

VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

ELAYAMPALAYAM, TIRUCHENGODE(Tk.), NAMAKKAL(Dt.).

(Affiliated to Periyar University, Approved by

AICTE, Re-Accredited with 'A' Grade by NAAC)

Recognized under section 2(f)&12(B)of UGC ACT 1956,

An ISO 9001:2015 (Certified institution)

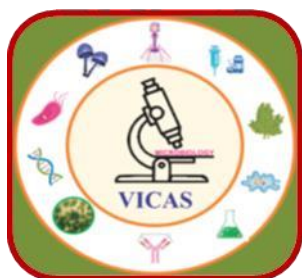


DEPARTMENT OF MICROBIOLOGY

B.Sc., MICROBIOLOGY

PROGRAMME CODE: UMB

SYLLABUS & REGULATIONS



FOR CANDIDATES ADMITTED FROM
2023-2024 ONWARDS

UNDER AUTONOMOUS, OBE AND TANSCHÉ PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS

Angammal Educational Trust

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B.Sc., Microbiology

1.SCOPE OF THE COURSE

The course of Microbiology is intended to prepare the students not only to be knowledgeable in the science of Microbiology, but also to be useful in the upliftment of the social and economic well being. Courses offered cover all areas of basic and applied microbiology and these prepare students for a Bachelor of Science degree in Microbiology.

The degree is a three-year full time programme. The programme is not only a specialist programme, but it is also designed to be relevant to the social and economic needs of the nation. In reflection to the specialized nature of the programme, emphasis is given to practical and acquisition of practical skills.

The Programme has been involved in teaching basic and applied microbiology as well as making findings on local problems of microbiology interest. The vision of the programme is therefore, to produce graduates who are not only knowledgeable in the science of microbiology, but who can make significant contributions to the development the human society.

The programme is aimed at training undergraduate graduate students who would have adequate background knowledge and practical skills for application in postgraduate research, teaching, industrial production, medicine, environmental management and biotechnology.

2.SALIENT FEATURES

- ❖ Course is specially designed for a higher level career placement.
- ❖ Special guest lecture from industries will be arranged.
- ❖ Enables students to gain a job oriented degree.
- ❖ Special industry orientations and training are parts of the degree course.

3.OBJECTIVES OF THE COURSE

The specific objectives of the programme are:

- ❖ To equip the undergraduate students with a sound knowledge of the fundamental principles involved in the study of microbiology.
 - ❖ To produce graduates that would make impact in the diverse fields of human endeavor considering the ubiquitous nature of microorganism and the wide – ranging applications of the knowledge of microbiology.
 - ❖ To provide focus for a career in various fields of applied science including medicine, pharmacy, bio-mining, biotechnology, industrial production, environmental management, agriculture and bioinformatics.
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4.ELIGIBILITY FOR ADMISSION

Candidates seeking admission to the first-year degree course for **B.Sc., Microbiology** shall be required to have passed

- a) Higher secondary examination with biology as major subjects conducted by the Government of Tamil Nadu (or)
- b) These regulations shall take effect from the academic year 2017-2018 and 2020 - 2021 i.e. for the students who are to be admitted to the first year of the course during the academic year 2017-2018 and 2020 - 2021 thereafter
- c) Any examination with biology as major subjects of any other University or Board accepted as equivalent there to by Periyar University.
- d) Academic and vocational stream candidates are eligible.

5.DURATION OF THE COURSE

- The course shall extend over a period of three academic years consisting of six semesters. Each academic year will be divided into two semesters. The first semester will consist of the period from July to November and the second semester from December to March.
- The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Vivekanandha College of Arts and Sciences for Women (Autonomous) with the approval of Periyar University.
- Each subject will have six hours of lecture per week apart from practical at the end of even semester.

6.CONTINUOUS INTERNAL ASSESSMENT

The performance of the students will be assessed continuously and the Internal Assessment Marks will be as under:

Theory

1. Average of two tests	-	05 Marks
2. Model examination	-	10 Marks
3. Assignment	-	05 Marks
4. Attendance	-	05 Marks
Total		25 Marks

ESE practical

1. Practical best average of two tests	- 30 Marks
2. Attendance	- 05 Marks
3. Observation note	- 5 Marks
Total	40 Marks

Break-up Details for Attendance

Below 75%	- No Marks
76 to 80%	- 1 Mark
81 to 85%	- 2 Marks
86 to 90%	- 3 Marks
91 to 95%	- 4 Marks
96 to 100%	- 5 Marks

PASSING MINIMUM

INTERNAL

The passing minimum for internal examination shall be 10 marks (out of 25 marks).

EXTERNAL

In the end semester examinations, the passing minimum shall be 40 % of 75 Marks (30 Marks)

7. ELIGIBILITY FOR EXAMINATION

A candidate will be permitted to appear for the end semester examination only on earning 75 % of attendance and only when her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Successful candidates passing the examination of language, core, allied, elective, skill based elective and non major elective courses and securing marks

- 75% and above shall be declared to have passed the examination in first class with Distinction provided they pass all the examinations prescribed for the course at first appearance itself.
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- b) 60% and above but below 75% shall be declared to have passed the examinations in first class without distinction.
- c) 50% and above but below 60% shall be declared to have passed the examinations in second class.
- d) All the remaining successful candidates shall be declared to have passed the examinations in third class.
- e) Candidates who pass all the examinations prescribed for the course at the first appearance itself and within a period of three consecutive academic years from the year of admission only will be eligible for University rank.

9.ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the above degree for a period of not less than three academic years comprising of six semesters and passed the examinations prescribed and fulfilled such conditions as have been prescribed therefore.

10.PATTERN OF QUESTION PAPER

- PART- A** (Objective) Answer all Questions 10 x 1 = 10 Marks
PART- B (Descriptive) Answer all 5 Questions (either or type) 5 x 7 = 35 Marks
PART - C (Descriptive) Answer any 3 Questions (three out of five) 3 x 10 = 30 Marks

11.PROCEDURE IN THE EVENT OF FAILURE

If a candidate fails in a particular subject, she may reappear for the university examination in the concerned subject in subsequent semesters and shall pass the examination.

12.COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2023 - 2024 *i.e.* for the students who are to be admitted to the first year of the course during the academic year 2023 - 2024 and thereafter.

13.TRANSITORY PROVISION

Candidates who were admitted to the UG course of Microbiology before 2023 – 2024 shall be permitted to appear for the examinations under those regulations for a period of three years *i.e.*, up to and inclusive of the examination of April/May 2026. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

VISION

To evolve into a centre of excellence in higher education through creative and innovative practices to secure social equity for women.

MISSION

1. To provide sufficient learning infrastructure to the students to pursue their studies.
2. To provide good opportunity for higher education and conducive environment to the students to acquire education.
3. To provide high quality academic programme, training activities and research facilities.
4. To facilitate industry-institute interface.

PG AND RESEARCH DEPARTMENT OF MICROBIOLOGY

VISION

Aspires to be a microbiologist committed to progress the quality of human lives by exploring environment, fighting with disease and to utilize microbes for healthy food.

MISSION

- To educate the students to acquire the academic excellence with national and international recognition.
 - To train the students to recognize, investigate and to resolve the myriad of microbiological problems affecting health and the environment through the programme designs
 - To contribute to the cutting edge in Microbiology by pursuing high quality research and other scholarly activities.
 - To motivate the students to become a women entrepreneur by applying their knowledge in the field of microbiology.
 - To establish as an expert resource within the geographical areas regarding all issues related to medical and environmental microbiology.
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B.Sc., MICROBIOLOGY

PROGRAMME OUTCOME:

POs	OUTCOME
PO-1	Problem Solving and Decision making Skill Ability to draw conclusions from one's knowledge and use one's skills to address a variety of unfamiliar problems and to encourage the development of analytical and critical thinking skills for data-driven decision-making.
PO-2	Employability and entrepreneurial skill Inculcate contemporary business practices to enhance employability skills in the competitive environment and to equip with skills and competencies to become an entrepreneur.
PO-3	Communication and Leadership Skill Capacity to enhance interpersonal, management, and communication abilities.
PO-4	Multi-cultural competence with Contribution to society Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO-5	Moral and Ethical Values The capacity to live a life that upholds moral and ethical principles, to think critically about and present arguments for positions on moral issues, and to apply moral principles to all aspects of one's job.

PROGRAMME SPECIFIC OUTCOME:

- PSO 1 This program provides comprehensive knowledge and practical training in the spread of microorganisms, disease causation, diagnosis and treatment of pathogens significant to public health.
- PSO 2 Students will acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.
- PSO 3 Students gain the knowledge of principles and practices in the main applications of microorganisms to the industrial production of foods, microbial metabolites, proteins and other useful products, including the use of genetically modified organisms.
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SCHEME OF CURRICULUM– B.Sc.,MICROBIOLOGY

(For the candidates admitted during the academic year 2024- 2025 onwards)

Sem	Subjectcode	Part	Course	Subjects	Hrs/ Week	Credits	Int. Mark s	Ext. Marks	Tot. Marks
I	23U1LT01	I	Language–I	Tamil–I	6	3	25	75	100
	23U1LH01			Hindi– I					
	23U1LM01			Malayalam–I					
	23U1LE01	II	English-I	English – I	4	3	25	75	100
	23U1MBC01	III	Core–I	Fundamentals of Microbiology and Microbial diversity	5	5	25	75	100
	23U1MBCP01	III	Core practical-I	Fundamentals of Microbiology Practical–I	5	3	40	60	100
	23U1BCGE01	III	GE –I	Basic and Clinical Biochemistry	4	3	25	75	100
	23U1MBS01	IV	SEC-I	Organic Farming and Biofertilizer Technology	2	2	25	75	100
	23U1ENAC01		AECC-I	Soft Skills for Effective Communication	2	2	25	75	100
	23U1VE01	V	Value education	Health Human Values and Yoga	2	2	25	75	100
Total					30	23	215	585	800
II	23U2LT02	I	Language–II	Tamil– II	6	3	25	75	100
	23U2LH02			Hindi–II					
	23U2LM02			Malayalam–II					
	23U2LE02	II	English – II	English – II	4	3	25	75	100
	23U2MBC02	III	Core–II	Microbial Physiology and Metabolism	5	5	25	75	100
	23U2MBCP02	III		Microbial Physiology Practical– II	5	3	40	60	100
	23U2BTGE01	III	GE–II	Bioinstrumentation	4	3	25	75	100
	23U2MBS02	IV	SEC-II	Sericulture	2	2	25	75	100
	23U2CSAC02	IV	AECC-II	Office Automation	2	2	25	75	100
	23U2EVS01	V	EVS	Environmental studies	2	2	25	75	100
Total					30	23	215	585	800
III	23U3LT03	I	Language– III	Tamil–III	5	3	25	75	100
	23U3LH03			Hindi–III					
	23U3LM03			Malayalam–III					
	23U3LE03	II	English – III	English – III	5	3	25	75	100
	23U3MBC03	III	Core–III	Cell Biology	5	5	25	75	100
	23U3MBC04		Core–IV	Microbial Genetics	5	5	25	75	100
	23U3MBCP03		Core Practical – III	Cell biology &Microbial Genetics Practical – III	4	2	40	60	100
	23U3MBDE01	III	DSE – I	Clinical Laboratory Technology	4	3	25	75	100
	23U3MBDE02			Antimicrobial Resistance Theory and Practice					
	23U3MBN01	IV	NMEC– I	Selected from the list	2	2	25	75	100
Total					30	23	190	510	700
IV	23U4LT04	I	Language–IV	Tamil– IV	5	3	25	75	100
	23U4LH04			Hindi–IV					
	23U4LM04			Malayalam–IV					
	23U4CE04	II	English – IV	English – IV	5	3	25	75	100
	23U4MBC05	III	Core–V	Immunology and Immunotechnology	5	5	25	75	100
	23U4MBC06		Core–VI	rDNA Technology	5	5	25	75	100

