CAUVERY COLLEGE FOR WOMEN(AUTONOMOUS)

NATIONALLY ACCREDITED (III CYCLE) WITH "A" GRADE BY NAAC

TIRUCHIRAPPALLI – 18

SYLLABUS

FOR

B.Sc., MICROBIOLOGY

2019-2022

PROGRAMME EDUCATIONAL OBJECTIVES

- Our program will produce graduates to impart skill-oriented education
- To provide quality education with innovative technology to gain technical expertise
- To enrich the ambitions of our students to steer with constructive collaboration to wards excellence

PROGRAMME OUTCOMES

1. Enable students to acquire expertise in the use and application of various methods used in microbiology
2. Provide learning opportunity to be reflective about their role as are searcher
3. Handle and independently work on lab protocols involving molecular techniques
4. Awareness of ethical issues in Microbiology research and career options.
5. Production of substantial original research of significance and quality sufficient for publications.

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

TIRUCHIRAPPALLI -620018

B.Sc., Microbiology Course Structure

(For the candidates admitted from the academic year2019-2020onwards)

SEM.	PART	COURSE	TITLE	SUBJECTCODE	INST. HOURS / WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL
								INT	EXT	
I	I	Language Course–I (LC)–	Tamil*/Other	19ULT1/H1/F1/S1	6	3	3	25	75	100
	II	English Language	English	19UE1	6	3	3	25	75	100
	III	Core Course–I (CC)	General Microbiology	19UMB1CC1	6	6	3	25	75	100
		Core Practical–I(CP)	General Microbiology &Microbial Physiology Practicals	19UMB1CC1P	3	-	-		-	-
		First Allied	Fundamentals of Biochemistry -I	19UMB1AC1	4	4	3	25	75	100
		First Allied Practical–II(AP)	Fundamentals of Biochemistry I &II Practicals	19UMB1AC1P	3	-	-	-	-	-
	IV	Value Education		19UGVE	2	2	3	25	75	100
			TOTAL		**30**	**18**				**500**
II	I	Language Course–II(LC)–	Tamil*/Other Languages	19ULT2/H2/F2/S2	6	3	3	25	75	100
	II	English Language Course–II(ELC)	English	19UE2	6	3	3	25	75	100
	III	Core Course–II(CC)	Microbial Physiology	19UMB2CC2	6	6	3	25	75	100
		Core Practical–I(CP)	General Microbiology & Microbial Physiology Practical	19UMB1CC1P	3	3	3	40	60	100
		First Allied Practical–II(AP)	Fundamentals of Biochemistry I &II Practicals	19UMB1AC1P	3	3	3	40	60	100
		First Allied Course–III(AC)	Fundamentals of Biochemistry-II	19UMB2AC2	4	2	3	25	75	100
	IV	Environmental		19UGES	2	2	3	25	75	100

		Studies								
			TOTAL		**30**	22	-	-	-	**700**
III	I	Language Course– II (LC)–	Tamil*/Other Languages	19ULT3/H3/F3/S3	6	3	3	25	75	100
	II	English Language Course-	English	19UE3	6	3	3	25	75	100
	III	Core Course – III (CC)	Introductory Virology	19UMB3CC3	6	6	3	25	75	100
		Core Practical– II (CP)	Introductory Virology & Immunology Practicals	19UMB3CC2P	3	-	-	-	-	-
		Second Allied Course–I (AC)	Biostatistics	19UMB3AC3	4	4	3	25	75	100
		Second Allied Practical-II (AP)	Biostatistics and Bioinformatics Practicals	19UMB3AC2P	3	-	3	-	-	-
	IV	Non Major Elective I-for those who studied Tamil under Part-I	Herbal Medicine a)Basic Tamil for otherlanguage students b)Special Tamil for those who studied Tamil upto +2 but opt for other languages in degree Programme	19UMB3NME1 19ULC3BT1 19ULC3ST1	2	2	3	25	75	100
	V	Extra Credit Course	Swayam Online Course	To be fixed later	As per UGC Recommendation					
			TOTAL		**30**	**18**	-	-	-	**500**
IV	I	Language Course–IV(LC)-	Tamil*/Other Languages	19ULT4/H4/F4/S4	6	3	3	25	75	100
	II	English Language Course– IV(ELC)	English	19UE4	6	3	3	25	75	100
	III	Core Course – IV (CC)	Immunology	19UMB4CC4	5	5	3	25	75	100
		Core Practical– II (CP)	Introductory Virology & Immunology Practicals	19UMB3CC2P	3	3	3	40	60	100
		Second Allied Practical-II(AP)	Biostatistics and Bioinformatics Practicals	19UMB3AC2P	3	3	3	40	60	100
		Second Allied Course-III(AC)	Computer Application in Biology	19UMB4AC4	3	2	3	25	75	100
	IV	Non Major Elective II-for those who studied Tamil under Part I	Pharmacognosy a)Basic Tamil for otherlanguage students b)Special Tamil for those who studied Tamilupto +2 but opt for other languages in degree programme	19UMB4NME2 19ULC4BT2	2	2	3	25	75	100

		Skill Based Elective-I	(A) Mushroom Technology (B) Clinical Parasitology	19UMB4SBE1A 19UMB4SBE1B	2	2	3	25	75	100
	V	Extra credits Course	SWAYAM Online Course	To be fixed later	As per UGC Recommendation					
				TOTAL	**30**	**23**	**-**	**-**	**-**	**800**
V	III	Core Course–V (CC)	Medical Microbiology	19UMB5CC5	5	5	3	25	75	100
		Core Course–VI (CC)	Agricultural Microbiology	19UMB5CC6	5	5	3	25	75	100
		Core Course–VII (CC)	Molecular Biology	19UMB5CC7	6	5	3	25	75	100
		Core Practical-III (CP)	Medical Microbiology, Agricultural Microbiology Molecular Biology-Practicals	19UMB5CC3P	3	3	3	40	60	100
		Major Based Elective-I	(A)Fundamentals of Botany and Zoology	19UMB5MBE1A	5	5	3	25	75	100
			(B)Organic Farming	19UMB5MBE1B						
	IV	Skill Based Elective– II Practical	(A) Biofertilizer Technology Practical	19UMB5SBE2AP	2	2	3	40	60	100
			(B) Solid Waste Management Practical	19UMB5SBE2BP						
		Skill Based Elective– III Practical	(A) Medical laboratory Technology Practical	19UMB5SBE3AP	2	2	3	40	60	100
			(B) Vermitechnology Practical	19UMB5SBE3BP						
		UGC jeevan Kaushal Life Skills	Professional Skills	19UGPS	2	2	3	25	75	100
	V	Extra Credit Course	Swayam Online Course	To be fixed later	As per UGC Recommendation					
				TOTAL	**30**	**29**	**-**	**-**	**-**	**800**
VI	III	Core Course – VIII (CC)	Industrial Microbiology	19UMB6CC8	6	6	3	25	75	100
		Core Course – IX (CC)	Food Microbiology	19UMB6CC9	6	6	3	25	75	100
		Core Practical – IV (CP)	Industrial & Food Microbiology - Practicals	19UMB6CC4P	6	5	3	40	60	100
		Major Based Elective-II	(A) Microbial Biotechnology (B) Food Adulteration	19UMB6MBE2A 19UMB6MBE2B	6	6	3	25	75	100
		Major Based Elective-III	(A) Recombinant DNA Technology (B) Biological Techniques	19UMB6MBE3A 19UMB6MBE3B	5	5	3	25	75	100

		Extension		19UGEA	-	1	-	-	-	-
	V	Gender Studies		19UGGS	1	1	3	25	75	100
				TOTAL	**30**	**30**	**-**	**-**	**-**	**600**
				GRANDTOTAL	**180**	**140**	**-**	**-**	**-**	**3900**

CORE COURSE–I (CC)

GENERAL MICROBIOLOGY

Semester I	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB1CC1	**General Microbiology**	**Core**	**90**	**6**	**-**	**6**

Objective:

This subject aims to introduce the history and development of Microbiology. The contents of this course will help students understand history, biology of microorganisms, growth and control of microbes. Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	Recite the Development of Microbiology	K1
CO 2	Explain the Size and Shape of Microorganisms using Microscope	K2
CO 3	Illustrate the knowledge about Bacteria and Viruses	K2
CO 4	Revise the systematic classification of bacteria	K3
CO 5	Apply various technology for microbial cultivation	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNITI : 18 hours

Introduction- Definition, scope and History of Microbiology- theories of spontaneous generation. Domain and kingdom concepts. Microscopy: Principles and applications of brightfield, dark field, phase contrast, fluorescent SEM and TEM.

UNITII : 18 hours

Difference between prokaryotic and eukaryotic microorganisms. Bergey's manual of systemic bacteriology. Structural organization of bacteria – Size, shape and arrangement of bacterial cells - Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores , cysts, plasmid, mesosomes and cytoplasmic inclusions.

UNIT III : 18 hours

General characteristics and nature of Archaeobacteria, Cyanobacteria, Mycoplasma, Rickettsiae, Chlamydia, Spirochaetes, Actinobacteria, Protozoa, Algae, Fungi, lichens and Viruses. Basic understanding of classification of viruses -ICTV, algae - Fritch, fungi –Alexopoulos and protozoa.

UNITIV: 18 hours

Sterilization: Principles and methods – physical moist heat, dry heat, filtration and media preparation. Cultivation of microbes- Types of culture media with specific examples for each type. Aerobic and Anaerobic culture techniques- Pure culture techniques – Methods of maintenance and preservation of microbes. Principles and types of staining– Simple, differential Capsule staining.

UNIT V: 18 hours

Introduction to extremophiles –thermophiles, hyper thermophiles, psychrophiles, halophiles, alkanophiles, acidophiles, methanogenesis and their applications.

Unit - VI: Current Contours: (For Continuous Internal Assessment only) Quiz and Self reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

References:

1. Alcamo IE. Fundamentals of Microbiology, sixth edition, Addison wesley Longman, Inc. California. 2001.

2. Atlas RA and Bartha R. Microbial Ecology. Fundamentals and Application,Benjamin Cummings, New York. 2000.

3. Black JG. Microbiology-principles and explorations, 6th edition.John Wiley and Sons, Inc. New York. 2005.

4. Dubey RC and Maheswari DK. A Text Book of Microbiology. S Chand, New Delhi. 2010

5. Kanika Sharma. Textbook of Microbiology – Tools and Techniques.1st edition, Ane Books Pvt. Ltd., New Delhi. 2011.

6. Madigan MT, Martinko JM, and Parker J. Biology of Microorganisms, 12th Edition, MacMillan Press, England. 2009.

7. Moselio Schaechter and Joshua Leaderberg. The Desk encyclopedia of Microbiology. Elseiver Academic press, California. 2004.

8. Pelczar MJ, Chan ECS and Kreig NR. Microbiology, fifth edition. McGraw- Hill.Book Co.Singapore. 2009.

9. Prescott LM, Harley JP, and Klein DA. Microbiology (7th edition) McGraw Hill, Newyork. 2008.

10. Schlegel HG. General Microbiology, Cambridge University Press, U.K. 2008.

11. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore. 2009.

12. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.

CORE PRACTICALS- I (CC)
GENERAL MICROBIOLOGY & MICROBIAL PHYSIOLOGY–PRACTICALS

Semester I & II	Internal Marks : 40	External Marks : 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB1CC1P	**General Microbiology & Microbial Physiology–Practicals**	**Core Practical**	**45**	**-**	**3**	**3**

Objective:

To enable the students to understand the basic knowledge about Bacterial size,shapes and Gram nature.

Course outcome:

COs	CO Statement	Knowledge level
CO 1	Recall the safety practice in microbiological laboratory	K1
CO 2	Explain the ubiquitous nature of microorganisms	K2
CO 3	Understand the isolation and identification of Bacteria, Actinobacteria, Fungi and Cyanobacteria	K2
CO 4	Prepare various culture media, cleaning of glasswares and sterilization of media	K3
CO 5	Compute various pure culture techniques and biochemical test for identification of bacteria	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

General Microbiology: 30 Hours

1. Safety & Good laboratory practices

2. Basic concepts of Microscope and its operation

3. Principles and operations – Autoclave, Hot Air Oven, Incubators, Laminar Air Flow, Filtration, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer

4. Cleaning and sterilization of glassware.

5. Preparation of culture media – solid, semi-solid and liquid.

6. Demonstration of ubiquitous nature of microorganisms.

7. Measurement of size of microbes – micrometry.

8. Isolation of bacteria, actinobacteria, fungi and cyanobacteria.

9. Enumeration of bacterial numbers by viable count (Plate count) and Total count (Haemocytometer count).

10. Pure culture techniques - Streak plate, Pour plate and Spread plate.

11. Test for motility of bacteria – Hanging drop method

12. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining and LCB.

13. Observation of permanent slides to study the structural characteristics of algae (*Anabena, Nostoc, Spirulina, Oscillotoria), fungi (Pythium, Rhizopus,Saccharomyces, Penicillium, Aspergillus, Agaricus) and protozoa (Entamoebahistolytica and Plasmodium spp.).*

Microbial Physiology: 15 Hours

1. Bacterial growth curve: Cell count/viable count/absorbance (total count)

2. Carbohydrate fermentation tests: Glucose, Lactose, Sucrose and Mannitol.

3. Biochemical test for identification of bacteria: IMViC tests – TSI agar test- Urease- Catalase- Oxidase.

REFERENCES:

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.

2. Gunasekaran P. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.

3. Harry W. Seeley JR, Paul J. Van Demark and John J Lee. Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York. 1997.

4. Kanika Sharma. Manual of Microbiology – Tools and Techniques.2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.

FIRST ALLIED COURSE – I (AC)

FUNDAMENTALS OF BIOCHEMISTRY -I

Semester I	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB1AC1	**Fundamentals of Biochemistry -I**	**Allied**	**60**	**4**	**-**	**4**

Objectives:

To understand the structure, function and interrelationship of various biomolecules and consequences of deviation from normal.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	Recite the views of carbohydrates and their classification	K1
CO 2	Explain the structure of protein	K2
CO 3	Illustrate an idea about structure and function of nucleic acids	K2
CO 4	Relate the structure and properties of lipids	K3
CO 5	Compute view of vitamins and their deficiency diseases	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT I: 12 Hours

Introduction to biochemistry – concepts of macromolecules - Carbohydrate– Definition, sources, classification-monosaccharide, disaccharide and polysaccharide, structure of glucose, biological significance, digestion and absorption.

UNIT II: 12 Hours

Proteins – Definition, sources, classification and structure of proteins - structural and non- structural proteins, Amino acids–structure- classification - essential and nonessential, protein and non-protein amino acids. Biological Significance of Proteins.

UNIT III: 12 Hours

Definition, basic ideas about the biochemical functions of lipids. Classification of lipids with examples, classification of fatty acids, List of Essential and non-essential fatty acids. Compound lipids: Structure and functions of phospholipids and glycolipids, Steroids: C 27, 21, 19 sterols.

UNIT IV: 12 Hours

Nucleic acids – Definition, structure – Nucleoside, Nucleotides, forms and functions of DNA.Types, structure and functions of RNA. Difference between DNA & RNA (mRNA, tRNA, rRNA).

UNIT V: 12 Hours

Vitamins micro and macro minerals and their biological importance – Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A, D, E and K) and Water soluble vitamins (B complex and C).

UNIT VI: Current Contours: (For Continuous Internal Assessment only) Quiz and Self

reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

References:

1. Deb AC. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.

2. AmbikaShanmugam. Fundamentals of Biochemistry for Medical students.Nagaraj and Company Pvt ltd, India. 1998.

3. Thomas M Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley publisher. 2010.

4. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013.

