Explain the methods of microorganisms control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding. • Demonstrate practical skills in fundamental microbiological techniques.

**EXPERIMENTS**

1. Identify bacteria (any three of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS, Salmonella Shigella/BSA Agar.
3. Study of bacterial flora of skin by swab method.
4. Antibacterial sensitivity assay by Kirby-Bauer method.
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms).
7. Study of various stages of malarial parasite in RBCs using permanent mounts.

**SUGGESTED READINGS**

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication
2. Greenwood D, Slack R, Barer M, and Irving W. (2012). Medical Microbiology, 18<sup>th</sup> Edition. Churchill Livingstone.
3. Ryan KJ and Ray CG. (2014). Sherris Medical Microbiology, 6<sup>th</sup> Edition. McGraw-Hill Professional.
4. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8<sup>th</sup> edition, University Press Publication.

5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.
6. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007). Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.

**19MBU413 ENVIRONMENTAL MICROBIOLOGY – PRACTICAL****Semester – III  
(4H – 2C)****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 9 Hours****COURSE OBJECTIVES**

- To educate students about Environmental monitoring and environmental aspects of microbes.
- To impart a **skill** based knowledge on Microbes and environment and ecological importance.
- Appreciate the diversity of microorganism and microbial communities inhabiting a multitude of habitats and occupying a wide range of ecological habitats.
- Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection and characterization
- Competently explain various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.
- Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved

**COURSE OUTCOME**

1. Provides a comprehensive overview of biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.
2. Understand various plant microbes interactions especially rhizosphere and their applications especially the biofertilizers and their production techniques
3. Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems
4. waste water treatment and bioremediation
5. Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission
6. Comprehend the various methods to determine the Sanitary quality of water and sewage treatment methods employed in waste water treatment

**EXPERIMENTS**

1. Analysis of soil-pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
3. **Isolation of microbes from saline water and soil.**
4. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
5. Assessment of microbiological quality of water.
6. Determination of BOD of wastewater sample.
7. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase and urease) in soil.
8. Isolation of *Rhizobium* from root nodules.

**SUGGESTED READINGS**

1. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press.
2. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste Systems. 1<sup>st</sup> edition, Springer, New York.
3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA

4. SubbaRao NS. (1999). Soil Microbiology. 4<sup>th</sup> edition. Oxford & IBH Publishing Co. New Delhi.
5. Barton LL & Northup DE (2011). Microbial Ecology. 1<sup>st</sup> edition, Wiley Blackwell, USA      Campbell  
RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
6. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
7. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
8. Martin A. (1977). An Introduction to Soil Microbiology. 2<sup>nd</sup> edition. John Wiley & Sons Inc. New York & London.
9. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
10. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson/Benjamin Cummings.
11. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.
12. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17,      Springer-Verlag, Berlin Heidelberg.

Instruction Hours / week:L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 6 Hours

**COURSE OBJECTIVES**

- To study about the biofertilizers in increasing soil fertility and usage of Biopesticides for plant disease on the entrepreneurial basis.
- Appreciate the diversity of microorganism and microbial communities inhabiting a multitude of habitats and occupying a wide range of ecological habitats.
- Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection and characterization
- Competently explain various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.
- Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved
- Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers and their production techniques

**COURSE OUTCOME**

1. Provide the student knowledge about eco friendly product which play a crucial role in determining its future use and applications in environmental management.
2. Provides detailed idea about biofertilizer production and plant disease.
3. Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems
4. waste water treatment and bioremediation
5. Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission
6. Comprehend the various methods to determine the Sanitary quality of water and sewage treatment methods employed in waste water treatment

**EXPERIMENTS**

1. Mass production and application of *Rhizobium* spp. from root nodules
2. Mass production and application of *Azotobacter* spp.
3. Mass production and application of *Azospirillum* spp.
4. Mass production and application of phosphate solubilizing bacteria- quantification, infectivity and potential of bacteria
5. Mass production and application of mycorrhizae.
6. Mass production and application of *Bacillus thuringiensis*.
7. Mass production and application of *Trichoderma viridae*- Inhibition studies.
8. Mass production and application of *Beauveria bassiana*
9. Isolation and identification of potash solubilizing microbes.
10. Isolation and identification of zinc solubilizing microbes.

**SUGGESTED READINGS**

1. Kannaiyan, S. (2003). Biotechnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. *et. al.* (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG.

19MBU414B

RECOMBINANT DNA TECHNOLOGY – PRACTICAL

Semester – IV  
(3H – 1C)

Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 6 Hours

**COURSE OBJECTIVES**

- To learn the **entrepreneurial** basic tools in recombinant technology
- To understand the various concepts of cloning vectors and cloning strategies
- To emphasize the knowledge in biotechnology and techniques.
- Provide idea about DNA, protein purification from samples and quantification.
- To learn the techniques pertaining to amplification of biological molecules.
- To impart knowledge on basic microbial isolation and identification approaches

**COURSE OUTCOME**

1. Imparts the concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.
2. Students will develop understanding about isolation and enumeration of microorganisms from various samples.
3. Microbial identification and characterization using a number of approaches will be well understood.
4. Acquainted with molecular modification approaches that encompass extraction, purification, quantification and augmentation.
5. To give basic understanding of microbial genetic manipulations
6. To understand working of different laboratory equipments used in microbiological laboratories

**EXPERIMENTS**

1. Preparation of competent cells for transformation.
2. Demonstration of Bacterial Transformation and calculation of transformation efficiency.
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Ligation of DNA fragments.
5. Cloning of DNA insert and Blue white screening of recombinants.
6. Interpretation of sequencing gel electropherograms.
7. Designing of primers for DNA amplification.
8. Amplification of DNA by PCR.
9. Demonstration of Southern blotting.

**Suggested reading**

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

19MBU501A

MANAGEMENT OF HUMAN MICROBIAL DISEASES

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To provide a strong base in the fundamentals of pathogens.
- To learn techniques and methods used in the cultivation and isolation of pathogens.
- To obtain with the knowledge about the habitat and characteristics of pathogens in detail.
- Develop understanding about immune system, antigen antibody interactions.
- Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
- Theoretical knowledge on techniques employed for culturing and detection of plant and animal viruses.

**COURSE OUTCOME**

1. Develop skills for identification, classification, and characterization of various pathogens.
2. To describe and practice the basic principles of chemotherapy and disinfection through laboratory exercises accompanied by case studies.
3. Upon completion, students gained the knowledge of most common medically important organism and the infections they cause.
4. Different approaches, techniques and tools used to identify pathogens and control them.
5. Diagnostic approaches for microbial pathogens
6. Developing efficient vaccines and new drugs.

**Unit I**

Infectious and non-infectious diseases, microbial and non-microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections

**Unit II**

Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.