	23U4MBCP04		Core Practical-IV	Immunotechnology & rDNA Technology Practicals - IV	4	2	40	60	100	
	23U4MBDE03	III	DSE -II	Microbiology in Poultry Industries	4	3	25	75	100	
	23U4MBDE04			Vaccine Technology						
	23U4MBN02		NMEC-II	Selected from the list	2	2	25	75	100	
				Total	30	23	190	510	700	
V	23U5MBC07	III	Core-VII	Medical Bacteriology and Mycology	5	4	25	75	100	
	23U5MBC08	III	Core-VIII	Soil and Environmental Microbiology	4	4	25	75	100	
	23U5MBC09	III	Core-IX	Basics in Biostatistics and Bioinformatics	4	4	25	75	100	
	23U5MBCP05	III	Core practical-V	Bacteriology, Mycology, Soil and Bioinformatics Practical-V	5	3	40	60	100	
	23U5MBDE05	III	DSE - III	Microbial Quality control and Testing	4	3	25	75	100	
				Hematology and Blood Banking						
	23U5MBDE07	III	DSE-IV	Biodegradation and solid waste Management	4	3	25	75	100	
	23U5MBDE08			Plant Pathology and Hydroponics						
				SEC -I	Cyber Security & Ethical Hacking / Professional Ethics	2	2	25	75	100
		23U5MBPR01	IV		Group Project	2	1	40	60	100
		23U5INT01	IV		Internship (Minimum 15days during summer holidays IV Sem)	0	1	-	-	-
				Total	30	25	230	570	800	
VI	23U6MBC10	III	Core-X	Medical Virology and Parasitology	4	4	25	75	100	
	23U6MBC11	III	Core-XI	Food, Dairy and Probiotic microbiology	4	4	25	75	100	
	23U6MBC12		Core - XII	Bio-process Technology	5	4	25	75	100	
	23U6MBCP06	III	Core Practical-VI	Virology, Parasitology, Food and Bio-processes Practical-VI	5	2	40	60	100	
	23U6MBDE09	III	DSE-V	Pharmaceutical Microbiology	4	3	25	75	100	
	23U6MBDE10			Biosafety and Bioethics in Microbiology						
	23U6MBDE11		DSE-VI	Entrepreneurship and Biobusiness	4	3	25	75	100	
	23U6MBDE12			Food Process Technology						
				SEC -II	Academic Writing & Academic Portfolio	2	2	25	75	100
		23U6MBEX01	V		Extension activity – Report to be submitted as individual/group activity	2	1	-	-	-
				Total	30	23	190	510	700	
				Overall Total	180	140	1230	3270	4500	

NMEC offered by Microbiology Department: Women Health and Hygiene (23U3MBN01)

SEMESTER I



SEMESTER-I
23U1MBC01
Credits-5

CORE-I
Total Number of Hours:75
5 Hours/Week

FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

Course Objectives:

- Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
- Describe the structural organization, morphology and reproduction of microbes.
- Explain the methods of cultivation of microbes and measurement of growth.
- Understand the microscopy and other basic laboratory techniques –culturing, disinfection and sterilization in Microbiology.
- Compare and contrast the different methods of sterilization.

Course Outcome:

CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell-organelles.
CO3	Understand the various microbiological techniques, different types of media and Techniques involved in culturing microorganisms.
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their Function and scope of application.
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.

UNIT-I

No. of Hours:15

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity-ecological niche. Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.

UNIT-II

No. of Hours:15

General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of Cyanobacteria and Microalgae.

UNIT-III

No. of Hours:15

Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques. Microbial Preservation techniques.

UNIT-IV

No. of Hours:15

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM&SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.

UNIT-V

No. of Hours:15

Sterilization–moist heat -autoclaving, dryheat –Hot air oven, radiation–UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.

Text Books

1. Pelczar. M.J.,Chan E.C.S. and Noel.R.K.(2007).Microbiology.7thEdition.,McGraw–Hill, New York.
2. WilleyJ., SherwoodL.,and WoolvertonC.J.,(2017).Prescott’sMicrobiology.10th Edition., McGraw-Hill International edition.
3. Tortora,G.J.,Funke,B.R.,Case,C.L.(2013).Microbiology. AnIntroduction 11th Edition., A La Carte Pearson.
4. Salle.A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGrawHillInc. New York.
5. Boyd,R.F.(1998). General Microbiology, 2ndEdition., Times Mirror, Mosby College Publishing, St Louis.

Reference Books

1. Jeffrey C. Pommerville., Alcamo’s Fundamentals of Microbiology (9thEdition). Jones & Bartlett learning 2010.
 2. StanierR.Y,IngrahamJ.L.,Wheelis M.L., and Painter R.R.(2010). General Microbiology, 5th Edition., MacMillan Press Ltd.
Tortora, G. J., Funke, B.R. and, Case, C.L(2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
 3. NesterE., Anderson D., Roberts C.E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.
 4. MadiganM.T., Martinko J.M., Stahl D.A, and Clark D.P.(2010). Brock –Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.
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Web References

1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>
2. <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#>
4. <https://bio.libretexts.org/@go/page/9188>
5. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/>

SEMESTER-I
23U1MBCP01
Credits-3

CORE PRACTICAL-I
Total Number of Hours:45
5Hours/Week

PRACTICAL-I

FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

Course Objectives

- Acquire knowledge on Cleaning of glasswares, GLP and sterilization.
- Gain knowledge on media preparation and cultural characteristics.
- Learn the pure culture technique
- Learn the microscopic techniques and staining methods.
- Acquire knowledge on stain and staining methods

Course Outcome:

CO1	Practice sterilization methods; learn to prepare media and their quality control.
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.
CO3	Understand Microscopy methods, different Staining techniques and motility test.
CO4	Observe culture characteristics of microorganisms.
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount

1. Cleaning of glass wares,
2. Microbiological good laboratory practice and safety in laboratories
3. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.
4. Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates. Preparation of basal, differential, enriched, enrichment, transport, and Selective media preparation-
5. Quality control of media, growth supporting properties and sterility check of media.
6. Pure culture techniques: streak plate, pour plate, decimal dilution.
7. Culture characteristics of microorganisms: growth on different media, growth characteristics, and description.
8. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.
9. Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. Study on Microbial Diversity using Hay Infusion Broth-Wet mount techniques,
10. Types of microbes, hanging drop.

Text Books

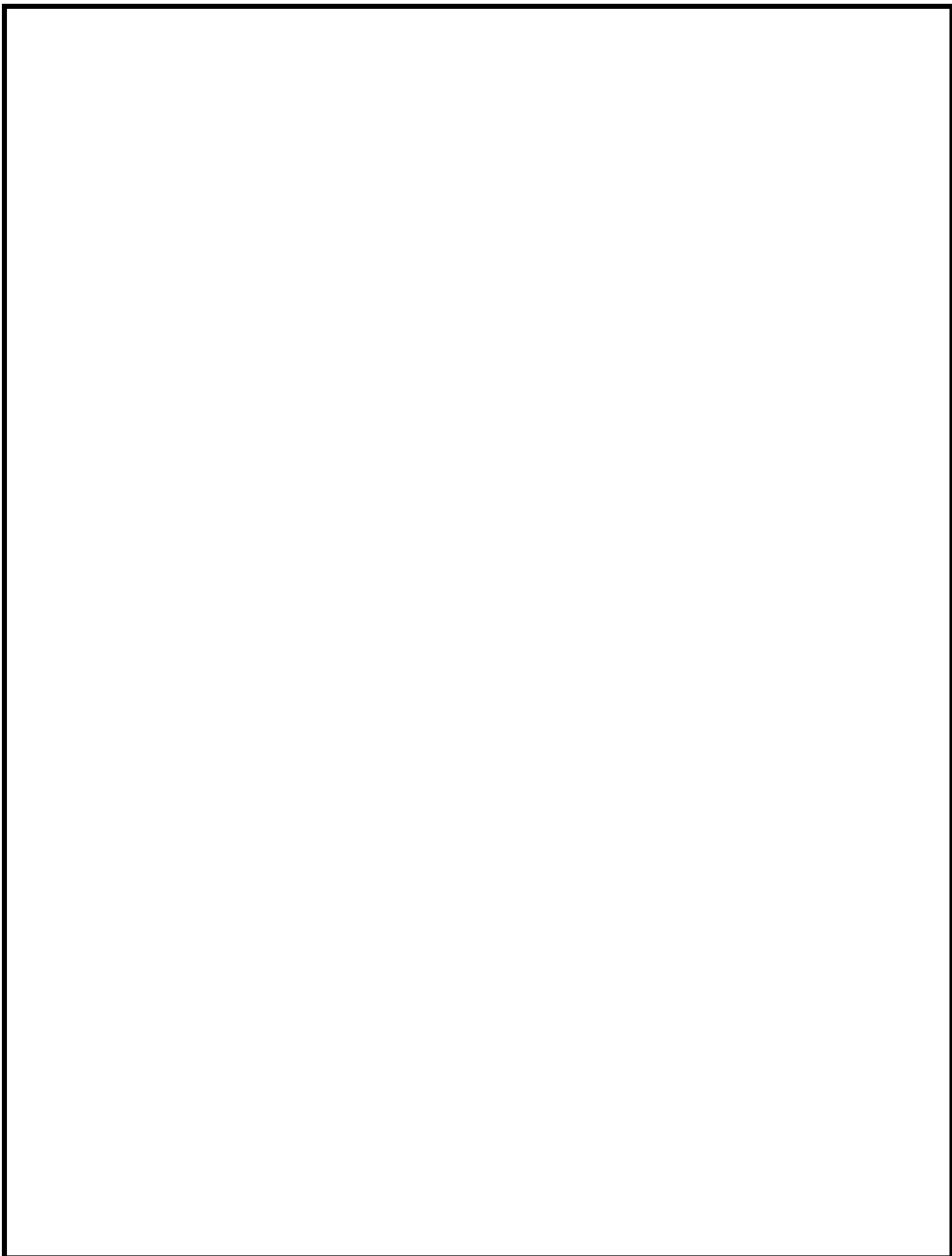
1. James G Cappucino and N. Sherman MB(1996).A lab manual Benjamin Cummins, New York 1996.
2. Kannan. N(1996).LaboratorymanualinGeneralMicrobiology.PalaniPublications.
3. Sundararaj T(2005).Microbiology Lab Manual(1stedition)publications.
4. Gunasekaran,P.(1996).LaboratorymanualinMicrobiology.NewAgeInternationalLd., Publishers, New Delhi.
5. RC Dubey and DK Maheswari (2002). Practical Microbiology. S. Chand Publishing.

References Books

1. Atlas. R(1997).Principles of Microbiology, 2ndEdition, Wm. C. Brown publishers.
2. AmitaJ, Jyotsna A and Vimala V(2018).Microbiology Practical Manual. (1stEdition). Elsevier India
3. Talib VH(2019). Handbook Medical Laboratory Technology. (2ndEdition). CBS
4. WheelisM,(2010).PrinciplesofModernMicrobiology,1stEdition.JonesandBartlett Publication.
5. Lim D.(1998).Microbiology, 2ndEdition,WCBMcGrawHillPublications.

Web Resources

1. <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.
2. <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
3. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4. <https://microbiologyinfo.com/top-and-best-microbiology-books/>
5. <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>



SEMESTER-I
23U1MBS01
Credits-2

SEC- I
Total Number of Hours:30
2Hours/Week

ORGANIC FARMING & BIOFERTILISER TECHNOLOGY

Course Objectives:

- Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.
- To encourage organic farming in urban areas.
- Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective.
- Structure and characteristic features of Cyanobacterial and fungal biofertilizer
- Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bio-efficacy of biofertilizers.

Course Outcome:

CO1	Become an Entrepreneur with wide knowledge about farming and sustainable Resources.
CO2	Implement organic farming in urban areas with knowledge on compost.
CO3	Gain knowledge about the bacterial Bio fertilizers and its advantages
CO4	Understand the significance about Cyanobacterial and fungal biofertilizers
CO5	Understand and implement the use of biofertilizers.

UNIT-I

No. of Hours: 06

Principle of organic farming: principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agro chemical need. Biodiversity –crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling.