5. Albert L Lehninger, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.

6. Rajagopal G. Concise textbook of biochemistry, 2nd edition, Ahuja Publishing House. 2010.

7. Reginald H Garrett and Charles M Grisham, 5th edition. Biochemistry, Brooks Cole publishers. 2012.

8. Denise R Ferrier. Biochemistry, 6th edition, LWW publishers. 2013.

9. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier publishers. 2013.

10. Rafi MD. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014

FIRST ALLIED PRACTICALS – I (AC)

FUNDAMENTALS OF BIOCHEMISTRY I & II -PRACTICALS

Semester I &II	Internal Marks : 40	External Marks : 60				
Course code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB1AC1P	**Fundamentals of Biochemistry I & II - Practicals**	**Allied Practical**	**45**	**-**	**3**	**3**

Objective:

To understand the structure, functions of various biomolecules and consequences of deviationfrom normal

COs	CO Statement	Knowledge level
CO 1	Identify the carbohydrate, amino acid, protein, lipid and nucleicacid both quantitatively and quantitatively	K1
CO 2	Interpret the amount of ascorbic acid present in the biological sample.	K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**S**	**S**	**S**	**M**	**S**

S- Strong; M-Medium; L-Low

Syllabus:

FUNDAMENTALS OF BIOCHEMISTRY I & II (P):45 hours

1. Qualitative analysis of carbohydrates, amino acids, proteins, lipids and nucleic acids.
2. Quantitative estimation of Glucose by Anthrone Method
3. Quantitative estimation of Amino acids by Ninhydrin Method
4. Quantitative estimation of Protein by Lowry's Method
5. Quantitative estimation of Cholesterol by Jacks Method
6. Quantitative estimation of DNA by DPA Method
7. Quantitative estimation of RNA by Orcinol Method

References:

1. Shawn O' Farrell and Ryan T Ranallo. Experiments in Biochemistry: A Hands on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.

2. Manipal manual of clinical Biochemistry.2013, JB brother medical publisher.

3. Practical clinical Biochemistry, Ranjna Chawla.2014, JB brother medical publisher.

4. Practical Biochemistry, Damodaran Geetha K.2016, JB brother medical publisher.

Part IV - VALUE EDUCATION

Semester I &II	Internal Marks : 25	External Marks : 75				
Course code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UGVE	**Value Education**	**Part IV**	**30**	**2**	**-**	**2**

Preamble

This course ensures the all round and well balanced personality of the students and shapes them to become morally finer, socially responsible and physically fit persons of the society.

Course outcome

CO1	Recognise the philosophy of life and social values	K1
CO2	Summarize Human Rights	K2
CO3	Apply the rights of consumers	K3
CO4	Demonstrate Yoga in day to day life	K3
CO5	Examine the functions of State Public Service Commission	K4

Unit I : Philosophy of Life and Social Values (6 Hours)

Meaning and Philosophy of Life; Law of Life: Five duties and responsibilities of Man (a) to himself (b) to his family (c) to his environment (d) to his society, (e) to the Universe in his life.

Unit II: Human Rights and Organizations (6 Hours)

Definition and Nature of Human Rights; Universal Declaration of Human Rights,

Unit III : Consumer Protection Act, 1986 (6 Hours)

Consumer Protection Act, 1986 – Definition, State and Central Consumer Protection Councils – Consumer Disputes Redressal Agencies.

Unit IV: Yoga and Health (6 Hours)

Definition and Meaning of Yoga and Health, Scope of Yoga - Aims and objectives ofYoga - Yoga practices: Asanas, Pranayama and Meditation.

Unit V : Role of State Public Service Commission(6 Hours)

TNPSC – Objectives- Role and functions of TNPSC.

References:

1. Chandrasekaran .K. (1999) SOUND HEALTH THROUGH YOGA -, Prem Kalyan Publications, Sedaptti

2. Swami Kuvalayananda and Dr.S.L.Vinekar (1963) Yogic Thearpy -, Government of India, Ministry of Health, New Delhi.

3. Right to Information Act, 2005-Website: www.tnpsc.gov.in/RTI%20ACT%202005.pdf

4.. The Consumer Protection Act, 1986 – Website: http://ncdrc.nic.in/bare_acts/consumer%20Protection%20Act-1986.html

CORE COURSE - II (CC)
MICROBIAL PHYSIOLOGY

Semester II	Internal Marks : 25	External Marks : 75				
Course code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB2CC2	**Microbial Physiology**	**Core**	**90**	**6**	**-**	**6**

Preamble:

To understand the growth, enzymology and physiological processes of microbes

Course outcome:

COs	CO Statement	Knowledge level
CO 1	State the Nutritional requirements of microorganisms	K1
CO 2	Explain the enzyme mechanisms	K2
CO 3	Describe the Carbohydrate metabolism	K2
CO 4	Illustrate the Protein and Amino acid Metabolism	K2
CO 5	Compute the view of Aerobic and Anaerobic Respiration	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT I : 22 Hours

Nutritional types, Growth and requirements of Microorganisms. Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals, Physiology of growth – Significance of various stages of growth.

UNIT II :14 Hours

Bacterial enzymes – classification –oxidoreductase, transference, hydrolase, lyases, ligasesand isomerases - properties, coenzymes and cofactors, isozymes.

UNIT III :18 Hours

Metabolism of carbohydrates : Anabolism – photosynthesis – oxygenic – anoxygenic, synthesis of carbohydrate– catabolism of glucose – Embden Mayer– Hoff – Parnas pathway –Pentose pathway, Entener- Doudoroff (ED) pathway, Kreb's cycle (TCA) –electron transport system and ATP production.

UNIT IV :18 Hours

Metabolism of protein – metabolic pathways of nitrogen utilization, synthesis of amino acids,peptides, proteins.

UNIT V :18 Hours

Anaerobic Respiration – Nitrate, sulphate& Methane respiration – Fermentations – alcohol, mixed acid, lactic acid fermentation - Anabolic and catabolic processes of lipids.

Unit VI: Current Contours: (For Continuous Internal Assessment only) Quiz and Self readingon Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

REFERENCES:

1. Nelson David L, Albert L Lehninger and Michael M Cox. Lehninger principles of biochemistry. Macmillan.2008.

2. Murray RK, Granner DK, Mayes PA and Rodwell VW. "Harper‘s Biochemistry, Appleton and Lange: New York, NY. 2004.

3. Doelle HW. Microbial Metabolism, Academic Press. 2005.

4. Gerhart G. Bacterial Metabolism, Springer Verlag. 1986.

5. Hall DC and Rao KK. Phototsynthesis, 6th edn, Cambridge University Press.1999.

6. Lansing M. Prescott JP, Harley and Donald A Klein. Microbiology, 5th edition, McGraw-Hill Company, New York. 2003.

7. Mathews CK and Holde KEV. Biochemistry – The Benjamin/Cummings Publishing company, Inc., New York. 2003.

8. Murray RK, Granner MD, Mayes PA and Rodwell VW. Biochemistry – Prentice Hall International Inc., London. 2000.

9. Salle AJ. Fundamental principles of Bacteriology, 7th edition, Tata McGraw- Hill publishing company limited, New Delhi. 1996.

10. Stryer L. Biochemistry, 4th edition, W.H. Freeman and company, New York. 1995.

11. Zubey CL. Parson WW and Vance DE. Principles of Biochemistry – Wim. C. BrownPublishers, Oxford, England. 1994.

FIRST ALLIED COURSE–III (AC)

FUNDAMENDALS OF BIOCHEMISTRY-II

Semester II	Internal Marks : 25	External Marks : 75				
Course code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB2AC2	**Fundamentals of Biochemistry-II**	**Allied**	**60**	**4**	**-**	**2**

Preamble:

To understand the structure and functions of blood, hormones and phytohormones.

Course Outcome

CO Number	CO Statement	Knowledge level
CO 1	Recall basic hematology	K1
CO 2	Identify the deficiency diseases associated with endocrine hormones	K1
CO 3	Explain the structure and functions of hormones	K2
CO 4	Restate the basic ideas about secondary metabolites	K2
CO 5	Apply the use of plant hormones and their biological role	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT I : 12 Hours

Blood – origin of blood cells, characterization and coagulation, composition - Serum and plasma, RBC, WBC and haemoglobin-structure and functions. Deficiency disease – anemia and haemophilia.

UNIT II : 12 Hours

Cytochemistry – structure and biochemical composition of plasma membrane – fluid mosaic model, Trilaminarmodel. Transport mechanisms –Active, Passive and Facilitated diffusion-Uni, sym and antiports.

UNIT III : 12 Hours

Endocrine glands – pituitary, thyroids, parathyroid, pancreas, adrenal, testis and ovary. Hormones – Definition – classification –protein hormone, steroid hormones, functions, regulations, diseases associated with deficiency of hormones.

UNIT IV : 12 Hours

General account and biosynthesis of major and accessory plant pigments – chlorophylls, carotenoids-astaxanthin, phycobilins and anthocyanins.

UNIT V : 12 Hours

Phytohormones and plant's secondary metabolites – structure and functions of auxin, gibberellins, cytokinins and abscisic acid.

UNIT VI:

Current Contours: (For Continuous Internal Assessment only) Quiz and Self reading on Current developments related to the microbiology during the semester through collection, discussion and evaluation. To be sourced from multiple reliable informative sources- Print, Internet, Interaction, Social Media, Webinars and so on.

REFERENCES:

1. Stryer, L.1995.Biochemistry. 4th Ed. W.H. Freeman and Company, New York.

2. Donald voet and Judith voet.1990. Biochemistry. John Wiley and Sons, New York.

3. Henry, R.Mahler and Eugene, H.Cerdesz, 1966. Biological Chemistry. Harper International Edition, New york.

4. Hubert, Stryer, 1995. Biochemistry – Freeman and Company, New York.

5. Dawn, B.Markus, 1994. Biochemistry.Harwal Publishing, New York.

6. William, J.Marshall and Stephan, K.Bangert.1995. Clinical Biochemistry – Metabolic and Clinical Aspects – Churchill Livingston, New York

ENVIRORMENTAL STUDIES

Semester II	Internal Marks :25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UGES	**Environmental Studies**	**Part IV**	**30**	**2**	**-**	**2**

Preamble

To train the students to get awareness about total environment and its related problems and tomake them to participate in the improvement and protection of the environment.

Course Outcome

COs	CO Statement	Knowledge Level
CO1	Outline the nature and scope of environmentalstudies	K2
CO2	Illustrate the various types of natural resources and its importance.	K2
CO3	Classification of various types of ecosystemwith its structure and function.	K2
CO4	Develop an understanding of various types of pollution and biodiversity.	K3
CO5	List out the various types of social issues related with environment .	K4

Unit: 1

Introduction to environmental studies Definition, scope and importance. Need for public awareness

Unit: 2

Natural Resources: Renewable and non-renewable resources:

a) Forest resources: use and over-exploitation, deforestation, case studies. Timber

extraction, mining, dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resources, land degradation, man induced Landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

Unit: 3 Ecosystems

- Concept, Structure and function of an ecosystem.
- Producers, consumers and decomposers
- Energy flow in the ecosystem and Ecological succession.
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:-

  a. Forest ecosystem

  b. Grassland ecosystem

  c. Desert ecosystem

  d. Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)

Unit: 4 Biodiversity and Environmental Pollution

- Introduction, types and value of biodiversity
- India as a mega diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Definition, Causes, effects and control measures of :
  a. Air Pollution

  b. Water Pollution

c. Soil Pollution

d. Noise pollution

e. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Disaster management: floods, earthquake, cyclone and landslides.

Unit: 5 Social Issues and the Environment

- Water conservation, rain water harvesting, watershed management.
- Climate change, global warming, acid rain, ozone layer depletion,
- Wasteland reclamation.
- Environment Protection Act
- Wildlife Protection Act.
- Forest Conservation Act.
- Population explosion – Family Welfare Programmes
- Human Rights - Value Education
- HIV/ AIDS - Women and Child Welfare
- Role of Information Technology in Environment and human health

References:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.

2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt ltd, Ahamedabad – 380013, India, E-mail: mapin@icenet.net(R)

3. Brunner R.C. 1989, Hazardous Waste Incineration, McGraw Hill Inc 480 p

4. Clark R.S. Marine Pollution, Clanderson Press Oxford (TB)

5. Cunningham, W.P.Cooper, T.H.Gorhani E & Hepworth, M.T. 2001.

6. De A.K. Environmental Chemistry, Wiley Eastern Ltd

7. Down to Earth, Centre for Science and Environment (R)

8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford University, Press 473p.

9. Hawkins, R.E. Encyclopedia of India Natural History, Bombay Natural History Society, Bombay (R)

10. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press 1140 p.

11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws Himalaya Pub.

House, Delhi 284 p.

12. Mckinney, M.L. & Schoch R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition 639

13. Mhaskar A.K. Matter Hazardous, Techno-Science Publications (TB)

14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)

15. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574 p

16. Rao MN & Datta, A.K. 1987 Waste Water treatment, Oxford & IBH Publication Co. Pvt Ltd 345 p.

17. Sharma B.K. 2001 Environmental chemistry Goel Publ House, Meerut.

18. Survey of the Environment, The Hindu (M).

19. Townsend C. Harper, J and Michael Begon, Essentials of Ecology, Blackwell science (TB)

20. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).

21. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB).

22. Wagner K.D. 1998 Environmental Management. W.B. Saunders Co. Philadelphia USA 499 p

(M) Magazine (R) Reference (TB) Textbook

23.http://nbaindia.org/uploaded/Biodiversityindia/Legal/33%20Biological%20Diversity%20Rules,%202004.pdf.

CORE COURSE-III

INTRODUCTORY VIROLOGY

Semester III	Internal Marks :25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB3CC3	**Introductory Virology**	**Core**	**90**	**6**	**-**	**6**

Preamble:

To enable the students to understand the basic knowledge about Viruses and their Specific Isolation, Cultivation Techniques.

Course Outcome:

CO Number	CO Statement	Knowledge level
CO 1	Define the basic knowledge of Viruses	K1
CO 2	Select the suitable Purification and Characterization methods of Viruses	K1
CO 3	Compare and Contrast Bacteriophages Life cycle	K2
CO 4	Illustrate impacts of the Plant Viral diseases	K2
CO 5	Organised views of Animal Viruses	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT–I: 16 Hours

Introduction – Definition, History of virology. General properties of viruses– cultivation of Viruses– Structure and replications of viruses–classification of Viruses.

UNIT- II: 18 Hours

Purification and characterization of viruses, separation and characterization of viral components and quantification of viruses. Assay of viruses – physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy). Infective assay of Bacteriophages (plaque method, end point method). Infective assay of Plant Viruses.

UNIT – III: 16 Hours

Bacterial Viruses–Classification and structure of Bacteriophage, The Lytic life cycle (T- Even coli phages) – Lysogenic life cycle (Escherichia coli, Phage Lambda). Bacteriophage typing, Phage therapy (Bacteriophage therapy).

UNIT - IV: 18 Hours

Plant Viruses, common plant viral diseases: TMV, Bunchy top of Banana, Cauliflower Mosaic Virus, Potato Leaf Roll Virus, and Rice Tungro Virus. Satellite Viruses, Viroid. Transmission of Plant Viruses with Vectors - Insects, Nematodes, Fungi - without vectors (Contact, Seed and Pollens). Control Measures of Plant Viruses- Generation of Virus-Virus free planting material, Vector Control.

UNIT- V: 22 Hours

Animal viruses: Morphology, pathogenesis and laboratory diagnosis of Prions, Rinder pest, Blue tongue, Raniketdion, Foot and Mouth Disease. Human Viruses– Retro, Hepatitis Pox, Polio, Rabies, Dengue Viruses, Oncogenic Viruses. Viral Vaccines. Prevention and Treatment of Viral Diseases. Antiviral agents.