**Unit III**

Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Anti-fungal and anti-parasitic agents. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.

**Unit IV**

General preventive measures, Transmission and prevention of microbial diseases. Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors.

**Unit V**

Importance, types, Vaccine preparation, synthetic or recombinant vaccines. Vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.

**SUGGESTED READINGS**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8<sup>th</sup> edition, University Press Publication



2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication.
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.

19MBU501B

MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- To impart knowledge microflora of air and water, sample collection, analysis and control of diseases.
- This paper is designed with the objective to impart hand-on experience and laboratory skills to students in area of bioprocess.
- Learning the basic principles of environment microbiology and be able to apply these principles to understanding and solving problems in current environmental, air and water issues.
- The students will develop set of skills to recognize the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.
- To reduce volume of sludge, to stabilize organic solids, and to recover resources. Typical Methods of Treatment: Thickening, chemical addition, centrifugation, filtration, digestion, incineration.
- Quality systems such as investigations, document management systems, Standard Operating Procedures (SOP), change management system, recall management and inspection management

**COURSE OUTCOME**

1. Provides **employability** skills involved in the air and water analysis
2. Characterization of microorganisms from water and air samples
3. Students will get the basic knowledge how to prepare and perform sampling and microbial analyses to determine the abundance, growth rate and microbial community composition together with the basic environmental parameters.
4. Validation for equipment, methods, cleaning and process
5. Students can develop their entrepreneurial skills in analysis of air and water sample.
6. Learning the basic principles of microbiological analysis of environmental sector

**Unit I**

Bioaerosols, Air borne microorganisms (bacteria, viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

**Unit II**

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

**Unit III**

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration. Precipitation, chemical disinfection, filtration, high temperature, UV light

**Unit IV**

Water borne pathogens and water borne diseases

**Unit V**

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

**SUGGESTED READINGS**

1. Da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water. A Laboratory Manual, CRC Press.

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press.
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007). Manual of Environmental Microbiology, 3<sup>rd</sup> edition, ASM press.

19MBU502A

BIOMATHEMATICS AND BIOSTATISTICS

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- This course has been intended to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use and applications of Biology.
- This course provides an introduction to a variety of statistical methods of use in describing and analyzing biological data.
- It includes a laboratory component in which biological data are analyzed using statistical software. No prior knowledge of the software will be assumed.
- Statisticians help to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- To develop students' skills in algebraic manipulation, the calculus of linear and non-linear differential equations, mathematical modelling, matrix algebra and statistical methods.
- To introduce students to the application of mathematical modeling in the analysis of biological systems including populations of molecules, cells and organisms.
- To show how mathematics, statistics and computing can be used in an integrated way to analyse biological systems.

**COURSE OUTCOMES**

1. Students get an idea about collection, interpretation and presentation of statistical data.
2. Statistics, a branch of applied Mathematics, is regarded as mathematics applied to observational data.
3. Conceivably everything dealing with the collection, processing, analysis and interpretation of numerical data belongs to the domain of statistics.
4. To introduce students to the use of R for the analysis of biological processes and data, including simple computer programming.
5. have an enhanced knowledge and understanding of mathematical modeling and statistical methods in the analysis of biological systems;
6. To analyse data from experiments and draw sound conclusions about the underlying processes using their understanding of mathematics and statistics be better able to assess biological inferences that rest on mathematical and statistical arguments..

**UNIT I**

Sets. Functions and their graphs : polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc. Simple observations about these functions like increasing, decreasing and, periodicity. Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits.

**UNIT II**

Intuitive idea of algebraic relationships and convergence. Infinite Geometric Series. Series formulas for  $e^x$ ,  $\log(1+x)$ ,  $\sin x$ ,  $\cos x$ . Step function. Intuitive idea of discontinuity, continuity and limits. Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of

differentiation. Integrals of the functions introduced above. Differential Equations of first order, Linear Differential Equations. Points in plane and space and coordinate form. Examples of matrices arising in Biological Sciences and Biological networks. Sum and Product of matrices upto order 3.

### **UNIT III**

Definitions-Scope of Biostatistics Principles of statistical analysis of biological data - Variables in biology, Data collection, classification and tabulation of data - Graphical and diagrammatic representation. Measures of Central Tendency – Arithmetic Mean, Median and Mode. Measures of Dispersion- Range, Standard Deviation, Coefficient of variation. Skewness and Kurtosis.

### **UNIT IV**

Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Emphasis on examples from Biological Sciences. Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson and Normal distribution.

### **UNIT V**

Sampling parameters: Difference between Sample and Population, difference between parametric and non-parametric statistics. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale.

#### **SUGGESTED READINGS**

1. Bear H.S.,(2003). Understanding Calculus, John Wiley and Sons (2<sup>nd</sup> ed.);
2. Batschelet E.,(1979). Introduction to Mathematics for Life Scientists(3<sup>rd</sup> ed.), Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi.
3. Edmondson and D. Druce.,(1996). Advanced Biology Statistics, Oxford University Press.
4. Danial W.,(2013). Biostatistics: A foundation for Analysis in Health Sciences(10<sup>th</sup> ed.), John Wiley and Sons Inc.

19MBU502B

BIOINFORMATICS

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES**

- To detail the importance of computer in field of life sciences.
- To obtain good understanding about the interpretation of biological data base.
- To uptake knowledge in latest tools and technology.
- Aimed to provide an overview of various bioinformatics tools, databases available and sequence analysis
- Provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis.
- To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis

**COURSE OUTCOME**

1. Provides computational [skill](#) on search engines and various software tools involved in bioinformatics
2. It will impart computational based techniques which includes genomics and proteomics in Bioinformatics.
3. Retrieve information from available databases and use them for microbial identifications and drug designing
4. Gain ability to modify gene and protein structures in simulated systems.
5. Introduction to the basics of sequence alignment and analysis.
6. Describe about the different types of Biological databases

**Unit I**

RDBMS - Definition of relational database. Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.

**Unit II**

Biological databases – nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.

**Unit III**

Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsimony, Maximum likelihood.

**Unit IV**

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi ToF spectroscopy. Major features of completed genomes: *E.coli*, *S.cerevisiae*, *Arabidopsis*, Human.

**Unit V**

Hierarchy of protein structure - primary, secondary and tertiary structures, modeling. Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.

**SUGGESTED READINGS**

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing.
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4<sup>th</sup> ed., BPB Publications.
3. Lesk M.A. (2008) Introduction to Bioinformatics . Oxford Publication, 3<sup>rd</sup> International Student Edition.
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and

drug discovery, 2<sup>nd</sup> ed. Prentice Hall India Publication.

5.Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell.