UNIT-II

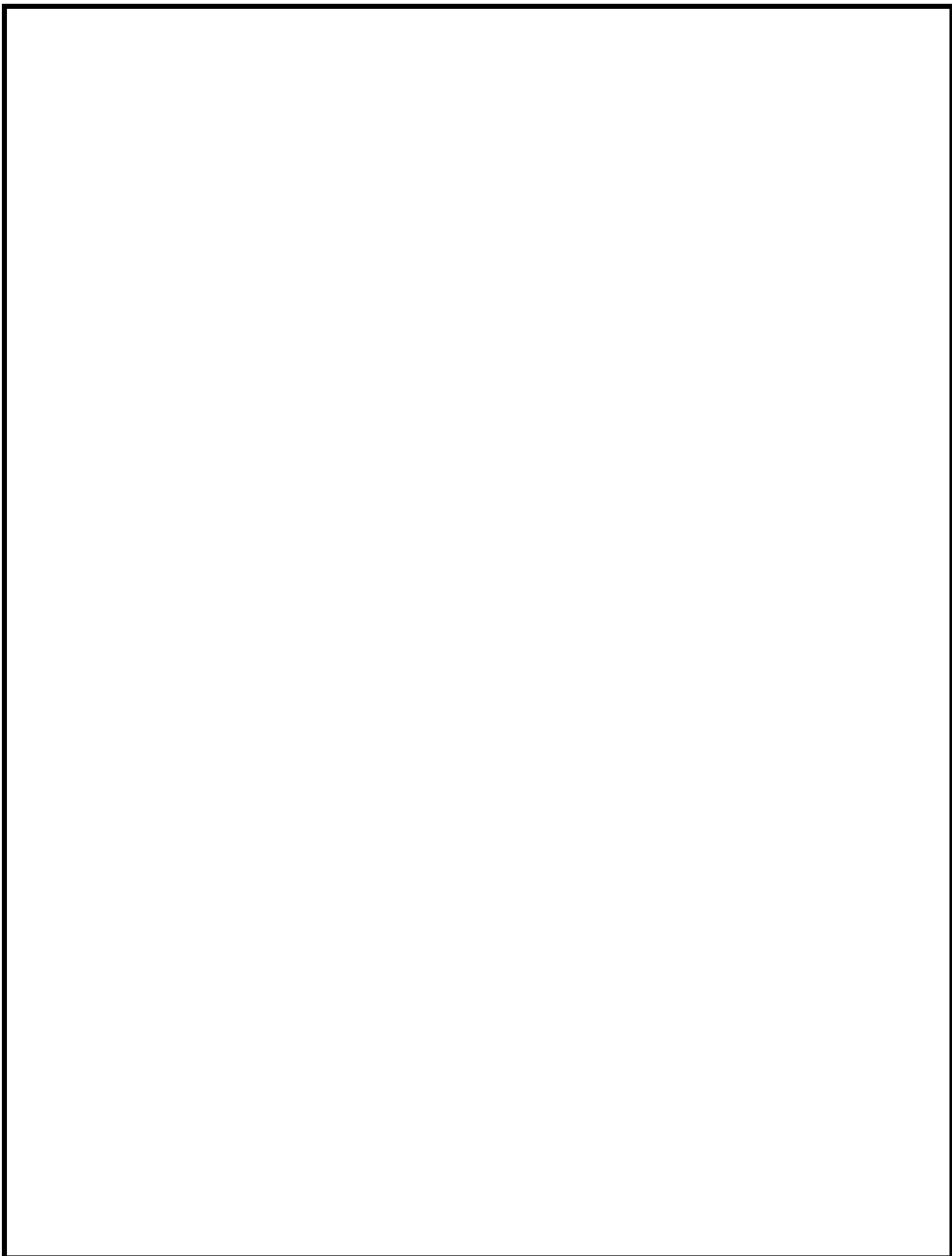
No. of Hours: 06

Organic farming for urban space; Create a Sustainable Organic Garden(Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming)Composting, Vermi-composting

UNIT- III

No. of Hours: 06

Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic



features of bacterial biofertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*

UNIT-IV

No. of Hours : 06

Structure and characteristic features of Cyanobacterial biofertilizers- *Anabaena*, *Nostoc*; Structure and characteristic features of fungal biofertilizers-AM mycorrhiza

UNIT-V

No. of Hours: 06

Production of *Rhizobium*, *Azotobacter*, *Anabena*; Biofertilizers-Storage, shelf life, quality control and marketing

Text Books

1. A.K. Sharma(2006).Hand book of Organic Farming
2. A.C.Gaur(2017).Hand book of Organic Farming and Biofertilizers
3. N.S.Subbarao(2017).Bio-fertilizers in Agriculture and Forestry (4thEdition) Med tech publisher
4. Subba Rao,N.S.(2002).Soil Microbiology. Soil Microorganisms and Plant Growth.(4thEdition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Dubey,R.C.(2008).A Textbook of Biotechnology. S. Chand & Co., New Delhi.

Reference Books

1. Masanobu Fukuoka, Frances Moore Lappe WendellBerry(2009).The One- Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
2. Sujit Chakrabarty (2018).Organic Home Gardening MadeEasy, 1stEdition,
3. Singh and Purohit (2008).Biofertilizer technology. Agrobios, India.
4. Bansal M(2019).Basics of Organic Farming CBS Publisher.
5. Hurst, C.J., Crawford R.L., Garl andJ.L.,LipsonD.A., Mills A.L.and Stetzenbach L.D.(2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.

Web sources

1. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2. <https://www.fao.org/organicag/oa-faq/oa-faq6/en/>
3. <https://www.india.gov.in/topics/agriculture/organic-farming>
4. <https://agriculture.nagaland.gov.in/bio-fertilizer/>
5. <https://vlab.amrita.edu/index.php?sub=3&brch=272>



SEMESTERII

SEMESTER-II
23U2MBC02
Credits- 5

MICROBIALPHYSIOLOGYANDMETABOLISM

CORE-II
Total Number of Hours: 75
5Hours/Week

MICROBIAL PHYSIOLOGY AND METABOLISM

Course Objectives

- Study the basic principles of microbial growth.
- Provide information on sources of energy and its utilization by microorganisms.
- Understand the basic concepts of aerobic and anaerobic metabolic pathways.
- Understand the basic concepts and mechanism of bacterial photosynthesis
- Study the reproduction in bacteria, fungi, algae and protozoa.

Course Outcome:

CO1	Know the concept of microbial growth and identify the factors affecting bacterial growth.
CO2	Describe microorganisms based on nutrition and explain the methods of nutrient uptake
CO3	Describe an aerobic and aerobic energy production.
CO4	Explain the mechanism of bacterial photosynthesis.
CO5	Elaborate on the process of reproduction in bacteria, fungi, algae and protozoa.

UNIT-I

No. of Hours:12

Physiology of microbial growth: Batch – continuous - synchronous cultures; Factors affecting microbial growth, Growth Curve and measurement methods (turbidity, biomass, and cell count). Control of microbial growth.

UNIT-II

No. of Hours:12

Nutritional requirements - classification- Photoautotrophs, Photo organotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs, Auxotrophs, Oligotrophs, Copiotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport.

UNIT-III

No. of Hours: 12

An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation - Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.

UNIT-IV

No. of Hours: 12

Bacterial Photosynthesis-Oxygenic and An oxygenic photosynthetic bacteria-Bacterial Photosynthetic Pigments, Light Reaction-Cyclic and Non-cyclic Photophosphorylation. Dark Reaction-Calvin Cycle

UNIT-V

No. of Hours: 12

Bacterial reproduction - Binary fission, Endospore formation- Fungal reproduction- Asexual and Sexual reproduction, Budding, Reproduction through spores, Microalgae reproduction - Asexual and Sexual reproduction of Protozoa- Cyst formation.

Text Books

1. Schlegel, H.G.(1993).General Microbiology.,7thEdition, Press syndicate of the University of Cambridge.
2. Rajapandian K.(2010).Microbial Physiology, Chennai: PBS Book Enterprises India.
3. Meena Kumari. S. Microbial Physiology, Chennai1stEdition MJP Publishers 2006.
4. DubeyR.C. and Maheswari, S.(2003).A textbook of Microbiology, NewDelhi: S.Chand &Co.
5. S. Ram Reddy, S.M. Reddy (2008).Microbial Physiology. Anmol Publications Pvt Ltd.

Reference Books

1. Robert K. Poole (2004).Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
2. Kim B. H.,Gadd G. M.(2008).Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
3. Daniel R.Caldwell.(1995).Microbial Physiology & Metabolism Wm.C.Brown Communications, Inc. USA.
4. Moat, A.G and J.W Foaster (1995).Microbial Physiology,3rdedition. Wiley– LISS, A John Wiley & Sons. Inc. Publications.
5. Bhanu Shrivastava. (2011).Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

Web References

1. <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
2. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5. <https://www.frontiersin.org/microbial-physiology-and-metabolism>

SEMESTER-II
23U2MBCP02
Credits-3

CORE PRACTICAL -II
TOTAL NUMBER OF HOURS: 60
5 HOURS/WEEK

MICROBIAL PHYSIOLOGY AND METABOLISM PRACTICAL - II

Course Objectives

- Understand the basic concepts of microscopic examination of microbes.
- Learn the bacterial count using different methods and bacterial growth curve.
- Understand the anaerobic culture methods and antibiotic sensitivity testing.
- Study the morphological demonstration of microorganisms and identification.
- Study the biochemical identification of the bacteria and preservation of cultures.

Course Outcome:

CO1	Describe wet mount preparation, staining and motility studies
CO2	Demonstrate different cell count methods and bacterial growth curve.
CO3	Explain anaerobic culture methods, antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains.
CO4	Describe demonstration of the size of yeast, fungal filaments, algae and protozoa by micrometry.
CO5	Elaborate on the bacterial identification using biochemical methods.

1. Demonstration of motility

- hanging drop,
- wet mount preparation,
- semi-solid agar,
- Craigie's tube method.

2. Staining techniques

- Smear preparation,
- Simple staining,
- Grams staining,
- Acid-fast staining,
- Capsular staining
- Spore staining.

3. Direct counts – Direct cell count (Petroff -Hausser counting chamber) and Turbidometry.

4. Viable count

- Pour plate, Spread plate and Streak plate methods
5. Determination of Bacterial growth curve.
 6. Anaerobic culture methods.
 7. Antibiotic sensitivity testing :Disc diffusion test-quality control with standard strains.
 8. Morphological variations in algae, fungi and protozoa.
 9. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.
 10. Methods of bacterial identification-
 - Biochemical methods- Oxidase, Catalase, IMViC test, H₂S, TSI, Urease test, and Carbohydrate fermentation test.
 11. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

Text Books

1. James G Cappucino and N.Sherman MB(1996). Lab manual Benjamin Cummins, New York 1996.
2. Kannan.N(1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual(1st edition) publications.
4. Gunasekaran,P.(1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
5. Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.

References Books

1. David White., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3. Kim B. H., Gadd G. M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4. Dawes, I.W and Sutherland L.W(1992). Microbial Physiology(2nd edition), Oxford Blackwell Scientific Publications.
5. Moat, A. Gand J. W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley-LISS, A John Wiley & Sons. Inc. Publications.

Web Resources

1. <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
2. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. <https://www.studocu.com/microbial-physiology-practicals>
5. <https://www.agr.hokudai.ac.jp/microbial-physiology>

SEMESTER– II
23U2MBGE01
CREDITS – 3

GENERIC ELECTIVE-II
TOTAL NUMBER OF HOURS: 45
4 HOURS/WEEK

BIOINSTRUMENTATION

Course Objectives:

- Understand the basic instruments and study the preparation of different solutions used in laboratory.
- To gain knowledge about principles and applications of spectroscopy.
- Understand the analytical techniques of Chromatography and electrophoresis.
- To understand the principle of different types of imaging techniques used in medical diagnosis
- To gain information about the principles of fluorescence, radioactivity and its applications with measurements.

Course Outcome:

CO1	Gain knowledge about the basics of instrumentation and preparation of solutions.
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.
CO3	Evaluate by separating the components by chromatography and Electrophoresis.
CO4	Understand the need and applications of imaging techniques.
CO5	Categorize the working principle and applications of fluorescence and radioactivity.

UNIT–I

No. of Hours:09

Basic instruments: pH meter, Buffers of biological importance, Biochemical calculations- preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE - Calculation of Normality, Molarity, Molality, PPM. Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.

UNIT–II

No. of Hours:09

Spectroscopic Techniques: Colorimeter, Ultraviolet and Visible, Infrared and Mass Spectroscopy.

UNIT–III

No. of Hours:09

Chromatographic Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE and PAGE.

UNIT-IV

No. of Hours:09

Imaging techniques: Principle, Instrumentation and applications of ECG, EEG, EMG, MRI, CT and PET scan.

UNIT-V

No. of Hours:09

Fluorescence and radiation based techniques: Spectro fluorimeter, Flamephotometer, Geiger Muller counter, Autoradiography and Scintillation counter.

Text Books

1. Jayaraman J(2011).LaboratoryManualinBiochemistry,2ndEdition.WileyEasternLtd.,New Delhi
2. Ponmurugan.P and Gangathara PB (2012).Biotechniques.1stEdition. MJ Ppublishers.
3. Veerakumari, L (2009).Bioinstrumentation-5thEdition -.MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002).Biophysical chemistry–Principles and techniques3rdEdition. Himalaya publishing home.
5. Chatwal Gand Anand(1989) .Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.

Reference Books

1. Rodney. F. Boyer (2000). Modern Experimental Biochemistry,3rd Edition. Pearson Publication.
2. Skoog A., West M (2014).Principles of Instrumental Analysis–14thEdition W.B. Saunders Co., Philadephia.
3. N. Gurumani. (2006).Research Methodology for biologicalsciences-1stEdition–MJP Publishers.
4. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7thEdition. Cambridge University Press.
5. Webster, J.G.(2004).Bioinstrumentation-4thEdition-John Wiley &Sons(Asia)Pvt. Ltd, Singapore.

Web Sources

1. <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types-uses-and-other-details-with-diagram/12489>
2. <https://www.watelectrical.com/biosensors-types-its-working-andapplications/>
3. <http://www.wikiscales.com/articles/electronic-analytical-balance/Page24of75>
4. <https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html>
5. <http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction>

SERICULTURE

Course Objectives:

- Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant.
- Describe the morphology and physiology of silkworm.
- Discuss the pathology and management of silk worm diseases.
- Demonstrate field skills in mulberry cultivation and silk worm rearing with an emphasis on technological aspects.
- Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Course Outcome:

CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.
CO2	Familiarize with the lifecycle of silkworm.
CO3	Explain common diseases of silk worm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.
CO5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the Importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.