Text Books:

1. Ananthanarayan and Paniker's Textbook of Microbiology. 10th E-edition, Universities Press .United States. 2017.
2. David Greenwood , Richard C. B. Slack M.A, Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control.17th Edition, Churchill Livingstone. 2007.
3. Geo. Brooks, Karen C. Carroll, Janet Butel, Stephen Morse. Jawetz Mel nick & Adel bergs Medical Microbiology. 26th Edition, McGraw-Hill Education. 2012

References:

1. Alan J. Cann. Principles of Molecular Virology. 6th edition, Academic press, California.2015.
2. Baishali C, Sumanta K Dutta, Patra Lekha RC and Ranjita S. Topley and Wilson's: Principles of bacteriology, Virology and immunity. 11th edition, vol 4, Edward Arnold, London. 2005.

3. Cook and Killington, R. Instant Notes in Microbiology. (2nd edition).Viva Books private limited, New Delhi. 2003.
4. Dimmock NJ and Primerose SB. Introduction to modern virology. 6th edition. Blackwell scientific publication, Oxford, London. 2007.
5. John Carter and Venetia Saunders. Virology: Principles and applications, 2nd Edition, John wiley and son's publishers, USA. 2013.
6. Maureen A Harrison and Ian F Rae. General techniques of cell cultures, Cambridge University Press, England. 2010.
7. Nayudu MV. Plant viruses, Tata McGraw Hill education, US. 2008
8. Robert I.Krasner.The microbial challenge: Human Microbe Interactions, American society for Microbiology, Washington. 2002.
9. Roger Hull. Mathews' Plant Virology. (4thEdition). Academic press- Aharcourt Science and technology company, NewYork. 2002.

Web links:

1. http://www.bocklabs.wisc.edu/ed/virustax.html
2. http:// www.bocklabs.wisc.edu/ed/genomes.html
3. http://www.virology.net/Big_Virology/BVHomePage.html

Pedagogy :

Power point presentations, Group Discussion, Seminar, Quiz , Assignment, Brain StormingActivity

SECOND ALLIED COURSE-II

BIOSTATISTICS

Semester III	Internal Marks :25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB3AC3	**Biostatistics**	**Allied**	**60**	**4**	**-**	**4**

Preamble:

- To study the basic concepts of statistics and sampling design
- To equip analytical thinking to solve biological problems

Course Outcomes

COs	CO Statement	Knowledge Level
CO1	Explain the basic concepts of biostatistics, functions and limitations	K3
CO2	Classify the data and sampling deign	K3
CO3	Compute the measures of central tendency and measures of dispersion	K3
CO4	Apply the concepts of skewness, moments, kurtosis, correlation and regression to solve the problems.	K4
CO5	Examine the various testing of hypothesis	K4

Mapping with Programme Outcomes

Cos/ Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S
CO6	S	S	S	S	S

S- Strong; M-Medium; L-Low

UNIT I: 12 Hours

Introduction to biostatistics - definition, statistical methods, biological measurement, kind of biological data, functions of statistics and limitation of statistics - Collection of data,sampling and sampling design.

UNIT II:12 Hours

Tabulation and Frequency distribution, types of representations graphic-bar diagrams,pie diagrams and curves.

UNIT III: 12 Hours

Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean - Measures of dispersion and variability changes- Mean deviation, standard deviation,and coefficient of variation.

UNIT IV: 12 Hours

Skewness, Moments and Kurtosis - Meaning - test of skewness, characteristics of dispersion and skewness. Measures of skewness, objectives - Karl Pearson's coefficient ofskewness, Bowley's Coefficient of skewness- Correlation and regression analysis.

UNIT V: 12 Hours

Testing of hypothesis for small samples-Students' T -Test- Chi square test-F-test orFisher's F test.

Text Books:

1. P.N. Arora & P.K. Malhan, Biostatistics, Himalaya Publishing house, 2008

References:

1. Bernard Rosner, Fundamentals of Biostatistics, Lengage learning, 2006
2. Norman TJ, Bailey. Statistical methods in biology, University press Cambridge Rastogi. 2009.
3. Bernard Rosner. Fundamentals of Biostatistics. 7th edition, Lengage learning,. 2010
4. R.S.N. Pillai & V.Bagavathi, Statistics Theory and Practice, S.Chand, 2016

Pedagogy

Group Discussion, Seminar, Quiz, Assignment.

NON MAJOR ELECTIVE - I

HERBAL MEDICINE

Semester III	Internal Marks :25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB3NME1	**Herbal Medicine**	**Non Major Elective**	**30**	**2**	**-**	**2**

Preamble:

To create a traditional knowledge of medicinally important plants in day to day life.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Define ethnomedicine	K1
CO2	Recite the knowledge about medicinally important plants.	K1
CO3	Describe about tribal medicine and their uses in diseases.	K2
CO4	Apply the traditional knowledge of medicinal plants in Tamilnadu	K3
CO5	Associate of plants in day to day life.	K4

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT I : 6 Hours

Ethnomedicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.

UNIT II : 4 Hours

Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

UNIT III : 6 Hours

Tribal medicine – methods of disease diagnosis and treatment – Plants in folk tradition – *Aegle marmelos, Ficus benghalensis, Curcuma domestica, Cyanodond actylonand Sesamum indicum.*

UNIT IV: 6 Hours

Traditional knowledge and utility of some medicinal plants in Tamilnadu – *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathod avasica, Azadirachat indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus fraternus, Cathanranthus roseus*

UNIT V : 10 Hours

Plants in day today life – *Ocimum sanctum, Centellaasiatica, Cassia auriculata, Aloe vera.* Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and vegetables - Greens (*Moringa, Solanum nigrum,* Cabbage).

References :

1. Ethnobiology – R.K.Sinha&ShwetaSinha. Surabhe Publications – Jaipur. 2001
2. Tribal medicine – D.C. Pal & S.K. Jain NayaPrakash, 206, BidhanSarani, Calcutta , 1998
3. Contribution to Indian ethnobotany – S.K. Jain, 3rd edition, Scientific publishers, B.No. 91, Jodhpur, India. 2001
4. A Manual of Ethnobotany – S.K.Jain, 2nd edition, 1995.
5. Quality control of herbal drugs by Pulok K Mukarjee, Ist edition, Business horizons Pharmaceutical publisher, New Delhi, 2002
6. Indian Herbal Pharmacopoeia, Vol.1&2, RRL, 1DMA, 1998, 2000
7. PDR for herbal medicines, 2nd edition, medicinal economic company, New Jersey, 2000
8. Drug industry by R.D. Choudhary, Ist edition, eastern publisher, NewDelhi: 1996

Web link:

1. http://www.ehtpa.eu/pdf/corecurriculum/Core%20Curriculum%20v11%2011-02-08.pdf
2. http://www.srtmun.ac.in/images/NEWBCUD/AcademicSection/Syllabus/MSc/MSC_CBCS/MScSecondYearCBCSJUne2015HerbalMedicine1.pdf

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, BrainStorming Activity

CORE PRACTICAL - II

INTRODUCTORY VIROLOGY & IMMUNOLOGY -PRACTICALS

Semester III &IV	Internal Marks :40	External Marks: 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB3CC2P	**Introductory Virology& Immunology - Practicals**	**Core Practical**	**45**	**-**	**3**	**3**

Preamble:

To enable the students to identify, analyze and observe various techniques in virology and immunology

Course Outcome:

COs	CO Statement	Knowledg elevel
CO1	Identify and isolate bacteriophages from sewage.	K1
CO2	Illustrate of various immune haematological techniques.	K2
CO3	Describe the virus cultivation methods.	K2
CO4	Apply knowledge about selected bacterial plant and animal viruses.	K3
CO5	Organized view on bacterial, plant and animal viruses	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Introductory Virology: 30 Hours

1. Isolation of Bacteriophage from sewage
2. Concentration of bacteriophages
3. Demonstration of mechanical transfer of viruses in plants
4. Demonstration of cultivation of viruses by embryonated egg inoculation method.
5. Observation of selected bacterial, plant and animal viruses – T4 and M13 Phage, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus

Immunology: 15 Hours

1. ABO Blood grouping
2. Rh typing
3. Widal Test
4. RPR
5. CRP
6. ASO
7. Total and differential blood cell count by haemocytometer
8. Double immunodiffusion (Ouchterlony method)
9. Demonstration of ELISA

References:

1. Atlas Ronald M. Hand book of media for clinical and public health microbiology, Boca Raton, FL: CRC press, Francis. 2013.
2. Li Zongxi, Zheng Li, FengHui, Cao Yan, Li Cheng and Pang Wei. Immunology Methods for Medical Students.Department of Immunology, China medicaluniversity.2006.
3. Fleming, Diane O, Debra long and Hunt. Biological safety: Principles andpractices, 4th edition, ASM press, Washington, DC.2006.
4. Florence G Burleson, Thomas M Chambers and Danny L Wiedbrauk. Virology: A laboratory Manual. Academic Press, UK.1992.
5. Goldman, Emanuel and Lorrence H Green. Practical Handbook of Microbiology, Boca Raton, FL: CRC press, Francis. 2009.
6. James G Cappuccino. Microbiology.The Benjamin / Cummings Pub.Co.California.1996.
7. Morag C Timbury. Medical Virology.10th edition, Churchill Livingston.1994.
8. O'Gorman, Manrice RG and Albert David Donnenberg. Hand book of humanImmunology. Boca Raton, FL: CRC press, Francis.2008.
9. Rajan S and Selvi Christy R. Experiments in Microbiology. Anjana Books House, Chennai. 2015.
10. Richard A Glodsby, Thosmas J Kindt and Barbera A Osborne. Kuby 10. Immunology (4th edition). W.H. Freeman and Company, New York. 2000.

Web link

1. https://microbiologyinfo.com/techniques-of-virus-cultivation/
2. .https://www.scribd.com/doc/53764085/Immunotechniques

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

SECOND ALLIED PRACTICAL - II
BIOSTATISTICS AND BIOINFORMATICS -PRACTICALS

Semester III & IV	Internal Marks :40	External Marks: 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB3AC2P	**Introductory Virology& Immunology - Practicals**	**Allied Practical**	**45**	**-**	**3**	**3**

Preamble:

To collect various data for representation using biological materials and to computenucleic acid sequence databanks

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Identify and collect various data for representation using biological materials.	K1
CO2	Illustrate t' test, 'chi' square, standard error and Deviation using SPSS programme.	K2
CO3	Compared views on Nucleic acid sequence databanks	K3
CO4	Compute multiple sequence alignment.	K3
CO5	Construct nucleic acid and protein structure databases.	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

BIOSTATISTICS AND BIOINFORMATICS (P): 45 Hours

1. Collection of Data, Sampling Designs, Tabulation and Graphic Representation using Biological Materials.
2. To find Mean, Mode, Median, Co-efficient of Variance using Biological Materials.
3. Tests of Significance‘t’ test, ‘chi’ Square, Standard Error and Standard Deviation.
4. ‘t’ Test, Chi Square, Statistical Error, Standard Deviation also, to be practically done through SPSS programme [statistical Package for Social Sciences].
5. Study of Nucleic acid Sequence Databanks – Gen Bank, NCBI, EMBL Nucleotide Sequence Databank, and DDBJ.
6. Study of Protein Structure and Classification Databases – PDB, SCOP and CATH.
7. Multiple alignments – Clustal W.
8. Evaluation of Protein Structure by Swiss PDB viewer and RASMOL.

REFERENCES:

1. Maicello Pagano, Kimberlee Gauvreau. Principles of Biostatistics, 2nd edition, Duxbury Press. 2000.
2. Roland Ennos. Statistical and Data Handling Skills in Biology, 3rd edition. Pearson. 2011.
3. http://en.m.wikipedia.org/wiki/Nucleotide sequence database
4. http://en.m.wikipedia.org/wiki/Multiple sequence alignment
5. http://en.m.wikipedia.org>wiki>Swiss PDB viewer
6. http://en.m.wikipedia.org>wiki>Rasmol

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

CORE COURSE – IV (CC)

IMMUNOLOGY

Semester IV	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB4CC4	**Immunology**	**Core**	**75**	**-**	**5**	**5**

Preamble:

The aim of the course is to teach the types of immunity, immune system, antigen, antigen – antibody reaction, T and B cell activation, lymphokines and cytokines, hyper sensitivity reaction, immune deficiency disorders, immune hematology and transplantation of immunity.

Course Outcome

COs	CO Statement	Knowledge level
CO1	Understand the history and types of immunity.	K4
CO2	Demonstrate the various antigen-antibody techniques.	K4
CO3	Differentiate the structure of MHC, Cytokines and lymphokines.	K6
CO4	Explain immuno technology and its applications.	K6
CO5	Explain the knowledge about hypersensitivity reactions	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT-I: 15 hours

History and overview of the Immune system. Cells and organs of the Immune system – Origin, development. Immuno haematology - blood groups, blood transfusion, Rh incompatibility. Immunity - types of immunity - cell mediated, Innate and acquired immunity. Differentiation of T and B cells and their receptors.

UNIT-II: 15 hours

Antigen- properties, types, biology of antigens- Haptens, adjuvants, epitope, paratope, cross reactivity and Forssman antigen. Immunoglobulin - structure, properties, types and functions. Theories of antibody production. Complement- alternative and classical pathways. Antigen - Antibody reaction - Precipitation, Agglutination, Immunodiffusion and Complement Fixation.

UNIT-III: 17 hours

Immune response - Cell mediated and humoral. MHC, Cytokines, lympokines - structure, function and their receptors. Vaccines – types, toxoids and anti-toxin. Transplantation Immunology- types of transplants, Tissue typing, Graft - rejection mechanism.

UNIT IV: 15 hours

Immunotechniques: Monoclonal antibody production, properties and its applications. ELISA, RIA, Immuno fluorescence - FISH, Immuno electrophoresis and WIDAL.

UNIT V: 13 hours

Hypersensitivity Reactions – Introduction, Definition - allergy, allergens, types - Immediate (Type I, Type II, Type III) and delayed (Type IV) Hypersensitivity reactions. Cancer Immunology - Introduction, tumour of immune system, tumour antigens, types of tumoursand immuno therapy . Basic concept of autoimmunity and immuno deficiency disorders.

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai	Basic Immunology: Functions and Disorders of the Immune System 6th Edition	Elsevier	2019
2.	Robert R. Rich, Thomas A Fleisher , William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand	Clinical Immunology: Principles and Practice	Elsevier	2018
3.	Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai	Cellular and Molecular Immunology 9th Edition	Elsevier	2017
4.	Peter J. Delves , Seamus J. Martin , Dennis R. Burton , Ivan M. Roitt	Roitt's Essential Immunology	Wiley-Blackwell	2017
5.	Richard Coico, Geoffrey Sunshine	Immunology: A Short Course	Wiley-Blackwell	2015

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Kenneth Murphy, Casey Weaver	Janeway's Immunobiology 9th Edition	Garland Science	2016
2.	William E. Paul	Fundamental Immunology 7th Edition, Kindle Edition	Lippincott Williams	2012

3.	A Wesley Burks , Stephen T Holgate , Robyn E O'Hehir , Leonard B. Bacharier, David H. Broide , Gurjit K. Khurana Hershey , Jr. R. Stokes Peebles	Middleton's Allergy E-Book: Principles and Practice	Elsevier	2019
4.	John E. Bennett , Raphael Dolin, Martin J. Blaser	Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases: 2-Volume Set 8th Edition,	Saunders	2014
5.	Lauren M. Sompayrac	How the Immune System Works	Wiley-Blackwell	2019

Web links

1. https://www.immunology.org/public-information/what-is-immunology
2. https://aacijournal.biomedcentral.com/articles/10.1186/1710-1492-7-S1-S1
3. https://onlinelibrary.wiley.com/journal/13652567
4. https://www.frontiersin.org/articles/10.3389/fimmu.2019.00684/full
5. https://emedicine.medscape.com/allergy_immunology

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz , Assignment, Brain Stormingactivity

SECOND ALLIED COURSE – III (AC)

COMPUTER APPLICATION IN BIOLOGY

Semester IV	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB4AC4	**Computer application in biology**	**Allied**	**45**	**-**	**3**	**2**

Preamble: The most important objective is to make the students understand inherent structure of biological information and to analyze the gene and protein sequences to reveal protein evolution. This syllabus would enlighten the students to understand the applications of computers in biology and acquiring basic knowledge about computers and internet.