19MBU503A

INSTRUMENTATION AND BIOTECHNIQUES

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- Understand the principles of various instruments used in the life sciences
- Ability to operate the instruments
- Data analysis and interpretations
- Introduce the basic concept of qualitative and quantitative analysis of a given sample
- Study various spectroscopic techniques and its instrumentation.
- Study the concept of separation science and its applications.
- To learn the fundamentals of research methodology, working principles and applications of instruments used in biology

**COURSE OUTCOME**

1. The students with an opportunity to develop skill on the bioinstrumentation and concepts of principles and applications.
2. Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis and characterize functionalities of biomolecules by using spectroscopic techniques.
3. Explain the various separation techniques and its instrumentation.
4. Describe the principle and working of various radiation detectors.
5. Evaluate the various types & applications of chromatography and electrophoresis.
6. Appreciate the working principles and applications of Microscopy

**Unit I**

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy).

**Unit II**

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column Chromatography - packing types (IEC, AC, SEC), fraction collection. GLC and HPLC.

**Unit III**

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

**Unit IV**

Principle, Instrumentation and application of spectrophotometer, colorimeter and turbidometer. MALDI-TOF, FTIR, MS, NMR.

**Unit V**

Filtration types-Micro and Ultra filtration, Principles of centrifugations – RCF and sedimentation coefficient. Types of centrifuges – rotors - fixed angle and swinging bucket rotors. Types of Centrifugation – differential, density gradient and ultracentrifugation. Analytical centrifugation.

**SUGGESTED READINGS**

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed., W.H. Freeman and Company.



3. Willey MJ, Sherwood LM & Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8<sup>th</sup> edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

19MBU503B

PLANT PATHOLOGY

Semester – V  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES**

- This paper aims at introducing students to the basic and applied aspects of plant biotechnology.
- Introduce students to the basic principles and concepts of plant pathology.
- Introduce and illustrate the major groups of organisms that cause plant diseases.
- Enhance student's understanding of scientific research, especially as it applies to the science of plant pathology and the study of microorganisms.
- Provide a framework that students can use in their profession to best approach plant disease management.
- Prepare students for additional classes in Plant Pathology and related disciplines..

**COURSE OUTCOME**

1. This will enable for learning the techniques to save endangered species which will be useful for mankind
2. Describe the concepts of what constitutes disease in plants.
3. Identify major principles of plant pathology.
4. Recognize the etiological agents of disease.
5. Employ methods to diagnose and manage a wide range of plant diseases.
6. Describe aspects of integrated pest management.

**Unit I**

Concept of plant disease- definitions of disease, disease cycle and pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

**Unit II**

Infection, invasion, colonization, dissemination of pathogens and perennation. Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

**Unit III**

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control.

- a. Important diseases caused by phytopathogenic bacteria: Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus.
- b. Important diseases caused by fungi: White rust of crucifers - *Albugo candida*, Downy mildew of onion - *Peronospora*, Powdery mildew of wheat - *Erysiphe graminis*.
- c. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro.

**Unit IV****a. Microbial Pathogenicity**

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

**b. Genetics of Plant Diseases**

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance- horizontal & vertical, apparent resistance.

### c. Defense Mechanisms in Plants

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological- cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

### Unit V

Principles and practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes.

### SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology.5<sup>th</sup> edition.Academic press, San Diego.
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens.3rd edition. Blackwell Science, Oxford.

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19MBU504A	MICROBIAL BIOTECHNOLOGY	Semester – V (3H – 3C)
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Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- To make students understand the aspects of industrial, soil, environmental, agricultural microbiology.
- Gain knowledge about the Industrially important microorganisms & nutritional requirements.
- Know about the Commercialization methods of Microbial products.
- To understand the industrially important microorganisms' commercial value and importance of patent and IPR.
- Describe about different sewage treatment methods employed in waste water treatment.
- know the microorganisms responsible for water pollution.

**COURSE OUTCOME**

1. This paper imparts knowledge on applications of microorganisms in various fields and helps to gain **employability** in pharmaceutical industries
2. Describe about different sewage treatment methods employed in waste water treatment.
3. Learn about the global environmental problems.
4. To provide a fundamental knowledge about the various scopes in environmental and industrial studies.
5. Learn about the applications of microbes in biotransformations, therapeutic and industrial biotechnology
6. Describe aspects of genetically engineered microbes for industrial application

**Unit I**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications. Genetically engineered microbes for industrial application: Bacteria and yeast

**Unit II**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics, Microbial biosensors. **Gene transfer technique.**

**Unit III**

Microbial based transformation of steroids and sterols. Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute. Phage typing, gene therapy. **biotransformation of antibiotics**

**Unit IV**

Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization. RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions.

## Unit V

**Basic cloning steps and product development.** Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents. Patents, patenting fundamental requirements- patent multicellular organisms, IPR, Copyrights, Trademarks

### SUGGESTED READINGS

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2<sup>nd</sup> edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2<sup>nd</sup> edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9<sup>th</sup> edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2<sup>nd</sup> edition, Rastogi Publications.
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2<sup>nd</sup> edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4<sup>th</sup> edition, ASM Press.
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2<sup>nd</sup> edition, Elsevier Science.
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2<sup>nd</sup> edition. Sinauer associates, Inc.

19MBU504B

## INHERITANCE BIOLOGY

Semester – V  
(3H – 3C)

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

## COURSE OBJECTIVE

- To make students understand the principles of Genetics and inheritance biology.
- understand that genes are the units of inheritance for individual characteristics and also may contribute to susceptibility to certain diseases
- understand the number of chromosomes that make up the human genome and where they are located within the cell
- understand the role of the X and Y chromosomes in determining sex and how they are inherited.
- understand how gametes are produced by the process of meiosis and how the full complement of 46 chromosomes is restored at fertilisation
- To identify and describe the process and purposes of the cell cycle, meiosis, and mitosis, as well as predict the outcomes of these processes..

## COURSE OUTCOME

1. This paper imparts knowledge on the different aspects of genetics and pedigree analysis.
2. Understand the central dogma of molecular biology and the genome of prokaryotic and eukaryotic microorganisms.
3. To gain knowledge about the microbial genetics and central dogma of molecular biology
4. Students will understand the cellular components underlying mitotic cell division.
5. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
6. To describe applications and techniques of modern genetic technology, as well as select the correct techniques to solve practical genetic problems.

## Unit I

General introduction to inheritance biology. Historical developments: Model organisms in genetic analyses and experimentation: *Escherichia coli*, *Saccharomyces cerevisiae*, *Neurospora crassa*, *Caenorhabditis elegans*, *Drosophila melanogaster*, *Arabidopsis thaliana*.

## Unit II

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity.

## Unit III

Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping Homologous and non-homologous recombination, including transposition, site-specific recombination.