UNIT–I

No. of Hours:06

General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.

UNIT-II

No. of Hours:06

Silkworm- biology-morphology of silkworm. Lifecycle of silkworm-egg, larva, pupa, and moth.

UNIT-III

No. of Hours:06

Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief account of Pests and Predators of Silkworms, Nature of damage and control measures.

UNIT-IV

No. of Hours:06

Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.

UNIT-V

No. of Hours:06

Entrepreneurship and rural development in sericulture: Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.

Text Books

- 1.Ganga,G. and Sulochana Chetty(2010). Introduction to Sericulture, J. ,Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
- 2.Dr. R.K. Rajan & Dr. M. T. Himantharaj (2005).Silkworm Rearing Technology, Central Silk Board, Bangalore.
- 3.DandinSB, Jayant Jayaswal and Giridhar K(2010).Handbook of Sericulture technologies, CentralSilk Board, Bangalore.
- 4.M.C.Devaiiah,K.C.NarayanaswamyandV.G.Maribashetty(2010).AdvancesinMulberry Sericulture, CVG Publications, Bangalore
5. T.V.SatheandJadhav.A.D.(2021).SericultureandPestManagement,DayaPublishingHouse.

Reference Books

1. S. Morohoshi (2001).Development Physiology of Silkworms2nd Edition,Oxford& IBH PublishingCo.Pvt. Ltd. New Delhi
2. Hamamura,Y(2001).SilkwormrearingonArtificialDiet.Oxford&IBHpublishingCo.,Pvt.Ltd. NewDelhi.
3. M. Johnson, M.Kesary(2019).Sericulture,5th.Edition. Saras Publications.
4. Manisha Bhattacharyya(2019).Economics of Sericulture, Rajesh Publications.
5. Muzafar Ahmad Bhat,Suraksha Chanotra, Zafar Iqbal Buhroo,Abdul Azizand Mohd.Azam (2020).
6. ATextbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication.

Web Resources

1. <https://egyankosh.ac.in/bitstream>
2. <https://archive.org/details/SericultureHandbook>
3. <https://www.academic.oup.com>
4. <https://www.sericulture.karnataka.gov.in>
5. <https://www.silks.csb.gov.in>

SEMESTER III

SEMESTER-III
23U3MBC03
Credits-5

CORE-III
Total Number of Hours:75
5Hours/Week

CELL BIOLOGY

Course Objectives:

- To understand the basic concept of cell biology.
- The basic knowledge on cell and their structure.
- To gain the knowledge on ultra structure and functions of cell organelles.
- To learn the ultra structure and functions of Nucleus.
- Acquire knowledge on cell division and cell cycle.

Course Outcome:

CO1	To understand about cells
CO2	To gain knowledge about the cells of microbes, plant and animal
CO3	To know about the Anatomy of the cell
CO4	To gain Knowledge about the nucleus and their function
CO5	To gain Knowledge about the Cell cycles and division of cell

UNIT-I

No. of Hours:15

History of Cell Biology- Discovery of cell, the cell theory, ultra structure of an eukaryotic cell- (both plant and animal cells), structural organization and functions of cell wall and plasma membrane Plasma membrane: Structure and transport of small molecules. Cell Wall: Eukaryotic cell wall, Extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata.

UNIT-II

No. of Hours:15

Structure and functions of cell organelles: Cytosol, endoplasmic reticulum, golgi complex, mitochondria, chloroplast, ribosomes, lysosomes, peroxisomes, vacuole and cytoskeletal structures (microtubules, microfilaments and intermediate filaments)

UNIT-III

No. of Hours:15

Nucleus- Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes-organization of chromosomes, Heterochromatin and Euchromatin-Nucleolus-Nucleolus

UNIT-IV

No. of Hours:15

Cell Cycle and its check points, cell division (mitosis and meiosis). Cancer, Ageing of Cells and Stem cells, types: Embryonic stem cell, induced pluripotent stem cells.

UNIT-V

No. of Hours:15

Cell communication – overview – types of cell signaling – signal molecules – signal amplification – receptor types – quorum sensing. Pathways of intracellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway.

Text Books

1. Powar, C.B., 2014, "CellBiology", ThirdEdition, HimalayaPublications, Mumbai.
2. Rastogi.S.C., 2015, "CellBiology", ThirdEdition, NewageInternational, NewDelhi.

Reference Books

1. Ambrose, E.J. and Dorothy, M. Easty, 1970. CellBiology, Thomas Nelson & Sons Ltd., 500pp.
2. Burke, Jack.D. 1970. Cell Biology, Scientific Book Agency, Calcutta.
3. Cohn, N.S., 1979, Elements of Cytology, Freeman Book Co., NewDelhi-110007, 495pp
4. De Robertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Infomed, HonKong, 734pp.
5. Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609pp.
6. Power, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay-400004, 368 pp.
7. Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
8. VeerBalaRastogi, Introductory cytology. KedarNathRamNath. Meerut 250001.
9. Verma, P.S. and V. K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S. Chand & co., New Delhi - 110 055, 567 pp.
10. Loewy, A.G. and P. Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.
11. Swansen, C.P. and P.L. Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi-110 001, 373 pp.

MICROBIAL GENETICS

Course Objectives:

- To gain knowledge about DNA and RNA
- To understand DNA replication and transcription in prokaryotes & eukaryotes
- To impart knowledge on translation and gene regulation
- To study the features of plasmid and mechanism of genetic exchange
- To gain knowledge about mutation and repair mechanisms

Course Outcome:

CO1	It enables to understand the historical perspective and background / basic knowledge of Genetics
CO2	It gives exposure on central dogma of life
CO3	It helps to uptake knowledge on translation and gene regulation in prokaryotes
CO4	It delivers basic knowledge and techniques used in gene transfer
CO5	It provides basic concepts of mutation and mutagenesis and gene repair mechanisms

UNIT–I

No. of Hours:15

Genetic Material (DNA&RNA):Discovery of DNA- Structure - Salient features of double helix, forms of DNA. DNA as a genetic material. RNA as genetic material. RNA types – mRNA, rRNA and tRNA. DNA organization in prokaryotes & eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Meselson and Stahl experiment. Mechanism of DNA replication – enzymes involved – Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. rolling circle, D-loop modes.

UNIT–II

No. of Hours:15

Transcription :Transcription in Prokaryotes& Eukaryotes - RNA Polymerases -promoter, operator, repressor. Genetic code - Salient features. **Translation**-Genetic code - Salient features – Wobble hypothesis. Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination in prokaryotes. Post translational modification. Wobble hypothesis. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - lac, trp and ara operons as examples.

UNIT-III

No. of Hours:15

Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair. Auxotrophic mutant detection - Replica plate technique. Mutagenicity testing – Ames Test.

UNIT-IV

No. of Hours:15

Plasmids- Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2 μ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.

UNIT-V

No. of Hours:15

Gene Transfer Mechanisms-, Transformation - Natural Competence and Transformation. Conjugation and its uses. Transduction - Generalized and Specialized. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons

Text Books

1. David Freifelder (2005).Molecular Biology.2ndEdition.NarosaPublishers, New Delhi.
2. Verma PS and Agarwal VK (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology .S. Chand &Company Ltd., New Delhi.

Reference Books

1. Friedberg EC, Walker GC, Siede W (2006). DNA repair and mutagenesis. ASM press, Washington DC.
2. Benjamin Lewin (2000).GenesVII.7thEdition.Oxford University press, Inc.
3. Maloy SR, Cronan JE, Freifelder D (1994).Microbial Genetics. Jones and Bartlett Publishers.
4. Gardner EJ, Simmons MJ, Snustad DP (2008).Principles of Genetics. 8thEd.Wiley-India.
5. WatsonJD,BakerTA,BellSP,GannA,LevineMandLosickR(2008).MolecularBiologyoftheGene,6thedition,ColdSpringHarbourLab.Press,PearsonPublication

Web sources:

1. http://biology.kenyon.edu/courses/biol63/watson_06.pdf
2. <https://nptel.ac.in/courses/102103015/33>
3. https://nptel.ac.in/courses/102103017/module26/lec26_slide9.htm

CELL BIOLOGY AND MICROBIAL GENETICS

Course Outcome:

CO1	Gain knowledge in basic cell structures and Mitosis and meiosis cell divisions
CO2	Elucidate the methods of Genomic and Plasmid DNA isolation.
CO3	Explain artificial transformation method.
CO4	Gain knowledge in mutation and isolation of Mutant strains
CO5	Outline the role of phages in genetics.

1. Identification of Structure of Prokaryotic cell (Bacterial cell) and Eukaryotic cell (Plant and Animal), Cell
2. Growth of fungi on liquid media and Identification of Structure of fungal cell.
3. Preparation of squash mounts of onion root tips to study mitosis,
4. Study of meiosis through permanent slides
5. Study of meiosis through Squash preparation of Grasshopper Testis/ Tradescantia anther
6. Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis,
7. Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A₂₆₀ measurement)
8. UV induced auxotrophic mutant production.
9. isolation of mutants by replica plating technique – Demonstration
10. Demonstration of Transformation in *E. coli*.
11. Isolation of antibiotic resistant mutants by gradient plate method.
12. Screening and isolation of phages from sewage

TEXT BOOKS

1. Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd. New Delhi.
2. Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
3. Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
4. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
5. James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.

Reference Books

1. Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
2. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3. Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th edition, ASM Press Washington-D.C. ASM Press.
5. Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.

CINICAL LABORATORY TECHNOLOGY

Course Objectives:

- Demonstrate ethical and professional conduct with patients, laboratory personnel, health-care professionals, and the public.
- Explain how accurate and reliable information might be obtained about proper procurement, storage, and handling of laboratory specimens.
- Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.
- Perform a full range of laboratory tests with accuracy and precision.
- Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

Course Outcome:

CO1	Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team. Practice safety or infection control procedures in the clinical laboratory, properly use safety equipment and maintain a clean, safe work environment..
CO2	Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and transmission-based precautions, Engage in the scientific process by understanding the principles and practices of clinical study design, implementation, and dissemination of results.
CO3	Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures.
CO4	Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies.
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies.

UNIT-I

No.of Hours: 09

Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Infection Control Practices.

UNIT-II

No. of Hours: 09

Specimen collection and processing - Blood, urine, stool, sputum CSF, Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results. Biomedical Waste Management.

UNIT-III

No. of Hours: 09

Introduction to histopathology-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections.

UNIT-IV

No. of Hours: 09

Introduction to Haematology- Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time, partial thromboplastin time , activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.

UNIT- V

No. of Hours: 09

Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards – NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.

Text Books

1. Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata Mc Graw Hill, Delhi
2. RamnikSood (2015).Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2nd Edition, Jaypee Brothers Medical Publishers, NewDelhi
3. *Ramakrishnan*, KN Sulochana (2012). **Manual of Medical Laboratory Techniques**, Jaypee Brothers Medical Publishers Pvt. Ltd

Reference Books

1. Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
2. Baker, F.J., Silverton, R.E., and Pallister, J. (1998). An Introduction to Medical Laboratory Technology, 7th Edition, CBS Publishers and Distributors Pvt. Ltd

Web Resources

1. https://dhr.gov.in/sites/default/files/Bio-medical_Waste_Management_Rules_2016.pdf
2. <https://vet.uga.edu/selection-collection-submission-of-samples-for-histopathology/>
3. https://terrance.who.int/mediacentre/data/ebola/training-packages/LQMS/11_cd_rom_quality_standards_in_health_laboratories_thailand.pdf

SEMESTER-III
23U3MBDE02
Credits-3

DSE-I
Total Number of Hours:45
4 Hours/Week

ANTI-MICROBIAL RESISTANCE – THEORY & PRACTICE

Course Objectives:

- Understand the role of antimicrobial agents.
- Basic knowledge development of Antimicrobial resistance.
- Comprehensive knowledge about Anti-Microbial Susceptibility Testing and its significance.
- Gain knowledge about Alternative Tools in AMR testing
- Understand about Critically Important Antimicrobials

Course Outcome:

CO1	Understand the role of antimicrobial agents.
CO2	Gain basic knowledge development of Antimicrobial resistance.
CO3	Acquire Comprehensive knowledge about Anti-Microbial Susceptibility Testing and its significance.
CO4	Gain knowledge about Alternative Tools in AMR testing
CO5	Understand about Critically Important Antimicrobials

UNIT-I

No. of Hours: 09

Introduction to Antimicrobial agents – Definition, Classification, Mode of Action and Applications

UNIT-II

No. of Hours: 09

Anti-Microbial Resistance – Development of Resistance, Causes, Mechanism of resistance with its dissemination patterns

UNIT-III

No.of Hours: 09

Anti-Microbial Susceptibility Testing – Definition, Different methods, Procedures – Gradient strips, Disk Diffusion, Agar Dilution, Broth Dilution.