Course Outcome

COs	CO Statement	Knowledge level
CO1	Define the basics of computer	K1
CO2	Recite the knowledge about internet	K1
CO3	Critique knowledge about bioinformatics	K4
CO4	Generalize the structure and classification of protein visualization tools	K6
CO5	Expand about the role of computers in biology	K6

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

UNIT-I: 09 Hours

Introduction and History of Computers, Basic Anatomy of Computers. Input and output devices, hardware and software. Operating system.

UNIT-II: 09 Hours

Internet –History and Uses of internet. Connection to Internet - Getting connection-Web page-Modem-Internet Service providers-E-mail and Voice Mail, Creating E-mail Address.

UNIT-III: 09 Hours

Introduction to bioinformatics – history and its development – Scope and applications of bioinformatics. Biological database – GenBank -NCBI, EMBL, DDBJ.

UNIT-IV: 09 Hours

Sequence Alignment Pairwise (BLAST and FASTA) and Multiple sequence alignment (ClustalW). Structure of Protein, Classification –PDB, Swiss-PROT, SCOP, CATH. Protein visualization tools-RASMOL, Swiss PDB viewer.

UNIT-V: 09 Hours

Computers in Taxonomy and Systemic Data Analysis in Microbiology. Computers in clinical microbiology - Computer applications in fermentation – application of Computers in Drug - Designing using various software's.

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Sumita Arora	A textbook of Information technology	Dhanpat Rai & Co	2020
2.	Nell Dale and John Lewis	Computer Science Illuminated	Jones and Bartlett Publishers	2019
3.	Arthur Lesk	Introduction to Bioinformatics	OUP Oxford	2019
4.	Daniel McGuire	Bioinformatics: Design, Sequencing and Gene Expression	Callisto	2019
5.	Vinay Sharma , Ashok Munjal and Ashish Shanker	Bioinformatics	Rastogi Publications	2018

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Alka Vishwa	Computer Organization and Architecture	Dreamtech Press	2019
2.	William T. Loging	Bioinformatics and Computational Biology in Drug Discovery and Development Reprint Edition	Cambridge University Press	2018
3.	Kevin P Hare	Computer Science Principles: The Foundational Concepts of Computer Science	Kevin P Hare LLC	2018
4.	Hamid Arabnia Quoc Nam Tran	Emerging Trends in Computational Biology, Bioinformatics, andSystems Biology	Morgan Kaufmann	2015
5.	Ramsden	Bioinformatics An Introduction	Springer-Verlag London	2015

Web links

1. http://en.m.wikipedia.org/wiki/Nucleotide sequence database
2. www.bioinformatics.org/wiki/sequence alignment
3. https://academic.oup.com/bioinformatics
4. https://www.ebi.ac.uk/training/online/course/bioinformatics-terrified/what-bioinformatics-0
5. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain stormingactivity.

NON MAJOR ELECTIVE II
PHARMACOGNOSY

Semester IV	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB4NME2	**Pharmacognosy**	**NME**	**30**	**2**	**-**	**2**

Preamble: To create awareness on traditional knowledge of medicinally important plants inday to day life.

Course Outcome

COs	CO Statement	Knowledge level
CO1	Outline study of traditional Indian medicine	K1
CO2	Explain the needs of crude drugs	K2
CO3	Demonstrate the crude and commercial drugs	K4
CO4	Compile view of Oraganoleptic study	K3
CO5	Relate the analytical Pharmacognosy of available medicinal plants	K3

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Unit I: 5 Hours

History, Definition and scope of Pharmacognosy; Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies in Pharmacognosy: Medical Ethnobotany, Ethno pharmacology, Phytotheraphy, Phytochemistry.

Unit II: 5 Hours

Classification of Crude drugs – Taxonomical, Morphological, Pharmacological and Chemical classifications; Chemistry of drugs and its evaluation.

Unit III: 6 Hours

Preparation of crude and commercial drugs. Making infusion, decoction, lotion, washers, insect repellents, suppositories, tincture, making herbal syrups, compresses, poultice, plasters, ointments, herbal oils and herbal salves,surgical fibres, sutures and dressing.

Unit IV: 7 Hours

Organoleptic study of the following medicinal plants: Fruit – Amla, Bulb – Garlic, Rhizome – Ginger, Seed – Castor, Bark – Cinchona, Leaves – Neem, Flower – Clove.

Unit V: 7 Hours

Analytical Pharmacognosy – drug adulteration and detection. Biological testing of herbal drug. Phytochemical investigations with reference to secondary metabolites of locally available medicinal plants: Phyllanthus amarus, Curcuma longa, Ocimum sanctum, Aloe vera.

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	S.B.Gokhale &Dr.C.K. Kokate	Pharmacognosy	Nirali Prakashan,Pune	2019
2.	S.B.Gokhale, Dr.C.K. Kokate & A U Tatiya	Pharmacognosy And Phytochemistry	Nirali Prakashan, Pune	2019
3.	Bhandari & Singh	Textbook of Pharmacognosy	CBS Publishers and Distributors Pvt Ltd,Delhi	2019

4.	J.S.Qadry	A Textbook of Pharmacognosy Theory and Practicals	CBS Publishers and Distributors Pvt Ltd,Delhi	2019
5.	Bire shah & A.K.seth	Textbook of Pharmacognosy and Phytochemistry	CBS Publishers and Distributors Pvt Ltd,Delhi	2019
6.	Penelope Ody	The Complete MedicinalHerbal	Skyhorse, US	2017

Reference Books

S.No	Authors Name	Title of thebook	Publishers Name	Year
1.	A.N.Kalia	Textbook of Industrial Pharmacognosy	CBS Publishers and Distributors Pvt Ltd, Delhi	2019
2.	Henry Kraemer	Scientific and Applied Pharmacognosy, Intended for the Useof Students in Pharmacy, as a HandBook for Pharmacists, and as a Reference Book for Food and Drug Analysts and Pharmacologists	Wentworth Press,Sydney	2018
3.	Ned Burnett	Encyclopedia of Drug Discovery and Development	Foster Academics,USA	2015

4.	Roy Upton, Alison Graff, Georgina Jolliffe & Reinhard Länger	American Herbal Pharmacopoeia: Botanical Pharmacognosy	CRC Press (Taylor & Francis), Florida	2015
5.	Francesco Capasso , Timothy.S, Gaginella& Giuliano Grandolini	Phytotherapy: A Quick Reference to Herbal Medicine	Springer, Newyork	2012

Web Links

1. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
2. https://www.pdfdrive.com/fundamentals-of-pharmacognosy-and-phytotherapy-2d-edition-e186515176.html
3. https://www.pdfdrive.com/textbook-of-pharmacognosy-and-phytochemistry-e184620437.html
4. https://www.pdfdrive.com/pharmacognosy-practice-e34345777.html
5. https://www.pdfdrive.com/an-introduction-to-pharmacognosy-e58091191.html
6. https://www.pdfdrive.com/pharmacognosy-fundamentals-applications-and-strategies-e158282041.html
7. https://www.pdfdrive.com/therapeutic-use-of-medicinal-plants-and-their-extracts-pharmacognosy-e186979045.html
8. https://www.pdfdrive.com/pharmacognosy-2-e38501617.html
9. https://www.pdfdrive.com/a-text-book-of-botany-and-pharmacognosy-e158788414.html
10. https://www.pdfdrive.com/introduction-to-pharmacognosy-e57734502.html

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity

SKILL BASED ELECTIVE–I

MUSHROOM TECHNOLOGY

Semester IV	**Internal Marks : 25**	**External Marks : 75**				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB4SBE1A	**Mushroom Technology**	**SBE**	**30**	**-**	**2**	**2**

Preamble:

To make the students to understand about the types of mushrooms, cultivation requirements and techniques, its storage and various mushroom food items.

COs	**CO Statement**	**Knowledge level**
CO1	Differentiateedible and Poisonous mushrooms	K5
CO2	Examine cultivation system of mushroom	K4
CO3	Create an nutrient profile of mushroom	K6
CO4	Formulation of mushroom food preparation	K6
CO5	Determine health benefits of mushroom	K4

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Unit–I: 6 hours

Introduction – History–scope of edible mushroom. Types of Mushrooms – Poisonous and Edible Mushroom. Different parts of a typical Mushroom and Variations in mushroom morphology. Natural Habitats – Humicolous, Lignicolous and Coprophilus. Color of Mushroom Spores.

Unit–II: 6 hours

Cultivation of mushroom - small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipments & facilities, pasteurization room & growing rooms. Principles ofcomposting, machinery required for compost making, materials for compost preparation. Methods of Composting- Long method of composting (LMC) & Short method of composting (SMC). Facilities required for spawn preparation, Preparation of spawn substrate,preparation of pure culture, media used in raising pure culture, culture maintenance, and storage of spawn.

Unit–III: 6 hours

Biology of mushroom - Button, Straw, Milky & Oyster- General morphology, distinguishing characteristics, spore germination and life cycle. Nutrient profile of mushroom - Protein, amino acids, Crude fibre, calorific values, carbohydrates, fats, vitamins & minerals.

Unit–IV: 6 hours

Cultivation of Button, Oyster, Milky & Straw mushroom - Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing. Visit to relevant Labs/Field Visits.Mushroom Food preparation - soup, sauce, cutlet, omelette, samosa, pickles, curry & biriyani.

Unit–V: 6 hours

Health benefits of Mushroom - Antiviral, Antibacterial, Antifungal, Anti-tumour Properities, haematological value of cardiovascular &Renal health therapeutic diets for adolescence, aged persons & diabetes mellitus.

Text Books:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	R.Gogoi, Y.Rathaiah, T.R.Borah	Mushroom Cultivation Technology	Scientific Publisher	2019
2.	T.Parveen Kumar	Mushroom Cultivation and Marketing	Jaya Publishing House	2019
3.	Bahl N	Handbook on Mushrooms	Oxford and Ibh Publishing	2018
4.	Santosh Kumar and Gireesh Chand	Techniques of Mushroom Cultivation	Daya Publishing House	2018
5.	B.C.Suman, V.P. Sharma	Mushroom Cultivation in India	Daya Publishing House	2017

Reference Books

S. No	Author	Title	Publisher	Year
1.	Russell, Stephan.	The Essential Guide to Cultivating Mushrooms: Simpleand Advanced Techniques for Growing *Shiitake, Oyster, Lion's Mane*and *Maitake Mushroom* at Home.	Storey Publishing	2014
2.	Cotter, Tradd.	Organic Mushroom Farmimg and Mycoremediation:	Chelsea Green Publishing	2014

		Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation.		
3.	Pathak Yadav Gour	Mushroom Production and Processing Technology	Agrobios	2010
4.	Krieger,L.C.	The Mushroom Handbook	Sufi Press	2010

Web Links

1. http://www.fungi.com
2. http://www.mushworld.com/home
3. http://forums.mycotopia.net/faq-frequently-asked-questions/5594-mushroom-growers-handbook-1-mushworld-com.html.
4. http://forums.mycotopia.net/faq-frequently-asked-questions/6556-mushroom-growers-handbook-2-mushworld-com.html
5. http://www.americanmushroom.org/news.html

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Stormingactivity.

SKILL BASED ELECTIVE I

CLINICAL PARASITOLOGY

Semester IV	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB4SBE1B	**Clinical Parasitology**	**SBE**	**30**	**-**	**2**	**2**

Preamble: Gain knowledge about clinical parasitology. The classification of clinically important protozoa, helminths and arthropods. Acquire knowledge about the areas in which parasitic infections are endemic.

COs	CO Statement	Knowledge level
CO1	Generalize diagnostic techniques in parasitology	K6
CO2	Examine the clinical significance of *Entamoebahistolytica*	K4
CO3	Elaborate the pathogenicity of *Leishmania donovani*	K6
CO4	Discuss about the *Plasmodium spp.*	K6
CO5	Determine *Taenia solium*	K4

Mapping with Programme Outcomes

COs	PO 1	PO2	PO3	PO4	PO5
CO1	**M**	**M**	**M**	**M**	**S**
CO2	**M**	**M**	**M**	**M**	**M**
CO3	**M**	**M**	**M**	**M**	**M**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**

S – Strong, M- Medium, L - Low

UNIT – I: 6 Hours

Introduction and Classification of Parasites – Protozoa and helminthic infection. Laboratory Diagnostic Techniques in Parasites – Direct Identification and Indirect Identification. Concentration methods - flotation techniques and sedimentation techniques.

UNIT - II: 6 Hours

Morphology,Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Entamoeba histolytica, Naegleria fowleri, Acanthamoeba* spp. *Cryptosporium.*

UNIT - III: 6 Hours

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Giardia intestinalis, Leishmania donovani, Trypanosoma cruzi* and *Tripanosoma brucei*.

UNIT - IV: 6 Hours

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention - *Toxoplasma gondii*, *Plasmodium* spp, *Fasciolopsis buski* and *Ascaris lumbricoids.*

UNIT - V: 6 Hours

Morphology, Clinical Significance, Symptoms, Pathogenicity, Lab Diagnosis, Treatment and Prevention – *Taenia solium, Fasciola hepatica, Ancylostoma duodinale* and *Wuchereria bancrofti.*

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Apurba S Sastry, SandhyaBhat	Essentials of Medical Microbiology	Jaypee Brothers Medical Publishers;	2018

2.	Ananthanarayan & Paniker's	Microbiology	The Orient Blackswan	2017
3.	Paniker's	Medical Parasitology	Jaypee Brothers Medical Publishers	2017
4.	Chatterjee K D	Parasitology, Protozoology& Helminthology	CBS Publishers	2016
5.	S. C. Parija Srinivasa and H – Trop	Medical Parasitology	All India Publishers and Distributors	2013

Reference Books

S.No	**Authors Name**	**Title of the Books**	**Publishers Name**	**Year of Publication**
1.	Burton J. Bogitsh, Thomas N. Oeltmann Clint E. Carter	Human Parasitology	Elsiver Publishers	2019
2.	Stefan Riedel, Stephen Morse, Timothy Mietzner&Steve Miller	Medical Microbiology	McGraw-Hill Education	2019
3.	Kenneth Ryan, Nafees Ahmad, J. Andrew Alspaugh, W. Lawrence Drew	Medical Microbiology	McGraw-Hill Education	2018
	Mahmud**,** Rohela, Lim**,** Yvonne Ai Lian, Amir**,**	Medical Parasitology	Springer International	2017

4.	Amirah		Publishing	
5.	B. S. Nagoba and Asha Pichare	Microbiology & Parasitology	Elsevier India	2016

Web References

1. http://dmoz.org/Science/Biology/Microbiology/
2. http://microbiology.mtsinai.on.ca/manual/default.asp
3. http://cal.vet.upenn.edu/parasite/links.html
4. http.www.suite101.com/links.cfm/microbiology
5. http://www.biosci.ohio-state.edu/-zoology/parasite/home.html

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.

CORE COURSE – V (CC)

MEDICAL MICROBIOLOGY

Semester V	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5CC5	**Medical Microbiology**	**Core**	**75**	**5**	**-**	**5**

Preamble: To impart the students with advanced knowledge of the characteristics of medically important human diseases. To focus the pathogenicity of the medically important microorganisms. To familiarize the lab diagnosis, prophylaxis and treatment of the diseases

Course Outcome:

CO Number	CO Statement	Knowledge level
CO 1	Describe and Classify the various pathogens and its Characterization.	K3
CO 2	Diagnose the various bacterial pathogens	K4
CO 3	Analyze various human viral diseases	K4
CO 4	Evaluate and compare the various fungal infections and protozoan diseases	K5
CO 5	Identification of pathogens from sample	K6

Mapping with Programme Outcome:

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

S-Strong M-Medium L –Low

UNIT – I: INTRODUCTION (15 Hours)

History, Koch's and River's Postulates-Normal microbial flora of the healthy human body, Host- pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity - virulence - toxigenicity, carriers and its types, endemic, epidemic, pandemic diseases and epidemiology – Infectious disease cycle.