#### **Unit IV**

Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in *Chlamydomonas*, mitochondrial, mutations in *Saccharomyces*, Maternal effects – Shell coiling in *Limnaea peregra* Infectious heredity - Kappa particles in *Paramecium*. Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.

#### **Unit V**

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities -Klinefelter syndrome, Turner syndrome, Down syndrome.

#### **SUGGESTED READINGS**

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8<sup>th</sup> Ed. Wiley-India.
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6<sup>th</sup> Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3<sup>rd</sup> Ed. McGraw-Hill Education.
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10<sup>th</sup> Ed. Benjamin Cummings.
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9<sup>th</sup> Ed. W.H. Freeman and Co., New York.
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7<sup>th</sup> Ed, Jones and Bartlett Publishers.
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3<sup>rd</sup> Ed, Benjamin Cummings.

19MBU511A

Semester – V  
(4H – 2C)**MANAGEMENT OF HUMAN MICROBIAL DISEASES - PRACTICAL****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 9 Hours****COURSE OBJECTIVES**

- To provide a strong base in the fundamentals of pathogens.
- To learn techniques and methods used in the cultivation and isolation of pathogens.
- To obtain with the knowledge about the habitat and characteristics of pathogens.
- Program aims to develop students' understanding of medical microbiology with hand on experience in the isolation of the bacteria from different sources.
- It gives the knowledge about the pathogenicity, understanding the biofilm formation in bacteria, role of biofilm in pathogenicity and their antibiotics resistance pattern of pathogenic bacteria which is useful for public awareness.
- The objective of this course is to instill awareness on basics of immune system where students will learn the components of immunity and various immune responses that work together to protect the host.

**COURSE OUTCOME**

1. Involves the identification, classification, and characterization of pathogenic species.
2. This paper imparts **employability** in hospital laboratories.
3. Properly use aseptic techniques, including sterilization. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria.
4. Basics in microbiology course is designed as an interdisciplinary course to acquaint the students of different streams with a very basic knowledge and understanding of
5. microbes, pathogens and their control Learning methods for antimicrobial susceptibility testing
6. In this course the students will observe and perform experiments related to clinical microbiology and virology which will enhance their laboratory skills, and scientific knowledge.

**EXPERIMENTS**

1. Diagnosis of respiratory tract disease.
2. Diagnosis of urinary tract disease.
3. Diagnosis of gastrointestinal tract disease.
4. Identification of dermatophytes

**SUGGESTED READINGS**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8<sup>th</sup> edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication.
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.



**19MBU511B****Semester – V  
(4H – 2C)****MICROBIOLOGICAL ANALYSIS OF AIR AND WATER – PRACTICAL****Instruction Hours / week: L: 0 T: P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 9 Hours****COURSE OBJECTIVES**

- Impart knowledge microflora of air and water, sample collection, analysis and control of diseases.
- Explain the significance of air Microflora and airborne diseases
- Gain knowledge about water pollution and waste water treatments.
- Learning the basic principles of environment microbiology and be able to apply these principles to understanding and solving problems in current environmental, air and water issues.
- Validation for equipment, methods, cleaning and process
- Students can develop their entrepreneurial skills in analysis of air and water sample

**COURSE OUTCOME**

1. This paper teaches different laboratory **skills** of analyzing air and water.
2. Hand on training of the general equipment used in microbiology laboratory
3. Develop capability to perform different gene transfer methods in microbes
4. Characterization of microorganisms from water and air samples
5. Enumeration of bacteria and fungi from air by membrane filtration technique
6. Gain knowledge about water pollution and waste water treatments

**EXPERIMENTS**

1. Enumeration of indoor and outdoor microflora of air (bacteria and fungi) by settle plate method.
2. Enumeration of bacteria and fungi from air by membrane filtration technique.
3. Microbicidal effect of UV light.
4. Evaluation of disinfectants – Phenol coefficient method.
5. MPN test.
6. Enumeration of bacteria and fungi from water by membrane filtration technique.

**SUGGESTED READINGS**

1. Da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water. A Laboratory Manual, CRC Press.
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press.
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007). Manual of Environmental Microbiology, 3<sup>rd</sup> edition, ASM press.

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19MBU512A	BIOMATHEMATICS AND BIOSTATISTICS - PRACTICAL	Semester – V (4H – 2C)
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**Instruction Hours / week:**L: 0 T: 0 P: 4

**Marks:** Internal: 40 External: 60 Total: 100

**End Semester Exam:** 3 Hours

### **COURSE OBJECTIVES**

- This course has been intended to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use and applications of Biology.
- Statisticians help to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- Statistics helps in the proper and efficient planning of a statistical inquiry in any field of study.
- Statistics helps in providing a better understanding and exact description of a phenomenon of nature.
- To develop students' skills in algebraic manipulation, the calculus of linear and non-linear differential equations, mathematical modelling, matrix algebra and statistical methods.
- To introduce students to the application of mathematical modeling in the analysis of biological systems including populations of molecules, cells and organisms.

### **COURSE OUTCOMES**

1. Students get an idea about collection, interpretation and presentation of statistical data.
2. Statistics help in providing data as well as tools to analyze the data.
3. Some powerful techniques are index numbers, time series analysis, and also forecasting.
4. Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results.
5. To show how mathematics, statistics and computing can be used in an integrated way to analyse biological systems.
6. Conceivably everything dealing with the collection, processing, analysis and interpretation of numerical data belongs to the domain of statistics.

### **List of Experiments (any 10 from the following using any software)**

1. Word Problems based on Differential Equations
2. Calculation of Mean
3. Calculation of Median
4. Calculation of Mode
5. Finding Standard Deviation and Coefficient of Variation
6. Calculation of Correlation Coefficient using Karl Pearson Methods
7. Calculation of Correlation Coefficient using Spearman
8. Problems based on Regression Coefficient
9. Finding area under the curve using normal probability
10. Testing of Hypothesis for large sample Z-test
11. Testing of Hypothesis for small sample t-test
12. Testing of Hypothesis using Chi-Square-test

19MBU512B

BIOINFORMATICS - PRACTICAL

Semester – V  
(4H – 2C)

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- Students get an idea about collection, interpretation and presentation of bioinformatics data.
- Develop competence to integrate biological information with computational softwares
- Impart basic understanding of bioinformatics approaches for bacterial/viral/fungal identifications and drug design
- Bioinformatics is the application of computer technology to get the information that's stored in certain types of biological data.
- Bioinformatics provides central, globally accessible databases that enable scientists to submit, search and analyse information.
- A sound knowledge on procedural repertoire allows students to innovatively apply these in basic and applied fields of biological research

**COURSE OUTCOME**

1. This course has been intended to provide the learner insights into helpful areas of Bioinformatics which plays an essential role in application-oriented biology.
2. Provides computational skill on search engines and various software tools involved in bioinformatics
3. Learning methods for designing primers and in-silico PCR
4. Develop competence to retrieve information from biological databases and integrate this biological information with computational softwares.
5. Design an experiment with step-by-step instructions to address a research problem
6. Technical know-how on versatile techniques in bioinformatics techniques

**EXPERIMENTS**

1. Introduction to different operating systems - UNIX, LINUX and Windows
2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
3. Sequence retrieval using BLAST
4. Sequence alignment & phylogenetic analysis using clustalW & phyip
5. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool
6. Protein structure prediction: primary structure analysis, secondary structure prediction using psi- pred, homology modeling using Swissmodel. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK)
7. Prediction of different features of a functional gene

**SUGGESTED READINGDS**

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition.
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell.