UNIT-IV

No.of Hours: 09

Alternative Tools in AMR testing - ResFinder tool - principles and applications, My Database Finder (MyDbFinder) tool - principles and applications, Quality Assurance & management in Antimicrobial susceptibility testing

UNIT-V

No.of Hours: 09

Critically Important Antimicrobials (CIA) - Background, detection and characterization of colistin & quinolone resistance, Beta-lactam resistance in Escherichia coli: ESBL, AmpC, Carbapenemases, Beta-lactam resistance in staphylococcus aureus: MRSA.

Text Books

1. Walter A. Orenstein, Paul A. Offit, Kathryn M. Edwards, Stanley A. Plotkin Plotkin's Vaccines, 8th Edition - 2022
2. Gregg N. Milligan and Allen DT Barret Vaccinology An Essential Guide, Wiley Blackwell

Reference Books

1. Baird R.M., Hodges N.A. and Denyer S.P. (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
2. Saghee M.R., Sandle T. and Tidswell E.C. (2011) Microbiology and Sterility Assurance in Pharmaceuticals and Medical devices, Business Horizons publishers.
3. Hanlon G. and Sandle T. (2015) Industrial Pharmaceutical Microbiology: Standards and Controls, Euromed Communications

Web Sources

1. <https://www.sciencedirect.com/book/9780323911467/vaccinology-and-methods-in-vaccineresearch>
2. <https://www.nature.com/articles/npjvaccines20169>
3. <https://pubmed.ncbi.nlm.nih.gov/33353987/>

SEMESTER IV

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Objectives:

- To gain knowledge about immune system, organs of immunity and cells involved.
- To distinguish the types of antigens and antibodies; their properties.
- To provide in-depth knowledge on immuno-techniques.
- To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.
- To impart knowledge on immunological disorders.

Course Outcome

CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in Immune responses
CO2	Investigate the structures of antigen and Antibodies and gain knowledge about the relevance of immunization
CO3	Justify immunoassays and Immunotechniques
CO4	Explain the immunologic process involved in graft rejection and therapeutic uses of immune suppression in graft rejection
CO5	Analyze the over reaction of by our immune system leading to hypersensitive conditions and its consequences

UNIT-I

No. of Hours:15

Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.

UNIT-II

No. of Hours:15

Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.

UNIT-III

No. of Hours:15

Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, ELISA, Immuno fluorescence techniques and Flow cytometry

UNIT-IV

No. of Hours:15

Transplantation and Tumor Immunology - MHC Antigens - structure and function; HLA system. Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immune therapy. Immunological disorders and diseases –

UNIT-V

No. of Hours:15

Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non-organ specific.

Text Books

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition., Wiley-Blackwell, New York.
2. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition., W. H. Freeman and Company, New York
3. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10th Edition., Elsevier.
4. Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018). Clinical Immunology: Principles and Practice, 5th Edition. Elsevier
5. Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

Reference Books

1. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
2. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition., Wiley-Blackwell.
3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rd Edition. John Wiley and Sons Inc. New York.
4. Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4th Edition., Wiley-Blackwell.
5. Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM. 3rd Edition.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/books/NBK279395/>
2. <https://med.stanford.edu/immunol/phd-program/ebook.html>
3. <https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/>
4. [Immunology Overview - Medical Microbiology - NCBI Bookshelf \(nih.gov\)](#)
5. [Immunology - an overview | ScienceDirect Topics](#)

SEMESTER-IV
23U4MBC06
Credits-5

CORE-V I
Total Number of Hours:75
5 Hours/Week

r DNA TECHNOLOGY

Course Objectives

- Understand the principles of rDNA technology.
- Illustrate the molecular tools employed in gene cloning.
- Discuss the importance of various molecular techniques and their importance in Biotechnology.
- Acquire knowledge about the concepts of tissue culture methods and transgenic organisms.
- Examine recent trends in genetic engineering and its application in human welfare.

Course Outcome

CO1	Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.
CO2	Discuss the various cloning vectors and their applications.
CO3	Assess the usage and advantages of molecular tools.
CO4	Explain plant and animal tissue culture protocols and gene transfer mechanism.
CO5	Elucidate and understand the application of genetic engineering and gene therapy.

UNIT-V

No. of Hours:15

Milestones in Rdna Technology- Gene Manipulation- Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action-Application of Ligase, DNA Polymerase, DNA Modifying enzymes and Topoisomerases. Use of Linkers and Adapters.

UNIT-II

No. of Hours:15

Artificial Gene Transfer methods-Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors – Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1.Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library-Construction and Screening.

UNIT-III

No. of Hours:15

Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE Blotting Techniques- Southern, Western & Northern. DNA sequencing methods-Sanger's and Automated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPRs. Gene Targeting-Knock-in & Knock-outs. DNA Finger Printing.

UNIT-IV

No. of Hours:15

Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture- Explant Culture- Micropropagation- Callus and Protoplast Culture-Production of Bio-Active Secondary Metabolites by Plant Tissue Culture -Agrobacterium and Crown Gall Tumors, Ti Plasmid and Ri Plasmid–Animal Biotechnology-Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types, Establishment and Maintenance of Cell Lines.

UNIT-V

No. of Hours:15

Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep- Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy- Germline and Somatic Cell Therapy- Ex-vivo Gene Therapy- SCID(Severe Combined Immuno Deficiency) – In-vivo Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) – Vectors in Gene Therapy-Viral and Non-Viral Vectors. Transgenic Plants–Bt Cotton, Bt Corn, Round Ready soybean, Flavr Savr Tomato and Golden Rice

Text Books

1. Brown T.A.(2016). Gene Cloning and DNA Analysis. 7th Edition . John Wiley and Jones, Ltd.
2. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. 3rd Edition. John Wileys and Sons Ltd.
3. Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute
4. Siddraljazz, Imran UIHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
5. Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition, Alpha Science International Ltd

Reference Books

1. Maloy S. R., Cronan J.E. Jr. and Freifelder D.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
2. Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
3. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New

International Edition.

4. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition. ASM Press Washington-D.C. ASM Press.
5. James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books

Web Resources

- 1 <https://www.britannica.com/recombinant-DNA-technology>
- 2 <https://www.byjus.com/recombinant-dna-technology>
- 3 <https://www..rpi.edu>
- 4 <https://www..ncbi.nlm.nih.gov>
- 5 <https://www.le.ac.uk/recombinant-dna-and-genetic-techniques>

SEMESTER-IV
23U4MBCP04
Credits-2

CORE PRACTICAL-IV
Total Number of Hours:30
4Hours/Week

IMMUNOTECHNOLOGY & rDNA TECHNOLOGY PRACTICALS - IV

Course Objectives

- To gain hands-on knowledge to identify Blood group and typing.
- To acquire adequate skill to perform latex agglutination reactions, to analyze precipitation reactions in gels.
- To investigate the antigen & antibody reactions in electrophoresis.
- To familiarize with Separation of Lymphocytes.
- Immobilization of products for preservation.

Course Outcome

CO1	Gain hands-on knowledge to identify Blood group and typing.
CO2	Acquire adequate skill to perform latex agglutination reactions, to analyze precipitation reactions in gels.
CO3	Investigate the antigen & antibody reactions in electrophoresis.
CO4	Familiarize with Separation of Lymphocytes.
CO5	Immobilization of products for preservation.

1. Blood smear preparation and differential staining of blood cells.
2. Identification of human ABO blood groups and Rh Typing.
3. Separation of serum/plasma from the blood sample.
4. Latex agglutination test-RA Test, CRP Test, ASO Test.
5. WIDAL slide and tube agglutination technique.
6. Flocculation test-RPR test.

7. Radial and Ouchterlony double immunodiffusion(ODD)technique.
8. Rocket immunoelectrophoresis.
9. Counter current immunoelectrophoresis.
10. Enzyme Linked Immunosorbent Assay (ELISA)–(demonstration).
11. Immobilization technique.
12. Screening of recombinants–Blue/white selection assay.
13. Separation of Lymphocytes by gradient centrifugation method.

Text Books

1. Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2. Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.
3. Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5th Edition., Wiley-Blackwell, New York.
4. Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7th Edition., W. H. Freeman and Company, New York.
5. Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

Reference Books

1. Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
2. Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
3. Rose. (1992). Manual of Clinical Lab Immunology, ASM.
4. Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition., Wiley-Blackwell.

Web Resources

1. https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
2. <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf>
3. https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
4. Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)

MICROBIOLOGY IN POULTRY INDISTRY

Course Objectives:

- To gain knowledge in poultry industries and government funds to set an industry.
- To acquire adequate skill to handle the eggs and its waste management.
- To investigate the Viral and Non-viral diseases in poultry farms.
- To familiarize with bacterial diseases among poultry industries.
- To gain knowledge on protozoan diseases among the chicks.

Course Outcome

CO1	Able to identify different poultry breeds, their body parts, explain production parameters, basic requirements to set-up a commercial poultry farm
CO2	Poultry Housing, Equipment, Hatching & Brooding Management
CO3	Poultry Feeding and Nutrition Management Practices
CO4	Poultry Healthcare, Treatment, prevention, and Bio-security Management
CO5	Capable to recognize various infectious and non-infectious Poultry diseases, able to diagnose various symptoms of Poultry disease and its prevention strategies.

UNIT-I

No. of Hours:09

General introduction to poultry farming -Definition of Poultry; Past and present scenario of poultry industry in India. Government subsidiaries and their role in promotion of poultry industries. Poultry entrepreneurship opportunities.

UNIT-II

No. of Hours:09

Formation of egg – Egg judging – Egg structure – Physical and chemical components of egg. Physical requirements of incubation – collection, selection, cleaning and sanitation of eggs. Storage of hatching eggs – incubation methods – single and multistage incubators. Poultry waste management.

UNIT-III

No. of Hours:09

Poultry feed Management- Enlistment of commonly occurring anti nutrients & toxicants in poultry feed, Explain various systems of Poultry feeding, Prepare a list of non- conventional feed stuff commonly used for poultry farming. use of probiotics in poultry.- selection of probiotics- health benefits- antibiotic resistance-in poultry industry- vaccines

UNIT-IV

No. of Hours: 09

Non – respiratory viral diseases - diagnosis and management of – Avian Encephalomyelitis – Marek’s disease – Coronaviral Enteritis. Viral respiratory diseases – Newcastle disease – Infectious Bronchitis – Laryngotracheitis. Viral like respiratory diseases – Chlamydiosis – *Mycoplasma gallisepticum* infection – *Mycoplasma synoviae* infection. Non – respiratory bacterial diseases – diagnosis and management of -Necrotic Enteritis – Fowl Cholera – Fowl Typhoid – Colibacillus - Salmonellosis. Bacterial respiratory diseases – Avian Tuberculosis – Infectious Coryza – Rhinotracheitis.

UNIT-V

No. of Hours:09

Protozoan Diseases - diagnosis and management of – Coccidiosis – Histomoniasis – Trichomoniasis. Endo parasitic diseases – Round worms – Cecal worms – Tape worms. Ecto parasitic diseases – Lice – Mites – Fowl ticks.

Case study : Students visit the poultry industries and record the operational management and disease control management

Text Books:

1. Mahajan Naresh, (2015). Poultry Nutrition and Management. 1st Edition. Anmol Publications Pvt. Ltd., New Delhi.
2. Wiseman, J., and Garnsworthy, P. C., (1999). Recent Development in Poultry Nutrition.
3. Titus Harry. Wand Fritz James. C (1971). The Scientific Feeding of Chickens. 5th Edition.

Reference Books:

1. F. Jordan ,M. Pattison, D. Alexander and T. Faragher. (2001).Poultry diseases W.B Saunders London.
2. B.W. Calrek (1997).Diseases ofpoultry.10thEd.,Iowastate university. Ames, Iowa. USA.
3. Reena Kandwal,(2013). Nutrient Requirements of Poultry.3rdEdition.
4. Bell D. Donald and Weaver D. William Jr., (2007). Commercial Chicken Meat and Egg Production.5thEdition.Springer India Pvt. Ltd., Noida.
5. Reddy Ramasubba V., and Bhosale T. Dinesh, 2004).Handbook of Poultry Nutrition. 1stEdition. International Book Distribution Co., Lucknow, India.

Web Resources:

1. <https://www.thepoultrysite.com/>
2. <http://www.agritech.tnau.ac.in/>
3. <https://www.poultrymed.com/>
4. <https://www.inpoultry.com/>

SEMESTER-IV
23U4MBDE04
Credits-3

DSE-I V
Total Number of Hours:45
4Hours/Week

VACCINE TECHNOLOGY

Course Objectives:

- To gain knowledge in Role of vaccines in immune protection
- To differentiate Different types of vaccines
- To Acquire knowledge in Production of vaccines
- To know about Composition of vaccines

Course Outcome:

CO1	Understand the history and basic concepts of vaccination
CO2	Gain knowledge about principles of vaccine development and administration
CO3	Understand New vaccine technologies
CO4	Gain knowledge about commercially available vaccines and their preparation
CO5	Gain knowledge about legal issues regarding vaccine safety and its use.