UNIT – II: BACTERIAL DISEASES (15 Hours)

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal pneumonia infections (b) *Staphylococcus aureus* infections (c) Meningitis - Neisseria, (d) Leprosy, (e) Leptospirosis, (f) Respiratory diseases: Tuberculosis (g) Gastrointestinal disorders: typhoid and cholera (h) Sexually transmitted diseases: syphilis (i) Anaerobic wound infection – tetanus.

UNIT – III: VIRAL DISEASES (15 Hours)

Diseases of various organ systems: Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a) Respiratory diseases: common cold and influenza (b) Neurological diseases: Rabies (c) Muscular diseases – Polio (d) Liver diseases: Viral hepatitis (e) Immunodeficiency disease: - AIDS. A brief account on Prion diseases.

UNIT – IV: FUNGAL & PROTOZOAN DISEASES (15 Hours)

Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following fungal and protozoan diseases (a) Fungal – superficial and subcutaneous mycoses, (b) Protozoan: Amoebiasis, Malaria (c) Helminths – Filariasis, Ascariasis. Zoonotic diseases, Nosocomial and Community acquired infections.

UNIT – V: LAB DIAGNOSIS (15 Hours)

Isolation and identification of pathogens from an infected patient: Collection and transport of various clinical specimens (Urine, stool, sputum and blood) for diagnosis – General methods of isolation and identification of bacterial, fungal, viral pathogens and protozoan parasites.

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Aejaz Iqbal and Zafar Nowshad	Medical microbiology: Millennium Edition	Notion Press	2020
2.	Baveja V and Baveja C P	Medical Parasitology	Arya Publishing company	2019
3.	Mishra B	Text Book of Medica Virology	CBS	2018
4.	Ananthanarayan and Paniker	A Text book of Microbiology	Kindle Edition	2013
5.	Greenwood	Medical Microbiology	International Edition	2012

Reference Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Geo Brooks, Karen C Carroll, Janet Butel and Stephen Morse	Medical Microbiology	Mc Graw Hill Publication	2020
2	Sastry Apurba S and Bhat Sandhya	Essentials of Medical Microbiology	Jaypee brothers Medica publishers	2020
3	Patrick R Murray , Ken S Rosenthal and Michael A PFaller	Medical Microbiology	Elsevier	2020
4	Ananthanarayan Paniker	A Text book of Microbiology	University Press	2020
5	Kenneth J Ryan, Nafees Ahmad and Andrew Alspaugh J	Sherris Medical Microbiology	McGraw-Hill Education	2018

Web References

1. https://www.cdc.gov/tb/education/corecurr/pdf/chapter2.pdf
2. http://apps.searo.who.int/PDS_DOCS/B5123.pdf3.http://loyce2008.free.fr/Microbiologie/%20Micro%20%20Gillespie%20Hawkey%20%20Principles%20And%20Practice%20Of%20Clinical%20Bacteriology%202Nd%20Ed.pdf

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

CORE COURSE – VI (CC)

AGRICULTURAL MICROBIOLOGY

Semester V	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5CC6	**Agricultural Microbiology**	**Core**	**75**	**5**	**-**	**5**

Preamble: To transform the knowledge as an eco-friendly one by introducing the relationship between microbes and nature, its roles and its utilization for the creation of sustainable environment and their concepts, Biofertilizer role, Biogeochemical cycles and Plant diseases.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	Define the basic view of soil Microorganisms	K1
CO 2	Explain the Microbial association in soil & organic forming	K2
CO 3	Understand the production of Biofertilizer	K4
CO 4	Discuss about Biogeochemical cycles	K6
CO 5	Discuss about Plant diseases & Control measures	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT-I (15 hours)

Introduction to soil microorganisms–Bacteria- PGPR- Cyanobacteria and Actinobacteria, Algae- *Chlorella, Nostoc*, Fungi- VAM, Protozoans- *Amoeba, Flagellates*, Nematodes- *Ascarids, Filarias* and Viruses –Role of microbes in soil fertility.

UNIT-II (15 hours)

Microbial associations in phytosphere: rhizosphere – phyllosphere – spermosphere. Mycorrhiza – types and importance to agriculture – Organic farming- organic matter decomposition – humus formation.

UNIT-III (15 hours)

Biofertilizer –Isolation, mass inoculum production, quality control, field application, Importance and marketing of bioinoculants – *Rhizobium*, *Azotobacter*, *Azospirillum*, *Frankia*, *Cyanobacteria*, *Azolla* and phosphate solubilizing microorganisms.

UNIT-IV (15 hours)

Biogeochemical cycles – carbon, nitrogen, phosphorus, Sulphur cycles; nitrogen fixers – root nodule formation – nitrogenase, hydrogenase – biochemistry of nitrogen fixation.

UNIT-V (15 hours)

Plant diseases (Mode of entry of pathogens, Symptoms, Disease cycle and control measures) Bacterial disease–Citrus canker, Fungal disease- Blast of paddy, Viral disease–*cauliflower mosaic*- Microbial Pesticides – types and applications – Bacteria: *Bacillus thuringiensis* – Fungi: *Beauveria bassiana*- Virus: Nuclear Polyhedrosis Virus (NPV). Biocontrol agents- *Pseudomonas fluorescens and Trichoderma viride.*

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Subba Rao	Soil Microbiology	Oxford Publishing	2020
2.	Mangesh Y Dudhe	Agriculture- Microbiology	New Vishal Publications	2020
3.	Krishnendu Acharya, Surjit Sen and Manjula Rai	Biofertilizers and Biopesticides	Techno World	2019
4.	Prabhakaran	Introduction-Soil-Agricultural- Microbiology	Himalaya Publishing House Pvt. Ltd.	2018
5.	Aneja	Fundamental- Agricultural-Microbiology	New Age International (P) Ltd Publishers	2017

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Pareek and Navneet Pareek	Agricultural Microbiology	Scientific Publishers	2019
2.	Madigan, Bender, Buckley, Sattley and Stahl	Brock Biology of Microorganisms	Global Edn	2017
3.	Paul	Soil Microbiology, Ecology and Biochemistry	Academic Press	2015
4.	Glick	Beneficial Plant Bacterial Interactions	Springer	2015
5.	Trivedi	Agriculture Microbiology and Microbial Applications	Pointer Publishers	2015

Web links

1. https://agrimoon.com/agricultural-microbiology-icar-ecourse-pdf-book/\
2. https://www.pdfdrive.com/principles-of-soil-microbiology-e19270224.html
3. https://www.pdfdrive.com/soil-microbiology-ecology-and-biochemistry-e44718717.html
4. https://www.pdfdrive.com/principles-and-practice-of-soil-science-the-soil-as-a-natural-resource-e34478756.html
5. https://www.pdfdrive.com/microbes-and-microbial-technology-agricultural-and-environmental-applications-e185517816.html

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

CORE COURSE – VII (CC)

MOLECULAR BIOLOGY

Semester V	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5CC7	**Molecular Biology**	**Core**	**90**	**6**	**-**	**5**

Preamble: The paper Molecular Biology encompasses the basic study and understanding the central dogma. It helps in understanding the basic organization of the genome of prokaryotes and eukaryotes. It is followed by prokaryotic and eukaryotic replication, transcription, translation processes and regulation. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life processes.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	State the Basic concept of Prokaryotic Genes	K1
CO2	Define the Prokaryotic DNA Replication	K1
CO3	Explain the DNA & RNA Transcription in Prokaryotes	K2
CO4	Apply the view of Gene Transfer Mechanisms	K3
CO5	Prepare the Mutation and DNA Repair Mechanisms	K3

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

Unit–I (18 Hours)

Milestones in history–Definition of nucleic acids-Experimental proofs of DNA as the genetic material (Griffith and Hershey Chase) – Experimental proofs of RNA as the genetic material - Chemistry and molecular structure of DNA double helix – Discovery of DNA structure – Brief account on types and forms of DNA –Definition of a gene. Organization of DNA in eukaryotic cell; Palindromic DNA; Types of RNA-rRNA; mRNA, SnRNA the 5' cap, non- coding region, initiation, coding region, termination codon; Poly (A) region, post transcriptional modification. Brief note on plasmids: structure and its types.

Unit–II (18 Hours)

Watson and Crick's model of DNA replication (experimental evidence); Enzyme involved in DNA replication (DNA polymerase I, Pol II, Pol III, DNA ligase); Mechanism of DNA replication; Models of DNA replication, inhibitors of DNA replication. Exonuclease and endonuclease. Theta replication and Rolling circle replication. Replication of RNA – reverse transcriptase.

Unit–III (18 Hours)

DNA Transcription: Definition – Brief account on transcriptional machinery and mechanism of transcription — RNA Translation: Definition – Brief account on translational machinery, mechanisms of translation and Splicing mechanism. Regulation of gene expression: Concept of Gene, Genetic code & its properties. Wobble concept, prokaryotic and eukaryotic ribosomes, detailed account of structure, function and regulation of *lac* operon, *trp* operon and *ara* operon.

Unit–IV (18 Hours)

Gene transfer mechanisms: Conjugation, Transformation and Transduction. Discovery of Transformation, Natural competence and its mechanism - Conjugation - Discovery, F+ v/s F-, Hfr+ v/sF. Transduction – Generalized and specialized transductions. Transposons – Structure, genetic organization and mechanism of transposition. Polymerase Chain Reaction & types.

Unit–V (18 Hours)

Definitions of mutations, mutagenesis and mutants - types of mutations; Gene diversity; Split genes, overlapping gene; Molecular nature of Mutation, Spontaneous and Induced mutation; DNA damage repair – Types of damage (deamination, Oxidative damage, Alkylation, Pyrimidine dimmers. Hybridization techniques: Southern, Northern & Western Blotting. Physical and Chemical mutagens, Carcinogenicity testing (AMES Test)- Applications of Mutations.

Text Books:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Clark David	Molecular Biology	Academic Cell	2019
2.	Gerald Karp, Janet Iwasa and Wallace Marshall	Karp's Cell and Molecular Biology	Wiley	2016
3.	Joanne Willey, Linda Sherwood and Christopher J Woolverton	Prescott's Microbiology	Mc-Graw – Hill Publishing Company Ltd.	2016
4.	Veer Bala Rastogi	Principles of Molecular Biology	Med tech	2015
5.	Verma P S and Agarwal V K	Cell biology, Genetics, Molecular Biology Evolution and Ecology	S. Chand and Company Ltd.	2015

Reference Books:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Ahern and Kevin	Biochemistry and Molecular Biology	Teaching company	2019
2.	Bruce Alberts, Karen Hopkin, Alexander D Johnson, David Morgan, Martin Raff, Keith Roberts and Peter Walter	Essential Cell Biology	Norton Publisher	2018
3.	David Clark, Nanette Pazdernik and Michelle McGehee	Molecular Biology	Academic Cell	2018
4.	Bernard R Glick and Cheryl L Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA	ASM Press	2017
5.	Geoffrey M Cooper	Cell: A Molecular Approach	Sinauer Associates Inc.	2016

Web Links

1. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf
2. https://www.fmed.uniba.sk/uploads/media/Introduction_to_Medical_and_Molecular_Biology.pdf
3. https://www.aacb.asn.au/documents/item/3400
4. https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf
5. https://users.ugent.be/~avierstr/pdf/principles.pdf
6. https://pages.jh.edu/rschlei1/Random_stuff/publications/molbiogene.pdf

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

CORE PRACTICAL – III (CP) MEDICAL MICROBIOLOGY, AGRICULTURAL MICROBIOLOGY MOLECULAR BIOLOGY - PRACTICALS

Semester V	Internal Marks: 40	External Marks: 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5CC3P	**Medical Microbiology, Agricultural Microbiology, Molecular Biology- Practicals**	**Core Practical**	**45**	**-**	**3**	**3**

Preamble: To impart the knowledge on isolation, identification of medically important organisms. To perform water and soil analysis and isolation of chromosomal and plasmid DNA.

Course Outcome:

CO Number	CO Statement	Knowledge level
CO 1	Illustrate the isolation procedures	K2
CO 2	Explain the symptoms of diseases	K2
CO 3	Sketch out the water borne microbes	K3
CO 4	Demonstration of auxotrophic mutants	K3
CO 5	Analyze agarose gel electrophoresis	K4

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

SYLLABUS

MEDICAL MICROBIOLOGY (25 Hours)

1. Isolation of bacterial flora of skin by swab method.
2. Isolation of bacteria from urine, stool and sputum.
3. Identification of Gram-positive organisms (using laboratory strains): *Streptococcus pneumoniae, Staphylococcus aureus* and *Bacillus sp.* and Gram-negative organisms (using laboratory strains): *Escherichia coli, Proteus sp*. and *Klebsiella pneumoniae* on the basis of microbiological, cultural and biochemical characteristics.
4. Saline and iodine wet mount to demonstrate protozoan parasites
5. Giemsa staining for the demonstration of blood parasites
6. KOH and Lactophenol cotton blue mount to demonstrate fungi.
7. Antibacterial sensitivity test – Kirby- Bauer method.

AGRICULTURAL MICROBIOLOGY (10 Hours)

8. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
9. Microbial assessments of air quality – open plate method and air sampler technique.
10. Isolation and counting of faecal bacteria from water.
11. Soil Analysis -pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
12. Isolation of cyanobacteria from water.
13. Isolation of *Rhizobium* form legume nodule.
14. Isolation of phosphobacteria from soil.
15. Observation of VAM from plant root.

MOLECULAR BIOLOGY (10 Hours)

16. Isolation of Chromosomal DNA from bacteria
17. Isolation of Plasmid DNA from bacteria
18. Isolation of Auxotrophic mutants.
19. Demonstration of Bacterial transformation technique.
20. Demonstration of Agarose gel electrophoresis (to study DNA/ RNA) and SDS – PAGE (to study proteins).

References:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Ananthanarayan and Paniker	Textbook of Microbiology	Universities Press	2020
2.	Subba Rao N S	Soil Microbiology	Oxford Publishing	2020
3.	Mangesh Y Dudhe	Agriculture-Microbiology	New Vishal Publications	2020
4.	Michael J Leboffe and Burton E Pierce	Microbiology: Laboratory Theory & Application	Morton Publishing Company.	2019
5.	Ashwani Kumar, Gakhar S K andMonika Miglani	Molecular Biology: A Laboratory Manual	Dreamtech Press	2019
6.	Tripathi K D	Essentials of Medical Pharmacology	Jaypee Brothers Medical publishers	2018
7.	Harsh Mohan	Textbook of Pathology with Pathology	Jaypee Brothers Medical publishers	2018
8.	Rajan S and Selvi Christy R	Experimental procedures in Life Sciences	CBS Publishers & Distributors Pvt Ltd	2018
9.	Aneja K R	Fundamental and Agricultural Microbiology	New Age International (P) Ltd	2017
10.	Koliantz.G and Szymanski D B	Genetics: A Laboratory Manual	American Society of Agronomy	2016
11.	RanganathanK apilan	Laboratory Manual of Molecular Biology	LAP Lambert Academic Publishing	2015

Web links

1.https://mountainscholar.org/bitstream/handle/20.500.11919/4774/OERW_MOLB_2021_20190101_ Spring%202019%20Micro%20Lab%20Manual.pdf?sequence=1

2.https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf3.https://batch.libretexts.org/print/url=https://bio.libretexts.org/Bookshelves/Ancillary_Materials/Laboratory_Experiments/Microbiology_Labs/Book%3A_General_Microbiology_Lab_Manual_(Pakpourand_Horgan).pdf

4. https://readfreepdf.com/read/medical-books/221-microbiology-laboratory-theory-application-brief-3e/

5. https://www.researchgate.net/publication/320508474_Molecular_Biology_Laboratory_manual

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

MAJOR BASED ELECTIVE – I (A)

FUNDAMENTALS OF BOTANY AND ZOOLOGY

Semester V	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5MBE1A	**Fundamentals of Botany and Zoology**	**Major Based Elective-I (A)**	**75**	**5**	**-**	**5**

Preamble: To gain the basic knowledge about plants and animals. To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications. To understand the systematic of the selected families of the flowering plants with their economic importance. To help our students to distinguish various animal kingdoms to know the evolutionary sequence of them.