**19MBU513A INSTRUMENTATION AND BIOTECHNIQUES – PRACTICAL****Semester – V  
(4H – 2C)****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- Understand the principles of various instruments used in the life sciences.
- Ability to operate the instruments.
- Data analysis and interpretations.
- Appreciate the working principles and applications of Microscopy.
- Understand the mechanics of thesis writing
- To understand working of different laboratory equipment used in microbiological laboratories

**COURSE OUTCOME**

1. Offers the students with an opportunity to gain practical skills on the bioinstrumentation and concepts of principles and applications.
2. Evaluate the various types & applications of chromatography and electrophoresis.
3. Evaluate the various types & phase contrast microscopy and Electron microscopy
4. Explain the various separation techniques and its instrumentation.
5. Hand on training of the general equipment used in microbiology laboratory
6. Comprehend the major spectrophotometric and titrimetric approaches of quantification in biological and environmental samples

**EXPERIMENTS**

1. Study of fluorescent micrographs to visualize bacterial cells – Demonstration
2. Ray diagrams of phase contrast microscopy and Electron microscopy – Demonstration
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Determination of  $\lambda_{max}$  for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Understanding density gradient centrifugation with the help of pictures.

**SUGGESTED READINGS**

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> edition, Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5<sup>th</sup> edition, W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition, McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8<sup>th</sup> edition. Lipincott Williams and Wilkins, Philadelphia.

6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. (2007). Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

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19MBU513B	PLANT PATHOLOGY – PRACTICAL	Semester – V (4H – 2C)
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Instruction Hours / week:L: 0 T: 0 P: 4

Marks: Internal: 40 External:60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- This paper aims at introducing students to the basic and applied aspects of plant biotechnology.
- Introduce students to the basic principles and concepts of plant pathology.
- Introduce and illustrate the major groups of organisms that cause plant diseases
- Provide a framework that students can use in their profession to best approach plant disease management.
- To study the importance of plant diseases and cutting sections of infected plant material
- To acquaint with different strategies for management of plant diseases.

**COURSE OUTCOME**

1. This will enable for learning the techniques to save endangered species which will be useful for mankind.
2. Identify major principles of plant pathology.
3. Demonstration of fungal, bacterial and viral plant pathogens.
4. Recognize the etiological agents of disease.
5. Employ methods to diagnose and manage a wide range of plant diseases.
6. To teach the students about the different groups of insects that vector plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases

**EXPERIMENTS**

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
2. Study of important diseases of crop plants by cutting sections of infected plant material - *Albugo*, *Puccinia*, *Ustilago*, *Fusarium*, *Colletotrichum*.

**SUGGESTED READINGS**

1. Agrios GN. (2006). Plant Pathology.5th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens.3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India.4th edition.Prentice Hall of India Pvt. Ltd., New Delhi.
5. Singh RS. (1998). Plant Diseases Management.7th edition. Oxford & IBH,Delhi.

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19MBU514A	MICROBIAL BIOTECHNOLOGY - PRACTICAL	Semester – V (3H – 1C)
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Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 6 Hours

**COURSE OBJECTIVE**

- To make students understand the aspects of industrial, soil, environmental, agricultural microbiology.
- To understand the methods for Production of industrially important compounds from fungal source.
- This paper is designed to provide an exposure to the students about the potential of fungi as food and in field of biotechnology as source of different enzymes, secondary metabolites, vitamins, polysaccharides, polyhydric alcohols, pigments and lipids.
- Develop an understanding of various aspects of bioprocess technology.
- Evaluate nanotechnology and microbial production of therapeutic compounds
- The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program

**COURSE OUTCOME**

1. Impart knowledge on applications of microorganisms in various fields
2. Provides skill development on microbial products.
3. To study the immobilization techniques and fungal pigment production.
4. Develop a xylanase and lipase production technology.
5. Demonstration of algal single cell proteins.
6. State of art knowledge about various methodological and analytic approaches that are used within the specialization.

**EXPERIMENTS**

1. Study yeast cell immobilization in calcium alginate gels and storage stability.
2. Study enzyme immobilization by sodium alginate method and storage stability.
3. Study of cell viability and enzyme estimation
4. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*).
5. Isolation of xylanase or lipase producing bacteria.
6. Study of algal Single Cell Proteins.
7. Study the stability of various formulation- powder, liquid, cream (additives, carriers at different pH, moisture, temperature and shelf life)

**SUGGESTED READINGS**

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2<sup>nd</sup> edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2<sup>nd</sup> edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current
4. Opinion in Biotechnology, 12, 195–201.
5. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9<sup>th</sup> edition, Mc Graw Hill Publishers.
6. Gupta PK (2009) Elements of Biotechnology 2<sup>nd</sup> edition, Rastogi Publications.

7. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2<sup>nd</sup> edition, Cambridge University Press.
8. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4<sup>th</sup> edition, ASM Press.
9. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2<sup>nd</sup> edition, Elsevier Science.
10. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2<sup>nd</sup> edition Sinauer associates, Inc.



19MBU514B

INHERITANCE BIOLOGY - PRACTICAL

Semester – V  
(3H – 1C)

Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 6 Hours

**COURSE OBJECTIVE**

- To make students understand the principles of Genetics and inheritance biology.
- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels
- Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.
- Describe the principal cell types comprising each tissue system
- Identify location and function of apical meristems, and describe their general structure
- Explain DNA repair and recombination in terms of mutation and evolution
- The objective of the course is to make student understand about the structure and function of biologically important molecules

**COURSE OUTCOME**

1. Imparts knowledge on the different aspects of genetics and pedigree analysis.
2. Students will understand the cellular components underlying mitotic cell division
3. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.
4. Identify the organs and tissue systems of plants, and explain their respective function
5. Understand how molecular cell biology forms the foundation of biotechnology
6. Students will learn about DNA, RNA and the molecular events that govern cell functions

**EXPERIMENTS**

1. Mendelian deviations in dihybrid crosses
2. Studying Barr Body with the temporary mount of human cheek cells
3. Studying *Rhoeo* translocation with the help of photographs
4. Karyotyping with the help of photographs
5. Chi-Square Analysis
6. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas / Drosophila* larvae
7. Study of pedigree analysis
8. Analysis of a representative quantitative trait

**SUGGESTED READINGS**

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6<sup>th</sup> Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3<sup>rd</sup> Ed. McGraw-Hill Education.
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10<sup>th</sup> Ed. Benjamin Cummings.
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9<sup>th</sup> Ed. W.H. Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers.
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings.

**Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To evaluate the biology and health benefits of mushrooms.
- To encode the importance of the role of microorganisms in food industries
- To obtain a good understanding of production and multiplication of spawn by different composting techniques.
- To obtain knowledge in harvest, storage, marketing and economic impacts on mushroom cultivation.
- To gain knowledge about nutritional profile and medicinal properties of mushroom.
- To obtain knowledge in depth the problem in mushroom cultivation

**COURSE OUTCOME**

1. Able to Know the architecture of mushrooms
2. To know the methods used to cultivate mushroom.
3. Students are able to predict where the mushroom placed in vegetable kingdom
4. Able to cultivate mushrooms from agricultural waste.
5. Have an idea about packaging and storing.
6. Have understand nutritional value of mushrooms.

**Unit I**

Mushroom morphology: Different parts of a typical mushroom and variations in mushroom morphology. Key to differentiate edible from poisonous mushrooms. Mushroom Classification: Based on occurrence – Epigenous and hypogenous, Natural habitats – Humicolous, Lignicolous & Coprophilous, Color of spores – white, yellow, pink, purple brown and black. Ainsworth et al classification (8<sup>th</sup> edition) and Bisby's 'Dictionary of Fungi'.

**Unit II**

Biology of Mushrooms: Vegetative characters, general morphology, spore germination and life cycle of button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea*).

**Unit III**

Equipment and sterilization techniques. Isolation and culture of spores, culture media preparation. Production of mother spawn, multiplication of spawn – Inoculation technique – Cultivation technology – Substrates, composting technology, bed, polythene bag preparation, spawning – casing – cropping – Mushroom production – harvest – packing, storage and marketing.

**Unit IV**

Nutritional profile of Mushrooms: protein, amino acids, calorific values, carbohydrates, fats, vitamins & minerals. Medicinal Properties of Mushrooms: Antibacterial, antifungal, antiviral, anti-tumour effect and hematological value. Cardiovascular and renal effect, in therapeutic diets, adolescence, for aged persons and diabetes mellitus. Mushroom nutraceuticals.

**Unit V**

Problems in cultivation – diseases, pests and nematodes, weed moulds and their management strategies. Mushroom economics: economics of spawn and mushroom, cultivation, postharvest technologies. Processing and preservation of mushrooms. Mushroom research centres in India.

### **SUGGESTED READINGS**

1. Alice, D., Muthusamy and Yesuraja, M. (1999). Mushroom Culture. Agricultural College, Research Institute Publications, Madurai.
2. Marimuthu, T. et al. (1991). Oyster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
3. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
5. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.

19MBU601B

**FOOD FERMENTATION TECHNIQUES****Semester – VI**  
**(4H – 4C)****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVES**

- To encode the importance of the role of microorganisms in food industries in beneficial ways.
- To Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
- To Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
- To Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
- To Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation

**COURSE OUTCOME**

1. Students Imparts knowledge on various microorganisms involved in food fermentation and develops the [skills](#) on Fermented Foods and production process.
2. Students able to Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation
3. Understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food
4. Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.
5. Have knowledge in fermented products and the role of microorganisms.
6. Able to discriminate pathogens and legatee.

**Unit I**

Introduction and scope of Fermentation Technology, Role of microorganism in fermentation process, History and development of fermentation technology, Health benefits of fermented foods.

**Unit II**

Design of Fermenter, Types of fermentation process - Batch fermentation, Fed-batch fermentation, Continuous fermentation, Solid state fermentation; Types of Fermenters – Tray fermenter, Packed bed column fermenter, Airlift fermenter, Tower fermenter, Stirred tank fermenter, Bubble column fermenter, Cyclone column fermenter.

**Unit III**

Diary based products – Cheese, Yoghurt, Buttermilk, Kefir; Fruit based products – Cider, Wine, Vinegar; Vegetable based products – Sauerkraut, Kimchi, Pickle; Grain based products – Beer, Idli, Dosa, Sourdough, Bread: Preparation of inoculums, types of microorganisms and production process.

**Unit IV**

Bean based products – Soy Sauce, Tempeh, Miso, Natto; Meat based products- Salami, Chorizo; Fish based products – Bagoong, Fish sauce: Preparation of inoculums, types of microorganisms and production process.

## **Unit V**

Management of food safety and quality, Control of hazards in food handling and food processing, Food Additives, Food Allergens, Food packaging and Labeling, Food Storage and Transportation, Food safety Programmes (HACCP), Food safety and standard Authority of India (FSSAI), FDA.

### **SUGGESTED READINGS**

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press.
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan.
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7<sup>th</sup> edition. Springer.

19MBU602A

BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS

Semester – VI  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

- To learn the basic handling of microorganisms.
- To understand the various biological containments.
- To emphasize on IPR issues and need for knowledge in patents in biotechnology.
- The ethical and philosophical issues associated with international agreements.
- Various modes of presenting and disseminating patent licensing and agreements.
- Enable students to acquire expertise in the use and application of the methods of data collection and analysis..

**COURSE OUTCOME**

1. Provides knowledge on safety aspects in biological laboratory and to create awareness on the Intellectual property rights and patenting of biotechnological processes.
2. To gain knowledge on steps of a patenting process and the role of biosafety committee.
3. To emphasize the components and design of laboratory.
4. Provide learning opportunities to critically evaluate research methodology and findings
5. Enable students to acquire expertise in the use and application of the methods of data collection and analysis.
6. Enable students to be reflexive about their role and others' roles as researchers

**Unit I**

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.

**Unit II**

Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

**Unit III**

AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions. Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

**Unit IV**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPRO).

## **Unit V**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

### **SUGGESTED READINGS**

1. Bare Act, (2007). Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson.

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19MBU602B MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT

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Semester – VI  
(4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

**COURSE OBJECTIVE**

- The goal of sustainable agriculture is to meet society's food and textile needs in the present without compromising the ability of future generations to meet their own needs.
- Able to evaluate the application of ecological principles and concepts in sustainable agriculture system.
- To know the role of microbes which make crop output more and increase the fertility of crops.
- To know the basics and concepts of various biotechnological related terms
- To know the physiological processes that occur during plant growth and development of methodology involved in plant growth
- To make them to understand issues related to plant nutrition, quality improvement, environmental adaptation, transgenic crops and their use in agriculture

**COURSE OUTCOME**

1. Develops the programmatic activities in sustainable agriculture and food systems
2. Able to relate their knowledge about ecology to its relevance in sustainable agriculture
3. Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field.
4. Understand on soil characteristics and biogeochemical cycling.
5. Students able to the uses of microorganisms as bio control agents.
6. Understand transgenic crops and their use in agriculture.