UNIT-I

No. of Hours: 09

History of vaccines- conventional vaccines- types of vaccines based on preparation- live Attenuated- Inactivated Vaccines- Toxoids- Subunit Vaccines- Peptide Vaccines.

UNIT-II

No. of Hours: 09

Active and passive immunization, epitopes, linear and conformational epitopes, characterization and localization of APC, MHC and immunogenicity adjuvants in vaccination: modulation of immune responses: induction of TH1 and TH2 responses using appropriate adjuvants and antigen delivery systems:

UNIT-III

No. of Hours: 09

New vaccine technologies rationally designed vaccines: DNA vaccination, mucosal vaccination, new approaches for vaccine delivery, engineering virus vectors for vaccination, vaccines for targeted delivery. Reverse vaccinology.

UNIT-IV

No. of Hours: 09

Licensed vaccines, viral vaccine- polio virus vaccine- inactivated & live, Rabies vaccines, Hepatitis A & B Vaccines, bacterial vaccine- Anthrax Vaccines, Cholera Vaccines, Diphtheria Toxoid, Parasitic Vaccine- Malaria Vaccine

UNIT-V

No. of Hours: 09

Vaccine Adjuvants and Additives, manufacturing residuals, regulation and testing of vaccines, regulation of vaccines in developing countries, quality control and regulations in vaccine research, animal testing, rational design to clinical trials, large scale production, commercialization, vaccine safety ethics and legal issues.

Text Books

1. Walter A. Orenstein, Paul A. Offit, Kathryn M. Edwards, Stanley A. Plotkin Plotkin's Vaccines, 8th Edition - 2022
2. Gregg. N. Millingan and Allen DT Barret Vaccinology An Essential Guide, Wiley Blackwell

Reference Books

1. Baird R.M., Hodges N.A. and Denyer S.P. (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
2. Saghee M.R., Sandle T. and Tidswell E.C. (2011) Microbiology and Sterility Assurance in Pharmaceuticals and Medical devices, Business Horizons publishers.
3. Hanlon G. and Sandle T. (2015) Industrial Pharmaceutical Microbiology: Standards and Controls, Euromed Communications

Web Resources

1. <https://www.sciencedirect.com/book/9780323911467/vaccinology-and-methods-in-vaccine-research>
2. <https://www.nature.com/articles/npjvaccines20169>
3. <https://pubmed.ncbi.nlm.nih.gov/33353987/>

SEMESTER V

MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

- Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
- Basic knowledge about Gram positive pathogenic bacteria and their epidemiology Acquire knowledge about Gram negative pathogenic bacteria and nosocomial infections
- Comprehensive knowledge about medically important, its classification and its significance
- Gain knowledge about the general characteristics and mode of action of various antibacterial agents

Course Outcome:

CO1	Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
CO2	Gain knowledge about principles of vaccine development and administration
CO3	Understand New vaccine technologies
CO4	Gain knowledge about commercially available vaccines and their preparation
CO5	Gain knowledge about legal issues regarding vaccine safety and its use.

UNIT-I

No. of Hours:15

History, Classification of Medically Important Microbes, Koch's, Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections. and River's postulates-A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions:

UNIT-II

No. of Hours:15

Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (Streptococcus pyogenes, Streptococcus faecalis), (b) Staphylococcal infections (Staphylococcus aureus), (c) Tetanus (Clostridium tetani)(d) Diphtheria (Corynebacteriumdiphtheriae) (e) Anthrax (Bacillus anthracis) (f) Tuberculosis (Mycobacterium tuberculosis), (g) Leprosy (Mycobacterium leprae).

UNIT-III

No. of Hours:15

Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (*Streptococcus pneumoniae*, *Neisseria meningitidis*) (b) typhoid (*Salmonella typhi*, *Salmonella paratyphi*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigella dysenteriae*); Sexually Transmitted disease (syphilis-*Treponema pallidum*. Gonorrhoea - *Neisseria gonorrhoeae*); Nosocomial infections – definition, importance, and their control (*Pseudomonas aeruginosa*).

UNIT-IV

No. of Hours:15

Medically important Fungi - Classification of medically important fungi; Superficial mycoses: *PityriasisVersicolor*; *Tinea Nigra*; Piedra. Cutaneous mycoses: *Microsporum* spps., *Trichophyton*spps., and *Epidermophyton floccosum*. Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis; Histoplasmosis; Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin

UNIT-V

No. of Hours:15

Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.

Text Books

1. Walter A. Orenstein, Paul A. Offit, Kathryn M. Edwards, Stanley A. Plotkin Plotkin's Vaccines, 8th Edition - 2022
2. Gregg. N. Millingan and Allen DT Barret Vaccinology An Essential Guide, Wiley Blackwell
3. Baird R.M., Hodges N.A. and Denyer S.P. (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
4. Saghee M.R., Sandle T. and Tidswell E.C. (2011) Microbiology and Sterility Assurance in Pharmaceuticals and Medical devices, Business Horizons publishers.
5. Hanlon G. and Sandle T. (2015) Industrial Pharmaceutical Microbiology: Standards and Controls, Euromed Communications

Web Resources

- <https://www.sciencedirect.com/book/9780323911467/vaccinology-and-methods-in-vaccine-research>
- <https://www.nature.com/articles/npjvaccines20169>
- <https://pubmed.ncbi.nlm.nih.gov/33353987/>

SEMESTER-V
23U5MBC08
Credits-4

CORE VIII
Total Number of Hours:60
4 Hours/Week

SOIL AND ENVIRONMENTAL MICROBIOLOGY

OBJECTIVES

- To understand soil properties and their role as a habitat for microorganisms
- To learn about microbial involvement in nutrient cycles within soil ecosystems
- To explore different types of microbial interactions and their significance.
- To identify airborne microorganisms and understand their impact on health and environment.
- To study bioremediation techniques for managing environmental pollutants

COURSE OUTCOMES

CO1	Students will understand how soil properties influence microorganisms, aiding in better agriculture and environmental practices
CO2	Students will learn how microorganisms impact soil fertility, helping optimize agricultural methods
CO3	Students will grasp how microorganisms interact in ecosystems, guiding strategies for sustainable agriculture
CO4	Students will recognize airborne microorganisms' effects on health and environments, leading to improved air quality management
CO5	Students will comprehend bioremediation's role in cleaning pollutants, offering solutions for waste management and environmental protection

UNIT – I

No. of Hours: 12

Development of Soil Microbiology - Physical and chemical properties of soil, classification of soils - soil profile – soil microflora and soil as a natural habitat for microbes. Soil organic matters and humus, Role of microorganisms in soil fertility, Microbes in different zones of soil. Decomposition of plant and animal residues by microorganisms.

UNIT – II

No. of Hours: 12

Microorganisms in soil processes - carbon cycle-Nitrogen cycle – Phosphorus and Sulphur cycle-Nitrogen fixation– symbiotic and non-symbiotic- Microbial transformation of phosphorus, sulphur and micronutrients in soil- Rhizosphere R: S ratio - spermosphere - phyllosphere.

UNIT – III

No. of Hours: 12

Microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers and biocontrol agents – Bacterial, cyanobacteria, VAM. Mass production of biofertilizer.

UNIT –IV

No. of Hours: 12

Composition of air - Indoor, outdoor of air - Distribution and sources of air borne microorganisms. Air as a carrier of microorganisms, droplet nuclei, Dispersal of Microorganisms in air - Techniques for microbiological analysis of air. Significance of air flora in human health, hospitals, industries. Air borne diseases - list of diseases caused by bacteria, fungi, viruses. Air pollution. Air sanitation – dust control, UV radiation, bactericidal vapors, filtration, laminar air flow system (HEPA filters).

UNIT –IV

No. of Hours: 12

Waste treatment and bioremediation: Solid waste management: Sources and types of solid waste, composting, vermin composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: scope of bioremediation. Degradation of hydrocarbons, oilspills, heavy metals – Chromium, lead, and xenobiotics – PCB.

Text Books

1. "Soil Microbiology" by N. Subba Rao (2010, Oxford & IBH Publishing Co. Pvt. Ltd.)
2. "Microbial Ecology: Fundamentals and Applications" by Ronald M. Atlas and Richard Bartha (1998, Benjamin Cummings)
3. "Environmental Microbiology" by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry (2015, Academic Press)
4. "Microbial Interactions" by K. R. Aneja (2003, New Age International (P) Ltd. Publishers)
5. "Fundamentals of Microbial Ecology" by Thomas M. Schmidt (2014, John Wiley & Sons)
6. "Fundamentals of Microbiology" by P. R. Baveja (2017, Arya Publishing Company)
7. "Environmental Biotechnology" by A. K. Mishra (2017, I.K. International Publishing House Pvt. Ltd.)
8. "Soil Microbiology, Ecology and Biochemistry" by Eldor A. Paul (2014, Academic Press)
9. "Bioremediation: Principles and Applications" by Ronald L. Crawford and Don L. Crawford (1996, Cambridge University Press)

WEBLINK

1. Soil Biology & Environmental Microbiology Resources - USDA Agricultural Research Service:
<https://www.ars.usda.gov/northeast-area/beltsville-md-barc/beltsville-agricultural-research-center/sustainable-agricultural-systems-laboratory/docs/soil-biology-environmental-microbiology-resources/>
2. Environmental Microbiology- Microbiology Online: <https://www.microbiologyonline.org/about-microbiology/microbes-and-the-environment/environmental-microbiology>
3. Soil and Environmental Microbiology - Society for Applied Microbiology:
<https://sfam.org.uk/journals/education-resource-center/soil-and-environmental-microbiology.html>

Basics in Biostatistics and Bioinformatics

COURSE OBJECTIVES:

- Understand and apply the basic concepts of Bioinformatics and its significance in biological data analysis
 - Biostatistics course aims to develop competency and expertise in the application of statistical methods applied to biological data obtained in experimental techniques.
 - Bioinformatics aligned with biostatistics to provide the learners on the technical advancements in statistical analysis.
 - To understand the fundamentals and basics in bioinformatics
 - To explore the knowledge on new research with the usage of different bioinformatics tools
 - To be globally competent in research using the bioinformatics

COURSE OUTCOMES

CO1	Understand and apply basic concepts in biostatistics exemplifying sampling methods, graphical representation of data,
CO2	Familiarize with measuring central tendencies, dispersion etc.
CO3	Understand and apply skills in hypothesis testing using statistical methods for analysing One or two variables, interpret and explain a p-value, perform a two sample t- test and interpret the results.
CO4	Understand and apply the skills gained, in basic concepts of bioinformatics including databases, database searches and role of internet in bioinformatics.
CO5	Understand and analyze methods to characterize and manage the different types of Biological data and gain an insight into the basics of sequence alignment and analysis.

UNIT – I

No. of Hours: 12

Introduction to Biostatistics, kinds of data and variables - based on nature (numerical-discrete and continuous, categorical-ordinal and nominal) - based on source (primary and secondary data), sample size, sampling methods and sampling errors. Data tabulation and representation methods: graphical methods– stem and leaf plot, line diagram, bar graphs, histogram, frequency polygon, frequency curves; diagrammatic method - pie diagram.

UNIT – II

No. of Hours: 12

Measures of central tendency- mean median, mode; merits and demerits. Measures of dispersion- range, variance, standard deviation, standard error and coefficient of variation; merits and demerits. Correlation and regression analysis and their applications to biology.

UNIT – III

No. of Hours: 12

Introduction to Probability- definition; Normal distribution: definition and properties - Hypothesis testing- steps in testing for statistical hypothesis, null and alternative hypothesis, level of significance- type-1 and type-2 errors- Test of significance for large samples- Z-test for means and proportions Test of significance for small samples- student's t-test(one sample and two samples). - Chi-square test and its applications- goodness of fit (not based on distribution), test of Independence - Analysis of variance (One-way ANOVA) and their applications to biology.

UNIT – IV

No. of Hours: 12

Bioinformatics definition, history, scope and applications Internet Basics: Connecting to the Internet, E-mail, FTP, WWW, Difference between WWW and Internet Bioinformatics web portals: NCBI, EBI, ExPASy - Biological databases: Classification of databases - primary (Genbank), secondary (PIR) and tertiary or composite (KEGG) databases - Sequence databases - DNA sequence databases (ENA, DDBJ) - Protein sequence databases (Swissprot, PROSITE).