Course Outcome:

CO Number	CO Statement	Knowledge level
CO 1	State the Basic knowledge of Plant Nomenclature	K1
CO 2	Describe the Salient features and Economic importance of Monocot and Dicot Plants	K2
CO 3	Illustrate the views of Plant Physiology and Reproduction	K2
CO 4	Prepare Animal Kingdom and Reproduction	K3
CO 5	Prepare the Process of Animal Cell reproduction	K3

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT– I (15 hours)

Binomial Nomenclature – ICBN rules – taxonomic types, systems of Classification – Phylogenetic Artificial and Natural. Bentham and Hooker classification - merits and demerits. Plant taxonomy, Plant Nomenclature - Forms of Scientific names. Technical description of flower and floral diagram.

UNIT– II (17 hours)

General characteristics and economic importance of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

UNIT–III (13 hours)

Plant Physiology – Photosynthesis, Respiration and Transpiration. Reproduction of plants in Angiosperms - Vegetative, Asexual and Sexual.

UNIT–IV (15 hours)

Introduction to principles of taxonomy and outline classification of Animal Kingdom – Invertebrates - Prolifera, Cnidaria, Worms, Echinoderms, Molluscs and Arthropods. Vertebrates - Mammals, Birds, Reptiles, Fish and Amphibians. Darwin’s and Lamarck’s theory of evolution.

UNIT–V (15 hours)

Animal Physiology – Digestive, Respiratory, Circulatory, Excretion and Nervous system. Cell division – Mitosis and Meiosis.

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Kishore R Pawar and Ashok E Desai	An Introduction to Zoology	Nirali Prakashan	2020
2.	Sunidhi Miglani	Text Book of Economic Botany	ABS Publications	2016
3.	Kotpal R L	Modern text book of Zoology	Rastogi Publications	2016
4.	Afroz Alam	Textbook of Botany	I K International Publishing House Pvt. Ltd	2015
5.	Nanda A K	Text Book of Botany	Kitab Mahal - Cuttack	2015

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	James Bidlack and Shelley Jansky	Plant Biology	McGraw-Hill Education	2020
2.	James D Mauseth	An introduction to plant biology	Jones & Bartlett Learning	2019
3.	Smithsonian	Zoology	DK; Illustrated edition	2019
4.	NVS, KVS and DSSSB	Botany	Unique Publisher	2018
5.	Stephen Miller and Todd A. Tupper	Zoology	McGraw-Hill Education	2018

Web References

1. https://www.biologydiscussion.com/plant-taxonomy/quick-notes-on-plant-taxonomy/47582
2.https://www.studyandscore.com/studymaterial-detail/international-code-of-botanical- nomenclature-icbn-history-principles-and-aim
3. https://byjus.com/biology/plant-physiology/
4. https://www.slideshare.net/mjnepa/cell-reproduction-notes
5. https://biologywise.com/vertebrates-invertebrates

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity.

MAJOR BASED ELECTIVE – I (B)

ORGANIC FARMING

Semester V	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5MBE1B	**Organic Farming**	**Major Based Elective-I (B)**	**75**	**5**	**-**	**5**

Preamble: This course focuses on the need and generating knowledge and skill on various organic farming practices, so as to carry out organic agricultural production and management system that sustains the health of soils and ecosystems.

Course Outcome:

CO Number	CO Statement	Knowledge level
CO1	Determine the origin and importance of organic farming	K4
CO2	Explain the scope of organic farming	K5
CO3	Evaluate the methodology practiced in organic farming	K5
CO4	Generalize the management strategies in crop protection	K6
CO5	Compile the strategies for the commercialization of organic products	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT–I (15 hours)

Introduction- concept, Principles and development of organic farming. Types - Natural farming- Biodynamic farming. Conventional farming v/s Organic farming.

UNIT–II (15 hours)

Scope of organic farming - requirements for organic farming. Organic nutrients resources and their management, organic ecosystems and their concepts- Bioinoculants.

UNIT–III (15 hours)

Composting - principles – stages - types and factors. Composting methods – Vermicomposting. Biofertilizers - methods of application, advantages and limitations.

UNIT–IV (15 hours)

Plant protection- Insect Pest and disease management in organic farming- biopesticides, - biocontrol agents, Weed management in organic farming- preventive practices, biological control of weeds- mechanical control.

UNIT–V (15 hours)

Organic crop production, certification process and standards of organic farming in India, economic viability of organic farming, marketing and export potential of organic products.

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Maliwal P L	Principles of Organic Farming	Scientific Publisher	2020
2.	Joanne M Willey, Kathleen M Sandman and Dorothy H Wood	Prescotts microbiology	McGraw-Hill Education	2019
3.	Unni M R and Sabu Thomas	Organic Farming Global Perspectives and Methods	Woodhead publishing	2018
4.	Amitava Rakshit and H B Singh	ABC of Organic Farming	Jain Brothers	2018
5.	Reddy S R	Principles of Organic Farming	Kalyani Publisher	2017

References Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Bansal M	Basics of Organic Farming	CBS publishers and Distributors Pvt. Ltd.	2020
2.	Janet Wilson	Composting: Sustainable and Low- Cost Techniques for Beginners	Drip Digital Publisher	2020
3.	Debabrata Biswas, Shirley A. Micallef	Safety and Practice for Organic Food	Academic press Elsevier Science	2019
3.	Rhonda Sherman	The Worm Farmer's Handbook	Chelsea Green Publishing Company	2018
4.	Vinaya Kumar Sethi	Organic farming and bio-fertilizers	Discovery publishing house Pvt. Ltd.	2018

Web References

1. http://agrimoon.com/organic-farming-pdf-book/
2. https://www.britannica.com/topic/organic-farming
3. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
4. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
5. https://agritech.tnau.ac.in/org_farm/IPM%20Booklet%20for%20OF-Dr.P.D.pdf
6. https://agritech.tnau.ac.in/org_farm/orgfarm_oc%20guidelines.html

Pedagogy

Power Point Presentations, Group Discussion, Seminar, Quiz, Assignment and Brain Storming Activity

SKILL BASED ELECTIVE PRACTICAL - II (A)

BIOFERTILIZER TECHNOLOGY-PRACTICAL

Semester V	Internal Marks: 40	External Marks: 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5SBE2AP	**Biofertilizer Technology-Practical**	**Skill Based Elective Practical**	**30**	**-**	**2**	**2**

Preamble: The aim of the course is to make the student to know the importance of biofertilizers in agriculture and production technologies.

Course Outcome:

COs	CO Statement	Knowledge Level
CO1	Explain Biofertilizers and Production technology	K2
CO2	Illustrate Symbiotic Biofertilizers and study the mass cultivation methods	K2
CO3	Analyze Non- Symbiotic Biofertilizers and study the cultivation methods	K4
CO4	Create Knowledge about Phosphate solubilization and study the cultivation methods	K6
CO5	Expand view of Mycorrhizae and Bioinsecticides and study the cultivation methods	K6

Mapping with Programme Outcome

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

S- Strong M- Medium L - Low

BIOFERTILIZER TECHNOLOGY-PRACTICAL (30 Hours)

1. Isolation and identification of *Rhizobium* from leguminous plant roots
2. Isolation and identification of *Azospirillum* and *Azotobacter*
3. Isolation, identification and cultivation of Cyanobacteria from paddy field soil and water.
4. Isolation and cultivation of *Anabaena* from *Azolla*.
5. Isolation, identification and cultivation of Phosphate solubilizing bacteria from soil.
6. Isolation and identification of VAM from onion roots.
7. Isolation and identification of bioinsecticides - *Bacillus thurengiensis* and *Verticillium* sps
8. Preparation of liquid based inoculums.

Text Books:

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Krishnendu Acharya, Surjit Sen & Manjula Rai	Biofertilizer and Biopesticide	Techno World	2019
2.	S. Rajan & R. Selvi Christy	Experimental Procedures in Life Sciences	CBS publications	2018
3.	Dr. Reeta Khosla	Biofertilizers and Biocontrol Agents for Organic Farming	Kojo Press	2017
4.	Dr. Hyma	Biofertilizers: Commercial Production Technology and Quality	Random publications	2017
5.	Mahendra K Rai	Hand book microbial biofertilizers. 9th edition.	The Haworth press, Inc.	2015
6.	Borkar S.G.	Microbes as Bio-fertilizers and their Production Technology	Woodhead Publishing India in Agriculture	2015

Reference Books:

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Rao B.N.S	Biofertilizers in Agriculture and Forestry	Oxford & IBH Publishing House	2019
2.	Sharma R.A.	Biofertilizer Technology	Agro tech Publishing Academy	2019
3.	Ameta O.P and Sharma U.S	Biopesticides for Sustainable Agriculture	Agro tech Publishing Academy	2018
4.	Somani .L	Biofertilizers: Commercial Production Technology and Quality control	Agro tech Publishing Academy	2018
5.	Bikas R. Pati Santi M. Mandal	Recent Trends in Biofertilizers	I K International Publishing House	2016

Web links:

1. https://agritech.tnau.ac.in/ta/org_farm/orgfarm_biofertilizers.html
2. https://agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology.html
3. http://www.techno-preneur.net/technology/new-technologies/food-agro/vam-fungi.html
4. http://14.139.187.9/ta/org_farm/orgfarm_faq's.html

Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

SKILL BASED ELECTIVE PRACTICAL-II (B)

SOLID WASTE MANAGEMENT -PRACTICAL

Semester -V	Internal Marks - 40	External Marks - 60				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB5SBE2BP	**Solid Waste Management - Practical**	**Skill Based Elective Practical**	**30**	**2**	**-**	**2**

Preamble: To make the students conversant with the types, collection, transport, processing and disposal of municipal solid waste.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Explain the Sample collection methods	K2
CO2	understanding of the Physical characteristics of municipal solid wastes	K4
CO3	Determine the Chemical compounds of solid waste	K4
CO4	Discuss about the Processing techniques of solid waste	K6
CO5	Elaborate Mushroom Cultivation methods by using organic Solid wastes	K6

Mapping with Programme Outcomes:

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

S – Strong, M- Medium, L – Low

SOLID WASTE MANAGEMENT –PRACTICAL (30 Hours)

1. Visit and collect the sample from a local polluted site -Urban/Rural/Industrial/Agricultural.
2. Determination of physical parameters of solid waste. a) Temperature b) Colour c) pH
3. Determination of Nitrogen and phosphorus of solid waste.
4. Isolation and identification of Microorganisms from solid waste.
5. Physical and chemical treatment processes of solid waste (Saccharification, Gasification, Pyrolysis)
6. Biological treatment processes of solid waste by composting- Indore Method
7. *Pleurotus* mushroom production by using house hold solid waste
8. Button mushroom production by using Agro-solid waste

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Maulin P. Shah, GauravSaxena and Vineet Kumar	Bioremediation for Environmental Sustainability	Elsevier Science	2020
2.	Tobias Richards and Mohammad J. Taherzadeh	Resource Recovery to Approach Zero Municipal Waste	CRC Press	2018
3.	Kumar S	Integrated Waste Management Volume II	Intech Publishers	2016
4.	AmmaiyappanSelvam, Rao Y. Surampalli, R. D. Tyagi and Jonathan W. C. Wong	Sustainable Solid Waste Management	American Society of Civil Engineers	2016
5.	M.N.V. Prasad	Bioremediation and Bioeconomy	Elsevier Science	2015

Weblinks:

1. https://en.wikipedia.org/wiki/Waste_management
2. http://www.houstontx.gov/solidwaste/
3. https://www.unc.edu/courses/2009spring/.../SolidWasteIndiaReview2008.pdf
4. https://www.cyen.org/innovaeditor/assets/Solid%20waste%20management.pdf

Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

SKILL BASED ELECTIVE PRACTICAL – III (A)

MEDICAL LABORATORY TECHNOLOGY-PRACTICAL

Semester V	Internal Marks: 40	External Marks: 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB5SBE3AP	**Medical Laboratory Technology – Practical**	**Skill Based Elective Practical**	**30**	**-**	**2**	**2**

Preamble: Medical Laboratory Technology (MLT) is a Clinical laboratory science effectively and comprehensively meets the requirements of students to develop manpower for health sector by providing them the necessary knowledge and skill to ensure the quality services in health care sector. This is an innovative, need-based and relevant training program meant to create job opportunities and self-employment.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Understand the safety practice, anatomy and instrumentation in microbiological laboratory	K2
CO2	Describe the cleaning of glasswares and sterilization of media	K2
CO3	Analyses and estimation of clinical specimen	K4
CO4	Explain blood grouping and Rh typing	K5
CO5	Summarize the serological tests	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

SYLLABUS: (30 hours)

1. Ethics of laboratory practice and general laboratory safety rules.
2. Study of body parts and bony landmarks on body surface (charts and models).
3. Principles and operations – Autoclave, Hot Air Oven, Incubators, Laminar Air Flow, Filtration, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer.
4. Cleaning of glasswares and sterilization techniques.
5. Preparation of culture media – solid, semi-solid and liquid.
6. Study on simple, differential, capsule and acid-fast staining.

7. Specimen collection: blood, urine, stool and swab (nose and throat).
8. Separation of serum and plasma.
9. Determination of blood cell count: RBC, WBC and differential leucocyte count.
10. Haemoglobin estimation – Sahli's acid hematin method.
11. Erythrocyte sedimentation rate – Westergren method.
12. Physical examination and Chemical examination of urine: Albumin, Creatinine, Urea, Bile salt (Hay's Test), Bile pigments (Fouchet's Test) and urobilinogen test.
13. Urine sugar determination by Benedict's method.
14. Blood grouping and Rh typing.
15. Serology – Widal test (slide and tube method), VDRL (RPR method), CRP, ASO, Beta-HCG in urine (pregnancy test).

References:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Kanai L. Mukherjee and Anuradha Chakravarthy	Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests	Mc Graw Hill, India	2017
2.	Harsh M.	Textbook of Pathology	Jaypee Publications	2017
3.	Solomon E.P.	Introduction to Human Anatomy and Physiology	Saunders	2016
4.	Vasudevan D.M., Sreekumari S. and Vidhyanathan K.	Textbook of Biochemistry for Medical students	Jaypee& Brothers Medical Publishers (P) Ltd.	2016
5.	Arora D.R and Arora B.B.	Textbook of Microbiology	CBS Publishers & Distributors	2016
6.	Nanda M.	Clinical Pathology Hematology and Blood Banking (For DMLT Students)	Jaypee Brothers Medical Publishers (P) Ltd.	2016
7.	Praful. B. Godkar	Text book of Medical Laboratory Technology	Bhalani Publications	2016
8.	Gary W.Procop and Elmer W.Koneman	Koneman's Color Atlas and Textbook of Diagnostic Microbiology	Wolters Kluwer Health	2016
9.	Sood Ramnik	Text book of Medical Laboratory Technology	Jaypee Publications	2015
10.	**Baker** F.J., **Silverton** R.E. and **Luckcock** E.D.	An Introduction to Medical Laboratory Technology	Elsevier Science	2015

Web links:

1. https://www.pdfdrive.com/medical-laboratory-technician-hematology-serology-blood-banking-and-immunohematology-e21321666.html

2. https://www.pdfdrive.com/medical-laboratory-technician-microbiology-afsc-90470-e17289142.html

3. https://www.pdfdrive.com/introduction-to-medical-laboratory-technician-e184576491.html

4. http://downloadinfobook1.firebaseapp.com/Medical-Laboratory-Technology-Kanai-Mukherjee-PDF-c3f0077fe.pdf

Pedagogy:

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

SKILL BASED ELECTIVE PRACTICAL-III (B)

VERMITECHNOLOGY- PRACTICAL

Semester -V	Internal Marks - 40	External Marks - 60				
Course Code	**Course Title**	**Category**	**L**	**P**	**T**	**Credits**
19UMB5SBE3BP	**Vermitechnology-Practical**	**Skill Based Elective Practical**	**30**	**2**	**-**	**2**

Preamble: The aim of this course is to make the student to know the importance of Vermitechnology in decomposing food waste into nutrient-rich fertilizer.