**Unit I**

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil, Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

**Unit II**

Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

**Unit III**

Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds.

**Unit IV**

Plant growth promoting bacteria, biofertilizers – symbiotic (*Bradyrhizobium*, *Rhizobium*, *Frankia*, VAM, potash solubilizer), Non Symbiotic (*Azospirillum*, *Azotobacter*, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs

**Unit V**

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters, Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.

**SUGGESTED READINGS**

1. Agrios GN. (2006). Plant Pathology. 5<sup>th</sup> edition. Academic press, San Diego.
2. Singh RS. (1998). Plant Diseases Management. 7<sup>th</sup> edition. Oxford & IBH, New Delhi.



3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4<sup>th</sup> edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings SciencePublishing, USA.
5. Maier RM, Pepper IL and Gerba CP. (2009).Environmental Microbiology.2<sup>nd</sup> edition, Academic Press.
6. Barton LL & Northup DE (2011). Microbial Ecology.1st edition, Wiley Blackwell, USA.
7. Campbell RE. (1983). Microbial Ecology.Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002).Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

19MBU603A

CELL BIOLOGY

Semester – VI  
(3H – 3C)

Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 3 Hours**COURSE OBJECTIVES**

- To study cell structure and functions of organelle.
- Exposure on transportations through cell membrane.
- To focus on different receptors and model of signaling.
- To introduce the concept of cell signaling.
- To obtain knowledge in cell death and cell renewal.
- To gain knowledge in structural aspects of cells.

**COURSE OUTCOME**

1. Basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.
2. Students able to annotating cell organization of prokaryotic and Eukaryotic.
3. Students able to paraphrase cell death and cell renewal.
4. Able to bullet pointing protein sorting and transport
5. Expertise in interpreting cell internal organelles.
6. Knowledge in induced pluripotent stem cells

**Unit I**

Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic. Plasma membrane: Structure and transport of small molecules. Cell Wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects). Mitochondria, chloroplasts and peroxisomes. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.

**Unit II**

Nuclear envelope, nuclear pore complex and nuclear lamina. Chromatin – Molecular organization. Nucleolus.

**Unit III**

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids. Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Lysosomes.

**Unit IV**

Signalling molecules and their receptors. Function of cell surface receptors. Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway.

**Unit V**

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes and types, Programmed cell death, Stem cells, Embryonic stem cell, induced pluripotent stem cells.

### **SUGGESTED READING**

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Instruction Hours / week: **L: 3 T: 0 P: 0****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****COURSE OBJECTIVE**

- . To provide an experience for the students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology.
- To impart information on the historical developments in Molecular Biology
- An in-depth study on structure and organization of chromosome and mutagenesis.
- To expose the students on the basic understanding of various techniques used in molecular studies.
- To gather information to know mechanism of DNA replication.
- To gain the knowledge of translational machinery in prokaryotes and eukaryotes

**COURSE OUTCOME**

1. Explores technologies using molecular biology, embryo manipulation, cell and tissue culture.
2. Manipulate the genomes of animals for ways to improve the live stock for food production and biomedical purpose.
3. Develop the [skills](#) in molecular biology.
4. Executing concept of RNA splicing and mRNA and its significance.
5. Students able to inferring various model of DNA replication
6. Students able to contrast translational machinery.

**Unit I**

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA Structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

**Unit II**

Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends. Various models of DNA replication including rolling circle, D- loop (mitochondrial), (theta) mode of replication and other accessory protein, Mismatch and excision repair. [CRISPR](#).

**Unit III**

Transcription: Definition, difference from replication, promoter - concept and strength of promoter RNA Polymerase and the transcription unit, Transcription in Eukaryotes: RNA polymerases, general Transcription factors. Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si RNA, miRNA and its significance

**Unit IV**

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote

**Unit V**

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons, Sporulation in *Bacillus*, Yeast mating type switching , Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

### **SUGGESTED READINGS**

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6<sup>th</sup> edition, Cold Spring Harbour Lab. Press, Pearson Publication.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertonni GP (2009) The World of the Cell, 7<sup>th</sup> edition, Pearson Benjamin Cummings Publishing, San Francisco.
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6<sup>th</sup> edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4<sup>th</sup> Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3<sup>rd</sup> Ed., Jones and Bartlett Learning.
7. Gardner EJ, Simmons MJ, Snustad DP (2008). ). Principles of Genetics. 8<sup>th</sup> Ed. Wiley-India.

**19MBU611A****MUSHROOM CULTIVATION - PRACTICAL****Semester – VI  
(4H – 2C)****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 6 Hours****COURSE OBJECTIVES**

- To teach on cultivation, diseases and health benefits of mushrooms.
- To provide practical knowledge of different sterilization procedures and learn handling of mushrooms.
- To enhance the student's knowledge and impress upon them the important aspects of mushroom.
- To understand to know pure culture techniques and methods of culturing preservation and maintenance of mushrooms.
- To make the students more knowledge on mushroom cultivation.
- To make the students to know the classification.

**COURSE OUTCOME**

1. To impart knowledge on various mushrooms and its cultivation techniques to become an entrepreneur.
2. Students able to predict classification of edible mushroom.
3. Able to cultivate spawn from waste materials.
4. Have a knowledge in sterilization and handling of mushroom.
5. Students understand the application of mushroom biotechnology.
6. Students understand the characteristics and importance of mushrooms

**EXPERIMENTS**

1. Oyster cultivation and demonstration of Button mushroom cultivation
2. Tissue isolation and sub culturing
3. Spawn making using sorghum
4. Fruiting bags production – preparing beds (chopping and sterilization of straw)
5. Field trip to commercial mushroom farms and scientific institutions.

**SUGGESTED READINGS**

1. Alice, D., Muthusamy and Yesuraja, M. (1999). Mushroom Culture. Agricultural College, Research Institute Publications, Madurai.
2. Marimuthu, T. et al. (1991). Oyster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
3. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.
5. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
6. Tripathi, D. P. (2005). Mushroom Cultivation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

19MBU611B

**FOOD FERMENTATION TECHNIQUES – PRACTICAL****Semester – VI  
(4H – 2C)****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 6 Hours****COURSE OBJECTIVES**

- To encode the importance of the role of microorganisms in food industries in beneficial ways.
- Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
- To learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
- To Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation
- To Understand the use of standard methods and procedures for the microbiological analysis of food
- Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

**COURSE OUTCOME**

1. To impart knowledge on various microorganisms involved in food fermentation.
2. To nurture the student to gain employability in industrial area.
3. Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
4. Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products
5. Have an idea to isolate beneficial microorganisms from spoiled food.
6. Identify methods to control deterioration and spoilage

**EXPERIMENTS**

1. Preparation of Yogurt.
2. Preparation of Sauerkraut.
3. Beer production.
4. Wine production.
5. Isolation of Microbes from spoiled Meat and Fish.