UNIT – V

No. of Hours: 12

Basics of sequence alignment - match, mismatch, gaps, gap penalties, scoring alignment - Types of sequence alignment - pairwise and multiple alignment, local and global alignment -Dot matrix comparison of sequences - Scoring matrices - PAM and BLOSUM - Pairwise sequence similarity search by BLAST and FASTA - Concepts of phylogeny - Distance based (NJ method) and character based (ML method) tree Construction methods

TEXT BOOKS

1. Daniel, W.W. 1987. Biostatistics, John Wiley Sons, New York.
2. Sundarrao, P.S.S. and Richards, J.2003. An Introduction to Biostatistics, 3rd Edition, CMC, Vellore.
3. Selvin, S. 1991. Statistical analysis of epidemiological data, University press, NY.
4. Bishop, O.N, 1983. Statistics for biology, Houghton, Boston.
5. Introduction to Bioinformatics - S.Sundararajan and Balaji
6. Instant notes - Bioinformatics - Westhead, Howard parish and Twyman. Viva books Pvt. Limited. Chennai
7. Bioinformatics basic skills and applications - Rastogi
8. Freedman, P, 1950.The principles of scientific research, Pergamonpress,NY.

MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓
CO2	✓	✓		✓	✓
CO3	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓

SEMESTER–V
23U5MBCP05
Credits–3

CORE PRACTICAL V
Total Number of Hours: 45
5 Hours/Week

Bacteriology, Mycology, Soil microbiology and Bioinformatics Practical-V

COURSE OBJECTIVES:

- To obtain knowledge about fungal identification methods
- To gain information about immobilization technique
- To know the techniques in amylase production from bacteria
- To update the identification methods used in clinical pathogen detection
- To get knowledge about citric acid producing fungi

COURSE OUTCOME:

CO1	Diagnosis of pathogens from clinical samples
CO2	Demonstration of fungal pathogens
CO3	Screening of bacteria for amylase production
CO4	Screening of bacteria producing citric acid
CO5	Immobilization of products for preservation

1. Isolation, Biochemical characterizations and identification of clinical pathogens from
 - a. Urine,
 - b. Pus,
 - c. Throat swab and
 - d. Sputum.
2. Identification of the pathogens from the samples provided and characterization of the organisms such as
 - a. *Staphylococcus*
 - b. *Bacillus*
 - c. *E.coli*
 - d. *Klebsiella*
 - e. *Proteus*
 - f. *Pseudomonas*
 - g. *Salmonella*
 - h. *Shigella*
 - i. *Vibrio*
3. Identification of fungal specimens by direct microscopy – KOH and LCB

preparations.

- a. *Aspergillus*
- b. *Penicillium*
- c. *Mucor* and
- d. *Rhizopus*

4. Identification of Determatophytes from clinical samples
5. Screening of amylase producing bacteria from soil.
6. Production of citric acid and quantification from soil bacteria
7. Immobilization technique.

SUGGESTED MANUALS

1. Arora, B and D.R. Arora, (2013), **Practical Microbiology** CBS Publishers & distributors Pvt. Ltd, New Delhi.
2. Benson, J.H., (2001), “**Microbiological Applications: A Laboratory Manual in General Microbiology**”, Eighth Edition, McGraw-Hill, New York.
3. Cappuccino, J.G. and N. Sherman, (2005), “**Microbiology - A Laboratory Manual**”, Seventh Edition, Benjamin and Cummings Publications, San Francisco.
4. Gunasekaran, P., (2005), “**Laboratory Manual in Microbiology**”, New Age International (P) Ltd, New Delhi.
5. Kannan, N., (2003), “**Laboratory Manual in General Microbiology**”, Fourth Edition, Palani Paramount Publications, Palani.

MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER-V
23U5MBDE05
Credits-3

ELECTIVE III
Total Number of Hours:45
4Hours/Week

MICROBIAL QUALITY CONTROL AND TESTING

COURSE OUTCOME:

CO1	Understand good laboratory practices.
CO2	Understand the importance and food safety method.
CO3	Understand the isolation of microorganisms in food
CO4	Understand the how to cause spoilage of the food.
CO5	Understand the quality control agencies and their regulation in food safety

UNIT – I

No. of Hours: 09

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

UNIT – II

No. of Hours: 09

Determining Microbes in Food / Pharmaceutical Samples - Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products. Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – III

No. of Hours: 09

Pathogenic Microorganisms of importance in Food & Water - Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Sabouraud Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

UNIT – IV

No. of Hours: 09

HACCP for Food Safety and Microbial Standards - Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

UNIT – V

No. of Hours: 09

Food laboratories: Food testing laboratories in India- NABL accreditation of microbial products, Referred food lab by FSSAI, Food testing procedure food auditing, licensing requirements.

Text books

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

SEMESTER-V
23U5MBDE06
Credits-3

ELECTIVEIII
Total Number of Hours:45
4 Hours/Week

HEMATOLOGY AND BLOOD BANKING

COURSE OBJECTIVES

- To gain knowledge about the blood cells.
- To study hematological diseases.
- To impart knowledge on hematological tests.
- To gain knowledge about immunohematology.
- To study blood banking and blood transfusion.

COURSE OUTCOMES

CO1	Understand the principles of hematology, both blood physiology, functions, and disorders.
CO2	Master the pathobiology of hematological disorders encountering in hospital practice.
CO3	Gain knowledge about pathobiology of WBC
CO4	Interpret diagnostic test results and erroneous test results and able to fix them.
CO5	Familiarize with blood banking techniques

UNIT – I

No. of Hours: 09

Overview of haematopoiesis. -regulation of erythrocyte production , distribution ,morphology, kinetics of haemoglobin synthesis structure function, normal and abnormal.

UNIT – II

No. of Hours: 09

Anemias- classification of Anaemia - Hemolytic disease of the new born- approach to diagnosis and diagnostic tests.

UNIT – III

No. of Hours: 09

Neoplastic and non neoplastic disorders of WBC. Classification and lab diagnosis of leukemias, chronic myeloproliferative disorders and other malignant disorders of the haemopoietic system.

UNIT – IV

No. of Hours: 09

Principles of blood groups & antigen antibody reactions - Genetics in blood banking - ABO & Rh blood group systems - Other red cell antigens & their antibodies - clinical significance - Red cell compatibility testing - coombs tests - significance - Antibody identification - Hemolytic disease of newborn - Transfusion transmitted diseases & their lab diagnosis

UNIT – V

No. of Hours: 09

Blood collection & preservation including cryopreservation - Blood components, preparation, indications, - Blood substitutes - Blood donor motivation - Auditing in blood banks. - Quality assurance in blood banking practices

TEXT BOOKS

1. Drew Provan (2009). ABC of Clinical Haematology, 3rd edition. BMJ books.
2. Hoffbrand A.V, Pettit J.E and Moss P.A.H (2001). Essential Haematology. 2nd edition. Blackwell Science, New York.
3. Praful B. Godkar, Darshan P. Godkar (2003). Textbook of Medical Laboratory Technology, 3rd Edition.

Reference Books

1. Denise M Harmening (2012). Modern Blood Banking and Transfusion Practices. 6th Edition. F A Davis Company, Philadelphia.
2. Transfusion Medicine Technical Manual (2003). 2nd edition. DGHS, Ministry of Health and Family Welfare, Govt. of India,
3. Peter Delves, Seamus Martin, Dennis Burton (2006). Roitt's Essential Immunology. 11th edition. Wiley-Blackwell, New York.

WEB SOURCES

1. <https://nptel.ac.in/courses/102103012/pdf/mod7.pdf>
2. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/ln_hematology_mlt_final.pdf
3. <http://www.rajswashya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Blood%20Banking/Introduction.pdf>
4. <file:///H:/Hematology/abo%20blood%20grouping.pdf>

MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER–V
23U5MBDE07
Credits–3

ELECTIVE IV
Total Number of Hours:45
4 Hours/Week

BIODEGRADATION AND SOLID WASTE MANAGEMENT

COURSE OUTCOME

CO1	State solid waste characteristics and its sources.
CO2	Identify and analyze different methods of treatment of solid waste
CO3	Illustrate Industrial practices in solid waste management
CO4	Discuss the significance of recycling reuse and reclamation of solid wastes
CO5	Assess the relationships between environmental guidelines, human activities and quality of impacted soil, water and air

UNIT – I

No. of Hours: 09

SOLID WASTE HISTORY: Economics and solid waste, Legislation and regulations
MATERIAL FLOW: Reduction, reuse, recycling, recovery, disposal of solid waste in landfills, energy conservation. The need of integrated solid waste management: Municipal solid waste generation, municipal solid waste characteristics: Composition by identifiable items, moisture content, particle size, chemical composition, heat value, bulk and material density, mechanical properties, biodegradability.

UNIT – II

No. of Hours: 09

Refuse collection systems, commercial wastes, transfer stations, collection of recyclable materials. Landfill processes: Biological degradation, leachate production, gas production.

UNIT – III

No. of Hours: 09

Refuse physical characteristics, storing Municipal solid waste, conveying, compacting
SHREDDING: Use of shredders in solid waste processing, types of shredders used for solid waste processing, health and safety Pulping, roll crushing, granulating

UNIT – IV

No. of Hours: 09

Thermal conversion: Combustion or incineration systems, factors affecting efficiency
of incinerators, problems associated with incinerator operations, pyrolysis, gasification, pelletization.

UNIT – V

No. of Hours: 09

Biological processing: Composting (aerobic conversion), critical design parameters in composting, types of composting systems, properties of compost, anaerobic conversion, vermiculture, chemical processing,

TEXT BOOKS:

1. William A. Worrell, P. Aarne Vesilind “Solid Waste Engineering”, 2nd edition, Cengage, 2012.
2. Iqbal H Kahn, Naveed Ahsan “Text book of Solid Waste Management”, CBS Publishers, 2013.

REFERENCES:

1. Cheremisinoff N.P “Handbook of Solid waste management and waste minimization technologies” Butterworth-Heinemann Publisher, 2003.

MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER-V
23U5MBDE08
Credits-3

ELECTIVE-IV
Total Number of Hours: 45
4Hours/Week

PLANT PATHOLOGY AND HYDROPONICS

COURSE OBJECTIVES:

- To familiarize students with plant diseases, its control measures and management.
- To learn the symptoms, etiology, and control measures of bacterial, viral and fungal diseases.
- To gain expertise to cultivate plants with minimal use of water
- To get acquainted with diseases and weeds affecting hydroponics.
- To know the government initiatives and entrepreneurial opportunities in hydroponics

COURSE OUTCOME

CO1	Gain sound basis of knowledge in plant pathology and plant disease management
CO2	Learn about the bacterial, fungal and viral disease etiology, control and protection of plants
CO3	Learn to grow plants commercially in hydroponics
CO4	Learn about the nutrient medium, materials and equipments used in hydroponics
CO5	Gains entrepreneurial skills in hydroponics

UNIT – I

No. of Hours: 09

Introduction to plant pathology-classification of plant diseases - Etiology, symptomology, host pathogen interaction, Disease cycle and environmental relationship, mechanism of infection - Prevention and control measures, plant protection and quarantine - management of plant diseases

UNIT – II

No. of Hours: 09

Bacterial diseases of plants - transmission of bacteria, symptoms, etiology, and control measures of following diseases - Blight of rice, Citrus canker, Wilt of cotton. Fungal diseases of plants - symptoms, etiology, and control measures of following diseases -- Red rot of sugarcane, Tikka disease of ground nut, Black rust of wheat. Viral diseases of plants - transmission of viruses, symptoms, etiology, and control measures of following diseases - Bunchy top of banana, Tobacco mosaic virus (TMV), Cauliflower Mosaic Virus (CaMV).

UNIT – III

No. of Hours: 09

Introduction to hydroponic technology- History, Advantages and Disadvantages, Plants commonly used in hydroponics- Plant growth requirements - Light, Nutrition, Temperature - Hydroponic growing systems - basic concepts and design- Liquid hydroponic system, Aggregate hydroponic system, water culture system, Ebb and flow system, Drip, NFT, Aeroponic system. Nutrient management techniques, Rooting media and nutrient solutions, reagents ,formulations

UNIT – IV

No. of Hours: 09

Hydroponics application factors - environmental control- common pests and diseases affecting hydroponic plants-Identification and control of weeds-commercial hydroponic farming maintenance.

UNIT – V

No. of Hours: 09

Entrepreneurship in hydroponics- Production of Lettuce, Capsicum, Tomatoes, Cucumber,flowers - Good agricultural practices in hydroponics - Government of India initiatives for hydroponics production.- Major agencies promoting hydroponics.

TEXTBOOKS

1. Sinclair, W. A., Lyon, H. H., and Johnson, W. T. 1987. Diseases of Trees and Shrubs. Comstock Publishing Associates, a division of Cornell University Press. ISBN 0-8014-1517-9.
2. Greenwood, P., Halstead, A., Chase, A. R., and Gilrein, D. 2000. American Horticultural Society Pests and Diseases: The Complete Guide to Preventing, Identifying and Treating Plant Problems. DK Publishing, NY. ISBN 0-7894-5074-7.
3. Sunset Western Garden Problem Solver. 1998. Sunset Books Inc., California. ISBN 0-376-06132-4



SEMESTER VI

SEMESTER–VI
23U6MBC10
Credits–4

CORE X
Total Number of Hours:60
4Hours/Week

MEDICAL VIROLOGY AND PARASITOLOGY

Course Objectives:

- The learner will acquire knowledge about virology and parasitology, classification of viruses, parasites and their characteristics.
- The learner will learn the medically important viruses, parasites and their diseases.
- The learner will learn the diagnostic methods of microbes .
- The learner will get updated knowledge on microbes, disease control, treatment and prevention.