Course Outcome:

COs	CO Statement	Knowledge Level
CO1	Explain Vermitechnology and Production technology	K2
CO2	Illustrate methods of composting in a limited space and describe the decomposing process	K2
CO3	Analyze and study the biodiversity of local earthworms	K4
CO4	Create and maintain the environment pollution free	K6
CO5	Expand view of using worms to convert decomposing food waste into nutrient-rich fertilizer	K6

Mapping with Programme Outcome

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

S- Strong M- Medium L - Low

VERMITECHNOLOGY –PRACTICAL (30 Hours)

1. Key to identify different types of earthworms.
2. Field trip- Collection of native earthworms & their identification.
3. Study of sytematic position, habits, habitat &external characters, comparison of morphology & life stages of *Eisenia fetida* & *Eudrilus eugeniae.*
4. Study of vermiculture, vermiwash & vermicompost equipments
5. Preparation of vermibeds, maintenance of vermicompost & climatic conditions.
6. Harvesting, packaging, transport and storage of Vermicompost and separation of life stages.
7. Study the effects of vermicompost & vermiwash on any two short duration crop plants.
8. Study the effects of sewage water on development of worms.

Text Books:

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Debnarayan Roy	A Handbook of Vermitechnology	LAP Lambert Academic Publishing	2018
2.	LakshmiPrabha and Shanmuga Priya	Vermitechnology	LAP Lambert Academic Publishing	2014
3.	ShwetaYadav, Vinay Kumar Singh	Vermitechnology: Rebuilding of Sustainable Rural Livelihoods (Global Agriculture Developments)	Nova Science Publishers Inc	2014
4.	Madhab Chandra Dash	Charles Darwin's Plough Tool for Vermitechnology	I K International Publishing House	2013
5.	A Mary Violet Christy	Vermitechnology	MJP Publishers	2008

Weblinks:

1. https://composting.ces.ncsu.edu/vermicomposting-2/
2. https://www.planetnatural.com/composting-101/indoor-composting/vermicomposting/
3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermicomposting
4. https://foodprint.org/eating-sustainably/composting-and-food-waste/vermicomposting-101/

Pedagogy:

Power point presentation, Seminar, Assignment and Quiz.

CORE COURSE– VIII (CC)
INDUSTRIAL MICROBIOLOGY

Semester VI	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB6CC8	**Industrial Microbiology**	**Core**	**90**	**6**	**-**	**6**

Objective:

To inculcate the student knowledge about Industrial developments with respect to Microorganisms and find out the suitable technology for cultivating them under Industrial scale so as to develop them for employment in bioprocess industry. To learn the screening of industrial strains, fermenters, media, fermentation process and downstream process.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	List the History and Concept of Strain development	K1
CO 2	State the Fermentor and Fermentation media	K2
CO 3	Explain the Production and Purification Industrial Important Microbial Products	K2
CO 4	Describe the Production of Industrially valuable products.	K2
CO 5	Prepare the mass cultivation protocol for Pharmaceutical Products.	K3

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT I: 18 Hours

Introduction, Chronological development, Scope of Industrial Microbiology. Isolation and Identification of Industrially important microorganisms, major classes of products and processes. Isolation, Screening, preservation and improvement of industrially important Microbes. Development of inoculum for various fermentation processes. Strain improvements - Mutations, protoplast fusion and rDNA techniques for strain development.

UNIT II: 18 Hours

Fermentor design – Construction material for fermentors, Aeration and agitation in a fermentor, Temperature control in a fermentor, Foam control in fermenters. Types of fermentor and fermentation process - Batch, Fed batch and continuous.

UNIT III: 18 Hours

Solid and Submerged fermentation – Advantages & Disadvantages. Downstream processing –The recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation (Ammonium sulphate and Solvents), filtration, centrifugation, solvent recovery, chromatography (TLC), ultra filtration, drying, cell immobilizations and its applications.

UNIT IV: 18 Hours

Industrial media formulation strategies- economic means of providing energy- carbon, nitrogen, vitamin and mineral sources. Role of buffers, Prosthetic groups, Inducers, inhibitors and Antifoams. Computer applications in fermentation technology. Mass production of industrially important Products: Beer, Wine, Citric acid, Lactic acid and Lysine.

UNIT V: 18 Hours

Industrial production of pharmaceutically important Products: Amylase, Protease, Penicillin, tetracycline, Riboflavin, Cyanocobalamin, Steroids, Biopolymers, Recombinant vaccine (Hep B vaccine), Production of herbal drugs. Recycling and Safe disposal of industrial wastes by Trickling filter, Activated sludge and Oxidation ponds.

Text Books:

S.No	Author	Title	Publisher	Year of Publication
1.	Aydin Berenjian	Essentials in Fermentation technology	Springer	2020
2.	Hrudayanath Thatoi, Pradeep K. Das Mohapatra, Sonali Mohapatra and Keshab C. Mondal	Microbial Fermentation and Enzyme Technology	CRC Press	2020
3.	Casida LE	Industrial Microbiology	New Age International Private Limited	2019
4.	Stanbury P.F.A. Whitaker and S.J. Hall	Principles of fermentation techniques	Elsevier	2017
5.	Crueger W and Crueger A	Biotechnology: A Test Book of Industrial Microbiology	Medtech	2017
6.	Patel AH	Industrial Microbiology	Laxmi Publication	2011

Reference Books:

S.No	Author	Title	Publisher	Year of Publication
1.	Angelo Basile and Kamran Ghasemzadeh	Current Trends and Future Developments on (Bio-) Membranes:	Elsevier	2020
2.	T. A. Brown	Gene Cloning and DNA Analysis: An Introduction.	Wiley Blackwell., New Jersey	2020
3.	Michael L. Shuler and Fikret Kargi	Bioprocess Engineering: Basic Concepts	Pearson Education India	2015
4.	Agarwal AK and Pradeep Parihar	Industrial Microbiology	AGROBIOS	2012
5.	Doran	Bioprocess Engineering Principles	Elsevier	2012
6.	Richard H. Baltz, Arnold L. Demain and Julian E. Davies	Manual of Industrial Microbiology and Biotechnology	American Society for Microbiology	2010
7.	Prescott and Dunns	Industrial microbiology	CBS	2004

Web Links

1. https://www.youtube.com/watch?v=emUoAVOBGec
2. https://www.youtube.com/watch?v=eXEpiarmYkY
3. https://www.youtube.com/watch?v=Tdb0N_PMpEI
4. https://www.youtube.com/watch?v=opfPTm3z0rE
5. https://www.youtube.com/watch?v=YT34E_DJH24
6. https://www.youtube.com/watch?v=Uut1cUs6GpA
7. https://www.youtube.com/watch?v=RUoAmns7NiQ
8. https://www.youtube.com/watch?v=fL0CN_iyylA
9. https://www.youtube.com/watch?v=uOWS6q9HQGk
10. https://www.youtube.com/watch?v=D8jfLf_bODs

Pedagogy

Power point presentation, Group Discussion, Seminar, Quiz, Assignment, Animations.

CORE COURSE-IX (CC)

FOOD MICROBIOLOGY

Semester VI	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB6CC9	**Food Microbiology**	**Core**	**90**	**6**	**-**	**6**

Preamble: To understand the interactions between food, microorganisms and their environment to ensure food safety, quality, and value. Students study methods to preserve foods and prevent them from spoiling the food production chain.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	List the types of nutrition	K1
CO 2	State the sources of contamination in food	K2
CO 3	Explain the spoilage and preservation of food products	K2
CO 4	Describe food borne diseases	K2
CO 5	Prepare the physical and chemical methods of food preservation	K3

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT I: 18 Hours

Nutrition- Introduction and types of Nutrition- carbohydrates, proteins, vitamins, minerals & lipids. Nutrition for different ages – infants, adult, pregnant and lactating women, old age.

UNIT II: 18 Hours

Microorganisms in Food- bacteria, yeasts and molds. Types (chemical, physical and biological) and Sources of contamination (water, air, dust, equipment, sewage, insects, rodents, and employees)- Factors influencing microbial growth in food- Intrinsic factors: pH, water activity, oxidation reduction potential, nutrient content- Extrinsic factors: temperature, relative humidity, gaseous environments and processing operations.

UNIT III: 18 Hours

Contamination and spoilage of Food products- dairy products, cereals, Vegetables, Fruits, and meat. Fermented foods- Yogurt, cheese, bread, sauerkraut, pickles, beer- probiotics & prebiotics. Principles of food fermentation and the role of beneficial microbes.

UNIT IV: 18 Hours

Food borne diseases and food poisoning- *Staphylococcus*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Hepatitis, Amoebiosis. The role of microorganisms in food spoilage, pathogenic microorganisms, infection and intoxication, mycotoxin.

UNIT V: 18 Hours

Food preservations: principles- methods of preservations- Physical (drying, cooling, deep-freezing and heating) and chemical methods (Salting, sugaring and smoking), food sanitations. Microbiological quality standards of food. Goverment regulatory practices and policies. HACCP, ISI, Food safety- control of hazards.

Text Books:

S. No	Author	Title	Publisher	Year of Publication
1.	M. R Adams and M. O Moss	Food Microbiology	New Age International	2018
2.	R. C Dubey and D. K Maheshwari	A Textbook of Microbiology	S. Chand	2013
3.	G. Subbulakshmi and Shobha A Udipi	Food Processing and Preservation	New Age International	2006
4.	B. Srilakshmi	Food Science	New Age International	2018
5.	R.P Srivastava and Sanjeev Kumar	Fruit and Vegetable Preservation	CBS Publishers and distributors	2019

Reference Books:

S.No	Author	Title	Publisher	Year of Publication
1.	W.M Foster	Food Microbiology	CBS Publishers and distributors	2020
2.	Dr. M. Swaminathan	Handbook of Food and Nutrition	Bappco	2010
3.	William C Frazier and Dennis C Westhoff	Food Microbiology	Mc Graw Hill	2017
4.	James M Jay, Martin J. Loessner	Modern Food Microbiology	Springer	2005
5.	Bibek Ray, Arun Bhunia	Fundamentals of Food Microbiology	CRC Press	2014

Web Links

1. https://www.youtube.com/watch?v=kFvN_gZd2A4
2. https://www.youtube.com/watch?v=3qV0cqhH3JA
3. https://www.youtube.com/watch?v=T8_y24Wiugc
4. https://www.youtube.com/watch?v=3gi2IU520KA
5. https://www.youtube.com/watch?v=SIz19L2YbgI

Pedagogy

Power point presentation, Group Discussion, Seminar, Quiz, Assignments.

CORE PRACTICAL- IV (CP)

INDUSTRIAL & FOOD MICROBIOLOGY – PRACTICALS

Semester VI	Internal Marks : 40	External Marks : 60				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB6CC4P	**Industrial & Food Microbiology- Practicals**	**Core Practical**	**90**	**-**	**6**	**5**

Preamble: The main objective of this course is to understand the basic skills and production technologies applied in Industrial and Food Microbiology.

Course Outcome:

COs	CO Statement	Knowledge Level
CO1	Illustrate the immobilization of Yeast cell	K2
CO2	Describe about the Fermentation	K2
CO3	Organized view of industrially important products from microbes	K3
CO4	Critique knowledge about production of fermented foods	K4
CO5	Explain about the isolation of microbes from foods	K5

Mapping with Programme Outcome:

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

S- Strong, M- Medium, L - Low

SYLLABUS

INDUSTRIAL & FOOD MICROBIOLOGY - PRACTICALS

INDUSTRIAL MICROBIOLOGY

1. Immobilization of yeast cell using sodium alginate
2. Alcohol fermentation by *Saccharomyces cerevisiae*.
3. Estimation of alcohol using Potassium Di-chromate method.
4. Production of Citric acid from whey using *Aspergillus niger*
5. Production of antimicrobial substances from Lactic acid bacteria
6. Starch (Amylase), casein (Protease) and lipid (Lipase) hydrolyses tests

FOOD MICROBIOLOGY

1. Assessment of milk quality by methylene blue reduction test
2. Performance of phosphatase test for pasteurized milk.
3. Isolation and identification of bacteria from food by Standard Plate Count
4. Isolation and identification of Yeast from grapes.
5. Wet mount preparation of microbes in spoiled food- bread, tomato, grapes, potato.
6. Preparation of fermented food – Yoghurt, cheese and Wine
7. Industrial visit

References

S.No	Authors Name	Title of the Books	Publishers Name	Year
1.	Neelima Garg, K.L. Garg & K.G. Mukerji	Laboratory manual of Food Microbiology	Dream tech Press	2020
2.	S. Rajan & R. Selvi Christy	Experimental Procedures in Life Sciences	CBS publications	2018
3.	L. Arnold. Demain & Julian E. Davies	Manual of Industrial Microbiology and Biotechnology	ASM Press	2018
4.	Dr.Shalini Sehgal	Laboratory manual of Food Canners and Processors	Med tech Publishers	2018
5.	K.R.Aneja	Laboratory manual of Microbiology and Biotechnology	Med tech Publishers	2018
6.	Kulanthaivel S and. Janarthanan S.	Practical Manual on Fermentation Technology	I.K. International publishing	2012
7.	Ponmurugan P, Nithya R and Fredinose M	Experimental Procedure in Bioprocess Technology and Downstream Processing	Anjana Book House	2012

Web links:

1. https://en.wikipedia.org/wiki/Ethanol_fermentation
2. https://www.biologydiscussion.com/acids/citric-acid/citric-acid-discovery-fermentation-and-recovery-microbiology/66045
3. https://www.dairyknowledge.in/content/alkaline-phosphatase-test-pasteurized-milk
4. https://en.wikipedia.org/wiki/Yogurt

5. https://en.wikipedia.org/wiki/Cheese

Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

MAJAR BASED ELECTIVE - II (A)

MICROBIAL BIOTECHNOLOGY

Semester VI	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB6MBE2A	**Microbial Biotechnology**	**Major Based Elective**	**90**	**6**	**-**	**6**

Preamble:

The students will be able to understand the biological processes undergoing in Industries and exploit the knowledge to improve the process.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Predict the primary and secondary screening of microbes.	K3
CO2	Determine the applications of microbes	K4
CO3	Critique knowledge about industrial production	K4
CO4	Outline views of bio control agents	K5
CO5	Expand about Process of Bioremediation	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT I: 18 hours

Biotechnology: Definition –Milestones in History - Scope of microbial biotechnology and its applications. Industrially important microorganisms- Bacteria (Lactobacillus, Bacillus), fungi (Aspergillus, Penicillium), Actinomyces (Streptomyces).

UNIT II: 18 hours

Microbial production of bio fertilizers (Rhizobia, Azospirillum, BGA, Azolla, Frankia and VAM). Microbial production of bio-control Agents (Pseudomonas, Trichoderma viride). Microbial production of bioplastics.