**SUGGESTED READINGS**

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press.
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan.
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7<sup>th</sup> edition. Springer.

**Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 6 Hours****COURSE OBJECTIVES**

- To learn the basic handling of microorganisms.
- To understand the various biological containments.
- To emphasize on IPR issues and need for knowledge in patents in biotechnology.
- To gain knowledge on steps of a patenting process and the role of biosafety committee.
- To emphasize the components and design of laboratory.
- Provide learning opportunities to critically evaluate research methodology and findings

**COURSE OUTCOME**

1. Able to understand safety aspects in biological laboratory.
2. To create awareness on the Intellectual property rights and patenting of biotechnological processes.
3. To equip students with a basic understanding of the underlying principles of quantitative and qualitative patenting methods.
4. Provide students with in-depth training on the conduct and management of patent filing from inception
5. Enable students to acquire expertise in the use and application of the methods of data collection and analysis.
6. Enable students to be reflexive about their role and others' roles as researchers.

**EXPERIMENTS**

1. Study of components and design of a BSL-III laboratory
2. Filing applications for approval from biosafety committee
3. Filing primary applications for patents
4. Study on steps of a patenting process

**SUGGESTED READINGS**

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson.



**19MBU612B MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT – PRACTICAL(4H – 2C)****Instruction Hours / week:L: 0 T: 0 P: 4****Marks: Internal: 40 External:60 Total: 100  
End Semester Exam: 6 Hours****COURSE OBJECTIVES**

- Able to relate their knowledge about ecology to its relevance in sustainable agriculture
- Able to evaluate the application of ecological principles and concepts in sustainable agriculture system.
- To know the role of microbes which make crop output more and increase the fertility of crops.
- To analyses the degrading microorganisms by various techniques.
- Able to design biogas plant.
- To obtain knowledge in entrepreneur in agricultural area.

**COURSE OUTCOME**

1. Able to relate their knowledge about ecology to its relevance in sustainable agriculture
2. Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field.
3. Able to device biogas plant
4. Students will be annotate various zone in soil profile
5. Students will be isolate various degrading microorganisms for agricultural use.
6. Criticize the role of soil microbes in crop production.

**EXPERIMENTS**

1. Study and enumeration of soil microorganisms: Bacteria, fungi and actinobacteria
2. Study microflora of different types of soils
3. *Rhizobium* as soil inoculants characteristics and field application
4. *Azotobacter* as soil inoculants characteristics and field application
5. Design and functioning of a biogas plant
6. Isolation of cellulose degrading organisms, urea decomposers and nitrate utilizers
7. Screening of bacterial isolates for PHB production by using “Sudan black B” method
8. Estimation of soil microbial activity- CO<sub>2</sub> evolution method

**SUGGESTED READINGS**

1. Agrios GN. (2006). Plant Pathology.5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management.7th edition.Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4<sup>th</sup> edition, ASM Press.
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition.Benjamin/Cummings Science Publishing, USA.
5. Maier RM, Pepper IL and Gerba CP. (2009).Environmental Microbiology.2nd edition, Academic Press.
6. Barton LL & Northup DE (2011). Microbial Ecology.1st edition, Wiley Blackwell, USA.
7. Campbell RE. (1983). Microbial Ecology.Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, 1st edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002).Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012). Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

19MBU613A

CELL BIOLOGY - PRACTICAL

Semester – VI  
(3H – 1C)

Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 6 Hours**COURSE OBJECTIVES**

- To study cell structure and functions of organelle.
- Exposure on transportations through cell membrane.
- To focus on different receptors and model of signaling.
- To introduce the concept of cell signaling.
- The course will facilitate in understanding of cell biology by examining common processes and principles in cells.
- Knowledge about detailed structure of cell organelles and electron micro graphs.

**COURSE OUTCOME**

1. To understand the basic concept of cell structure, membrane, cellular functions of different types of cell
2. Able to analyses modes of cellular signaling and signal amplification.
3. Able to categorize cell internal organs.
4. Able to retrieve polypoid stage in vegetables
5. Able to predict cancer cells through photomicrograph
6. Knowledge about detailed structure of cell organelles and electron micro graphs.

**EXPERIMENTS**

1. Study a representative plant and animal cell by microscopy.
2. Study of the structure of cell organelles through electron micrographs.
3. Cytochemical staining of DNA – Feulgen.
4. Demonstration of the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B.
5. Study of polyploidy in Onion root tip by colchicine treatment.
6. Identification and study of cancer cells by photomicrographs.
7. Study of different stages of Mitosis.
8. Study of different stages of Meiosis.

**SUGGESTED READINGS**

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

19MBU613B

MOLECULAR BIOLOGY - PRACTICAL

Semester – VI  
(3H – 1C)

Instruction Hours / week: L: 0 T: 0 P: 3

Marks: Internal: 40 External: 60 Total: 100  
End Semester Exam: 6 Hours**COURSE OBJECTIVE**

- To provide an experience for the students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology.
- The course will facilitate in understanding of molecular biology by examining common processes and principles in genes to illustrate complexity.
- To obtain knowledge in resolution and visualization of proteins
- To evaluate genetic material in different samples.
- The student will receive hands-on training in various culturing and molecular techniques for studying microbial diversity and microbial activity.
- To introduce the student to the advanced concepts in molecular biology

**COURSE OUTCOME**

1. Explores technologies using molecular biology, cell and tissue culture to manipulate the genomes of animals for ways.
2. Develop the **skills** in molecular biology.
3. Students are capable of explaining process involved in genetic changes and mutations
4. The identification of genetic regulatory mechanism
5. Students are able to distinguish different mechanism of gene regulation
6. The design of different techniques based on utilizing the genetic mechanism of microbes.

**EXPERIMENTS**

1. Study of different types of DNA and RNA using micrographs and model / schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic representations.
3. Isolation of genomic DNA from *E. coli*.
4. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylaminereagent) or UV spectrophotometer (A260 measurement).
5. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement).
6. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
7. **Estimation of protein** by Lowery's method
- 8 Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

**SUGGESTED READINGS**

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4<sup>th</sup> Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.

**19MBU691****PROJECT****Semester – VI  
(8H - 6C)****Instruction Hours / week:L: 8 T: 0 P: 0****Marks: Internal: 40 External: 60 Total: 100**