UNIT III: 18 hours

Single cell protein (algae and yeast). Micro algal technology - Industrial cultivation methods of Spirulina biotechnological potentials of Spirulina as: food and feed. Fuel (bio-diesel) production from microalgae, pharmaceutically valuable compounds from microalgae. Commercial production of bio-ethanol using lignocellulosic waste.

UNIT IV: 18 hours

Genetic engineering of plants: Features of Ti plasmid and Mechanism of DNA Transfer, Role of virulence gene, Use of Ti vectors, promoters, Genetic markers, Methods of nuclear transfer – Electroporation, Microinjection. Herbicide and insect resistance. Transgenic plants-BT Cotton. Production of human growth hormone-Insulin.

UNIT V: 18 hours

Introduction to the use of Efficient microbes in environmental applications, Bioremediation- Degradation of xenobiotics, bioaugemntation, Bioemulsifiers, biosurfactants, MEOR (Microbial enhanced oil recovery), Leaching of ores.

REFERENCES

Text Books

S.No	Authors Name	Title of the Books	Publishers Name	Year of Publication
1	Singh, J., Vyas, A., Wang, S.,Prasad, R	Microbial Biotechnology: Basic Research and Applications	Springer	2020
2	Prakash Kumar Sarangi & Sonil Nanda	Biotechnology for Sustainable Energy and Products	I.K. International Publishing House Pvt. Ltd	2019
3	Jayanta Kumar Patra, Chethala N. Vishnuprasad, Giti shree Das	Microbial Biotechnology: Applications in Agriculture and Environment.	Springer	2017
4	Dr. Rita Singh and Dr. S.K. Ghosh	Industrial Biotechnology	Gvph-Publishers	2016
5	R C Dubey	Textbook of Biotechnology	S.Chand Publishing	2015

Reference Books

S.No	Authors Name	Title of the Books	Publishers Name	Year of Publication
1	William J. Thieman, Michael A. Palladino .	Introduction to Biotechnology (What's New in Biology),	Pearson Publications	2018.
2	N. Dane Scott.	Food, Genetic Engineering and Philosophy of Technology	Hardcover, Springer ;	2018.
3	Fernandes	Comprehensive Biotechnology,	M. Moo Young, Pergamon Press, UK	2016
4	Mahendra K Rai	Hand book microbial biofertilizers	The Haworth press, Inc. New York.	2015.
5	Ashim K. Chakravarty.	Introduction to Biotechnology,	Oxford University Press	2015

Web References

1.https://blackopscool.blogspot.com/2018/10/download-industrial-biotechnology-pdf.html

2.https://www.researchgate.net/publication/311576484_Industrial_Biotechnology_An Overview

3.https://onlinelibrary.wiley.com/doi/book/10.1002/9783527807833

4.https://stuvera.com/biotechnology-books-pdf/

5. https://content.kopykitab.com/eReader.html

Pedagogy

Power point presentation, Seminar, Assignment and Quiz.

MAJOR BASED ELECTIVE – II (B)

FOOD ADULTERATION

Semester VI	Internal Marks : 25	External Marks : 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credit**
19UMB6MBE2B	**Food Adulteration**	**Major Based Elective**	**90**	**6**	**-**	**6**

Preamble: The course is designed to provide comprehensive knowledge to the students regarding food safety and standardization act and quality control of foods.

Course Outcome:

COs	CO Statement	Knowledge level
CO1	Define the basics of Food adulteration	K1
CO2	Recite the knowledge about Food Safety and Standards	K1
CO3	Critique knowledge about Standardization of Foods	K4
CO4	Generalize the basic idea of Food additives	K6
CO5	Expand the role of Quality control	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

UNIT – I: 18 hours

Food adulteration – Introduction of food adulteration, definition. New adulterants in foods, Historical food legislation in India; Central food laboratory, Municipal laboratories, Export inspection council laboratory, Central grain analysis laboratory, standards of weights and measures act, solvent extracted oil, de-oiled meal and edible flour order, export and quality control, inspection act, other acts and orders.

UNIT –II: 18 hours

Food Safety and Standards Act 2006.vertical standards Vs horizontal standards .Food safety officer; powers, procedures, role of food analyst most important international laws; Codex alimentarius, FDA, USDA, FAO,HACCP,FSSAI and WHO. National and International regulatory bodies.

UNIT – III: 18 hours

Standardization of Foods; Definition, Standards of Quality, for cereals, starchy foods, spices and condiments, sweetening agents, meat and meat products, vinegar, sugar and confectionary, beverages-alcoholic and non-alcoholic , carbonated water, milk and milk products , oils and fats , canned foods , fruits and vegetables products.

UNIT – IV: 18 hours

Food additives – classification, nature and characteristics and use of additives in food such as antioxidants, chelating agents, coloring agents - algal colorants (natural & artificial), curing agents, emulsions, flavors and flavor enhancers, flour improvers, humectants and anti-caking agents, nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners. Raising agents – types and their role in food processing.

UNIT-V: 18 hours

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories for companies ,private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education, consumer problems rights and responsibilities, Consumer protection act (COPRA 1986), tips for wise purchasing, redressal measures how to give complaints and proforma of complaints.

Text Books:

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Mousumi Sen	Food Chemistry: Role of Additives, Preservatives and Adulteration	John Wiley and Sons	2021
2.	*Jonathan Rees*	Food Adulteration and Food Fraud (Food Controversies)	Reaktion Books	2020
3.	*Fredric Accum*	A Treatise on Adulterations of Food, And Culinary Poisons	Lector House LLP	*2019*
4.	*Rowland J. Atcherley*	Adulteration of Foods	Wentworth Press	2019
5.	*United States Congress*	Adulteration of Food	Forgotten Books	2019

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Rosalee S. Hellberg Karen Everstine Steven A. Sklare	Food Fraud: A Global Threat with Public Health and Economic Consequences	Academic Press Inc.	2020
2.	James Bell	The Analysis and Adulteration of Foods	Forgotten Books	2019
3.	Harvey Washington Wiley	Foods and Food Adulterants, Vol. 4	Forgotten Books	2019
4.	John W. Spink	Food Fraud Prevention: Introduction, Implementation, and Management (Food Microbiology and Food Safety)	Springer	2019
5.	William Ernest Mason	Adulteration of Food Products	Forgotten Books	2018

Web links:

1. https://www.sciencedirect.com/topics/food-science/food-adulteration
2. https://www.vedantu.com/biology/food-adulteration
3. https://www.publichealthnotes.com/food-adulteration-types-of-food-adulteration-and-mitigation-measures/
4. https://en.wikipedia.org/wiki/Adulterated_food
5. https://www.slideshare.net/SurajPanpatte1/different-methods-of-food-adulteration

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

MAJOR BASED ELECTIVE- III (A)

RECOMBINANT DNA TECHNOLOGY

Semester VI	Internal Marks: 25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB6MBE3A	**Recombinant DNA Technology**	**Major Based Elective**	**75**	**5**	**-**	**5**

Preamble: To acquaint the students to versatile tools and techniques employed in recombinant DNA technology. A sound knowledge on methodological repertoire allows students to innovatively apply these in basic and applied fields of biological research.

Course Outcome:

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

COs	CO Statement	Knowledge level
CO1	Understand the role of enzymes in rDNA technology	K2
CO2	Sketch the basic techniques of vectors and its biology	K3
CO3	Illustrate the gene cloning strategies in recombinant DNA	K4
CO4	Explain the importance of rDNA techniques	K5
CO5	Summarize the applications of recombinant technology	K6

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I: Introduction to rDNA Technology (18 hours)

History and recent developments in rDNA technology, Enzymes used in rDNA technology – Restriction enzymes: types and importance of Type II restriction enzymes, DNA Ligases, DNA polymerase, Ribonucleases, Reverse transcriptase, Alkaline phosphatase, T4 Polynucleotide kinase, Terminal deoxynucleotidyl transferase,

Nucleases: S1Nuclease and DNase.

Unit II: Cloning Vectors (15 hours)

Cloning Vectors: properties and types. Plasmids – vectors for cloning in *E. coli*: pUC, pBR322 and pGEM3Z. Bacteriophage vectors: Lambda, M13, Phagemids and T7 promoter-based vector. Shuttle vectors: YACs, YEps, BACs. Animal viruses: SV40, Baculo and their use as vectors.

Unit III: Gene Cloning Strategies (12 hours)

Gene cloning strategies, Uses of adapters and linkers. Screening and selection of recombinant clones: Colony Hybridization techniques, lacZ complementation (Blue-white selection) and Immuno-screening. Construction of genomic DNA and cDNA libraries.

Unit IV: rDNA Techniques (18 hours)

Introduction to Gene sequencing methods: Sanger's termination, automated and next generation sequencing, Polymerase chain reaction and RT-PCR, DNA finger printing: RAPD and RFLP, Chromosome walking, Blotting techniques and Electrophoresis (Agarose Gel and SDS – PAGE). Brief introduction of CRISPR-Cas9 gene editing technology. Methods of gene transfer techniques in plants and animals: *Agrobacterium* mediated, electroporation and particle gun.

Unit V: Applications of rDNA (12 hours)

Transgenic animals - sheep and mice, Transgenic plant - BT brinjal, Molecular pharming, Brief introduction to Gene therapy, Corona vaccine and Human genome project. Merits and demerits of recombinant products. Hazards and safety regulations in r-DNA Technology.

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	T. A. Brown	Gene Cloning and DNA Analysis. An Introduction. (8th Edition)	Blackwell Publications	2020
2.	Monika Jain	Recombinant DNA Techniques: A Text book	Narosa, India	2020
3.	Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA. (5thEdition)	ASM Press	2017
4.	Mukherjee, Siddhartha	The Gene: An Intimate History	Scribner Publication	2017
5.	S.B. Primrose and R.M. Twyman	Principles of Gene manipulation and Genomics. (7th Edition)	Blackwell Scientific Publications, India	2014

Reference Books

S.No.	Authors Name	Title of the book	Publishers Name	Year
1.	Daniel L.Hartl	Analysis of Genes and Genomes. (9th Edition)	Jones & Bartlett Learning, US	2019
2.	Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick	Lewin's genes XII	Jones and Bartlett Learning, US	2018
3.	Fridos Alam Khan	Biotechnology Fundamentals (2nd Edition)	CRC Press	2017
4.	T.A. Brown	Gene Cloning and DNA analysis. (7th Edition)	Blackwell Publication	2016
5.	Chaudhuri, Keya	Recombinant DNA Technology	TERI, New Delhi	2015

Web links:

1. https://physicscatalyst.com/biotechnology/recombinant-dna-technology.php
2. https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod2.pdf
3. https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter14.pdf
4. http://www.bio.brandeis.edu/classes/heredity/Lecture%20Powerpoints/Chapter_13_1.pdf
5. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

Pedagogy

Power point presentations, Group discussion, Seminar, Quiz, Assignment, Brain storming activity.

MAJOR BASED ELECTIVE–III (B)

BIOLOGICAL TECHNIQUES

Semester VI	Internal Marks :25	External Marks: 75				
Course Code	**Course Title**	**Category**	**L**	**T**	**P**	**Credits**
19UMB6MBE3B	**Biological Techniques**	**Major Based Elective**	**75**	**5**	**-**	**5**

Preamble: To educate the students with the basic principles of microbial techniques so as to develop their research aptitude and career prospects.

Course Outcome:

COs	CO Statement	Knowledge level
CO 1	Recall microscopic techniques.	K1
CO 2	Apply the spectroscopic, Spectrophotometric methods & analytical techniques.	K3
CO 3	Critique knowledge about chromatographic techniques.	K5
CO 4	Revise about electrophoresis & its applications.	K6
CO 5	Combine view of molecular techniques.	K6

Mapping with Programme Outcomes:

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

S- Strong; M-Medium; L-Low

Syllabus:

UNIT-I: MICROSCOPIC TECHNIQUES (15 Hours)

Basic principles, mechanisms and application of Bright Field, Dark field, Phase contrast, Polarization, Confocal laser scanning microscope, Fluorescence, Scanning Electron microscope & Transmission Electron Microscope (SEM & TEM) and Radio- frequency scanning tunneling microscopy, Atomic force microscopy. Preparation of microbial, animal and plant samples for microscopy.

UNIT-II: SPECTROSCOPY & SPECTROPHOTOMETRY (15 Hours)

Basic concepts and applications of Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy,UV/Visible spectrophotometry, Infrared spectroscopy, Fourier-transform infrared spectroscopy (FTIR), Nuclear Magnetic Resonance spectroscopy (NMR).

UNIT III- CHROMATOGRAPHIC TECHNIQUES (13 Hours)

Basic Principles and application of Bioautography, Thin-layer chromatography, Paper chromatography, Gel filtration chromatography, Ion- exchange chromatography, Affinity chromatography, Gas chromatography and High Performance Liquid chromatography.

UNIT IV- CENTRIFUGATION & ELECTROPHORESIS (15 Hours)

Basic principles and applications of Centrifuges - Preparative, analytical, high speed, low speed, ultracentrifuge, differential and density gradient.

Basic concepts and applications of Gel Electrophoresis- Agarose and acrylamide (native, denaturing and gradient), Isoelectric focusing, 2D Electrophoresis, Immunoelectrophoresis and Pulse field Electrophoresis.

UNIT V- RADIOGRAPHY & MOLECULAR TECHNIQUES (17 Hours)

Basic principles and application of Autoradiography. Liquid scintillation counting, phosphor imaging, Imatinib Resistance Mutation Analysis. Types of PCR- Real time PCR, Reverse Transcriptase PCR, Multiplex PCR, Nested PCR and In-situ PCR. Blotting (Southern, Western, Northern) Techniques, DNA Finger printing, RFLP, RAPD and AFLP application.

Text Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	RaoD M	Instrumental Methods of Analysis	CBS publishers and distributors pvt ltd	2020
2.	Gurdeep R. Chatwal	Instrumental Methods of Chemical Analysis	Himalaya publishing house	2019
3.	Bhawana Pandey M.H. Fulekar	Bioinstrumentation	Dreamtech Press	2019
4.	Gilbert H mitchell	Gel Electrophoresis: Types, Applications & Research	Nova Science Publishers	2017
5.	Jessica carol	Textbook of Analytical Biochemistry	Syrawood Publishing House	2016

Reference Books

S.No	Authors Name	Title of the book	Publishers Name	Year
1.	Ankita Jain, Haresh Kalasariya, Varsha Tailor, Nikunj B. Patel	Bioinstrumentation techniques-Basics and applications	Notion Press	2020
2.	Gakhar, Monika Miglani, Ashwani Kumar	Molecular Biology: A Laboratory Manual	Dreamtech Press	2019
3.	Almroth E. Wright	Principles of Microscopy: Being a Handbook to the Microscope	Forgotten Books	2018
4.	*Andreas Hofmann and Samuel Clokie*	*Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*	*Cambridge University Press*	2018
5.	*Sanjay B Bari*	*Theory and Practice of Chromatographic Techniques*	*Pharma Med Press*	2017

Web links:

1.http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf

2. https://research.ipmu.jp/seminar/sysimg/seminar/574.pdf

3.http://www-keeler.ch.cam.ac.uk/lectures/Irvine/

4. https://www.ccamp.res.in/sites/default/files/Basics%20of%20Chromatography_KR_C-CAMP.pdf

5. http://www.bdu.ac.in/schools/biotechnology-and-genetic-engineering/biomedical-science/docs/course_materials/Biotechniques/Electrophoresis.pdf

6.https://ehs.psu.edu/sites/ehs/files/lsc_theory_of_operation_part_1.pdf

7.https://www.youtube.com/watch?v=kOCcmJ3nVQ4

Pedagogy

Power point presentations, Group Discussion, Seminar, Quiz, Assignment, Brain Storming Activity.