Course Outcome:

CO1	Understand the general characteristics and different methods of classification of viruses and parasites .
CO2	Demonstrate the basic techniques in staining, microscopy, culturing, and isolation of microbes.
CO3	Understand the medically important viruses and protozoa
CO4	Understand the clinically importance of helminths.
CO5	Understand the pathogenesis, life cycle ,prophylaxis and prevention of viral and other parasitic diseases

UNIT I

No. of Hours: 12

Introduction and Classification of Virus: Introduction and Historical perspective of medical virology. General properties of viruses –Nomenclature and classification of viruses-ICTV system of classification , Baltimore classification of viruses. Viral related agents. - Viroids and Prions Cultivation of viruses – viral assay.– Serological and molecular diagnosis of viral infections. Biosafety and contaminant facility in virology lab.

UNIT II

No. of Hours: 12

DNA Viruses: Pathogenesis, laboratory diagnosis, Prevention and Treatment of animal viruses: Pox viruses – Variola virus. Adenoviruses, Herpes viruses-type-I and type-II, Polio virus, Rabies virus, Hepatitis-A,B and C, Orthomyxoviridae-Influenza A, H1N1,Paromyxoviridae-Measles, Mumps.

UNIT III

No. of Hours: 12

RNA Viruses: Pathogenesis, laboratory diagnosis, Prevention and Treatment of following animal viruses: Togoviridae- Chickungunya virus. Flaviviridae- Yellow fever virus, KFD virus, Dengue virus, Zika virus, Ebola virus, Marbug virus. Coronaviridae- MERS-CoV, SARS-CoV, SARS- CoV2, Retriviridae-HIV. Antiviral agents and vaccines.

UNIT-IV

No. of Hours: 12

Medical Protozoa: Introduction to medical parasitology: Classification and characteristics of Protozoa Common diagnostic methods in parasitology - Examination of faeces– Concentration methods. Blood smear examination of parasites. General Characteristics, life cycle, diagnosis, prophylaxis and control of following protozoans- *Entamoeba histolytica* - *Giardia lamblia* - *Trichomonas vaginalis* - *Leishmania donovani* - *Trypanosoma brucei* – *Plasmodium*.

UNIT V

No. of Hours: 12

Medical Helminths: General Characteristics, life cycle, diagnosis, prophylaxis and control of following helminths- *Ascaris lumbricoides* - *Ancylostoma duodenale* -*Schistosoma haematobium* - *Taenia solium* –*Diphyllobothrium latum* - *Enterobius vermicularis*- *Trichuris trichiura* – *Wuchereria bancrofti*.

Suggested Reading

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall

publication, New Jersey.

5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Parija S.C. (2013) Text book of Medical Parasitology. 4th edition. All India Publishers and Distributors, New Delhi.
9. Jagdish Chander (2012). Text book of Medical Mycology. 3rd edition. Mehta Publishers, New Delhi.

SEMESTER–VI
23U6MBC11
Credits–4

CORE XI
Total Number of Hours:60
4Hours/Week

FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY

UNIT I

No. of Hours: 12

Food as a substrate for micro organisms-.Micro organisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of micro organisms, - High temperature – Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation.

UNIT II

No. of Hours: 12

Contamination and spoilage of food products -Food borne infections (Bacillus cereus,,Salmonellosis, Shigellosis, ,Listeria monocytogenes and Campylobacter jejuni) and intoxications – (Staphylococcus aureus, Clostridium botulinum ,Clostridium perfringens and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures.

UNIT III

No. of Hours: 12

Principles and methods of food preservation and Sanitation - Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO₂, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins. HACCP standadards, Indices of food sanitary quality and sanitizers.

UNIT IV

No. of Hours: 12

Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics- Brief overview of gut microbiome;– criteria of prebiotics, effects of prebiotics on metabolism and or absorption of nutrients. immune response, cancer prevention, elderly health and infant health, prebiotics in foods.; prebiotics in infant formulas; Functional foods- health claims and benefits, Development of functional foods

UNIT V

No. of Hours: 12

Probiotics: Criteria for probiotics,; Probiotic microorganisms, concept, definition safety of probiotic microorganisms, Development of Probiotics for animal and human use, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods. Biopreservation

Text Books

1. Frazier WC and West off DC. (2017). Food microbiology. 5 th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
2. Adams, M.R., Moss, M.O.(2018). Food Microbiology 1 st edition. New Age Publishers by New Age International (P) Ltd., Publishers
3. 3.R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers

Reference Books

- Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7 th Edition
- Prescott, Harley and Klein Wim.(2008). Microbiology, 7 th Edition McGraw Hill Publications.
- Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.

Web sources

2. https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_BacterialGrowth_in_Food/link/5a1d2e02aca2726120_b28eba/download
3. <https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate>
4. https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_-_A_review

SEMESTER–VI
23U6MBC12
Credits–4

COREXII
Total Number of Hours:60
5Hours/Week

BIO-PROCESS TECHNOLOGY

UNIT I

No. of Hours: 12

Concept of Fermentation and Bioprocess technology -The fundamental concept of Fermentation and bioprocess technology - Types of bioprocesses -Design and formulation of Media for industrial bioprocess - Criteria for medium design, carbon/nitrogen sources, nutrients - Sterilization of media

UNIT II

No. of Hours: 12

Bioreactors-design, types and operation -Bioreactors, bioreactor design- criteria, operation and types of bioreactors - Agitation and aeration in the bioreactor, impeller and sparger design. -Concept of scale up, scale up challenges- Influence of various bioprocess parameters viz. pH, temperature, medium components on product synthesis- Bioprocess monitoring and control, automated control vs manual control of bioprocesses.

UNIT III

No. of Hours: 12

Downstream processing - Downstream processing: definition, cost involved in downstream processing - Typical steps involved in Downstream processing. - Criteria for downstream processing, Target application of product vs cost, separation of cells and broth-Typical unit operation for downstream processing filtration, centrifugation, chromatography, solvent extraction, HPLC. - Methods for cell breakage for harvesting intercellular products.

UNIT IV

No. of Hours: 12

Bioprocess based products and application - Commercial production of various bioprocess based products (Bioethanol, butanol, citric acid, acetic acid) –

UNIT V

No. of Hours: 12

Antibiotics-penicillin, streptomycin, tetracycline. Single cell protein; amino acids: glutamic acid, lysine - Types and nature of wastes generated from bioprocesses .

TEXT BOOKS

1. Arnold L. Demain & Julian E. Davis. Industrial Microbiology & Biotechnology, ASM Press.(2004).
2. Coulson, J.M. and J.F. Richardson; 6th Edition, Chemical Engineering Elsevier. Mc Graw HillPublication. (1999).
3. Emt.el-Mansi & CFA. Bryce Fermentation Microbiology & Biotechnology, Taylor & Francis Ltd.(2004).
4. Stanbury, P.F., A. Whitaker & S.J. Hall. Principles of fermentation technology Oxford Press.(1997).“Prescott and Dunn’s Industrial microbiology”, edited by Reed, G., 4th edition, 1982.
5. “Industrial microbiology”, by Miller B. M., and W. Litsky, 1976 Mc Graw-hill, New York.
6. “Pharmaceutical microbiology”, edited by Hugo, W.B. and A.D. Russell 1977, Blackwell scientific, oxford.
7. “Biotechnology: A textbook of industrial microbiology”, by Crueger, W. and A. Crueger, 1982, Sinauer Associates, Inc., Sunderland, Mass

SEMESTER–VI
23U6MBCP06
Credits–2

CORE PRACTICAL VI
Total Number of Hours:30
5 Hours/Week

VIROLOGY, PARASITOLOGY, FOOD AND BIO-PROCESSES PRACTICAL-VI

Course Objectives:

- To obtain knowledge about virus identification methods
- To gain information about the identification of human parasites
- To know the techniques in the isolation of bacteria from root nodules
- To update the identification methods used in assess the water quality
- To get knowledge about the microbes from spoiled food materials

Course Outcome:

CO1	To understand the haemagglutination techniques
CO2	Able to understand the cultivation of viruses
CO3	Able to understand the cultivation of soil microbes
CO4	Able to understand the water quality parameter techniques
CO5	To understand the isolation of bacteria from spoiled fruits

1. Haemagglutination Assay
2. Egg inoculation methods
3. Wet mount examination of parasites.
4. Concentration methods for egg / ova
 - Flotation technique
 - Sedimentation technique
5. Isolation of bacteria from rhizosphere.
6. Isolation and Identification of Plant pathogen
7. Determination of Water Quality by MPN and Settle Plate method.
8. Determination of Milk Quality by MBRT and Resazurin test.
9. Isolation of bacteria from spoiled fruits and soft drinks.
10. Determination of indices of pollution by measuring BOD/COD of different effluents

11. Determination of indices of pollution by measuring COD of different effluents

12. Isolation of Probiotic microorganisms from curd

MAPPING

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

SEMESTER–VI
23U6MBDE09
Credits–3

ELECTIVE V
Total Number of Hours:45
4 Hours/Week

PHARMACEUTICAL MICROBIOLOGY

Course Objectives

- To provide the knowledge on basics of chemotherapy
- To learn the assays and testing methods of antibiotics.
- To gain information about spoilage of pharmaceutical products
- To provide the knowledge on drug discovery and clinical trials
- To learn about regulations in pharmaceutical industry

Course Outcome:

CO1	Understand methods of identification, cultivation and preservation of various microorganisms
CO2	Understand the importance and implementation of sterilization in pharmaceutical processing and industry
CO3	Learn sterility testing of pharmaceutical products.
CO4	Carried out microbiological standardization of Pharmaceuticals.
CO5	Understand the cell culture technology and its applications in pharmaceutical industries

UNIT I

No. of Hours: 09

Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing

UNIT II

No. of Hours: 09

Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.

UNIT III

No. of Hours: 09

Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, Lasperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.

UNIT IV

No. of Hours: 09

Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests. Design and layout of sterile manufacturing unit. Contamination and Spoilage of Pharmaceutical products - sterile injectable and non injectable, ophthalmologic preparation, implants.

UNIT V

No. of Hours: 09

Quality assurance and quality management in pharmaceuticals – Modular Clean Rooms, Sterility Assurance Level, In-Process, Final-Product Control and sterility tests. Regulatory aspects – BIS (IS), ISI, ISO, WHO and US certification.

TEXTBOOKS

1. Stanbury P. T. and Whitaker. (2016). Principles of Fermentation Technology. (3rd Edition). Pergamon Press. NY.
2. Handa S. S. and Kapoor V. K. (2022). Pharamcognosy, (4th Edition). Vallabh Prakashan Publishers, New Delhi.
3. Kokate C. K., Durohit A. P. and Gokhale S. R. Pharmacognosy. (2002). (12th 90 Edition). Nirali Prakasham Publishers, Pune.
4. Hugo W. B. and Russell A. D. (2004). Pharmaceutical Microbiology. (7th Edition). Blackwell Scientific Publication, Oxford.
5. Wallis, T.E. (2005). Text book of Pharmacognosy. (5th Edition). CBS publishers and distributors, New Delhi.
6. Handa, S.S. and Kapoor, V.K. (2022) .Pharamcognosy. 4thEdition. Vallabh Prakashan Publishers, New Delhi.
7. Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition NiraliPrakasham Publishers, Pune.
8. S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
9. Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi. Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds).Churchill Livingstone.

SEMESTER-VI
23U6MBDE10
Credits-3

ELECTIVE V
Total Number of Hours:45
4Hours/Week

BIOSAFETY AND BIOETHICS IN MICROBIOLOGY

Course Objectives:

- To create a research environment - encourage investigation, analysis and studying the
- bioethical principles, values, concepts, and social and juridical implications contained in the Universal Declaration on Bioethics and Human Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.
- To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.
- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To understand the importance of IPR, Patents and Patent laws.

Course Outcome:

CO1	Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment
CO2	Develop stratagems for the use of genetically modified organisms and Hazardous materials
CO3	Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care.
CO4	Analyze and respond to the comments of other students regarding philosophical issues.
CO5	Pave the way for the students to catch up Intellectual Property(IP) as a career option

UNIT I

No. of Hours: 09

Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP)

UNIT II

No. of Hours: 09

Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.

UNIT III

No. of Hours: 09

Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC.

UNIT IV

No. of Hours: 09

Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons.

UNIT V

No. of Hours: 09

IPR, Patents and Patent laws - Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.

TEXT BOOKS

1. Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-10 1645878856
2. Sateesh.M.K.,(2009). Bioethics and Biosafety- 1st Edition, J. K International Publishing House Pvt. Ltd: Delhi, ISBN :9788190675703
3. DeepaGoel and ShominiParashar, (2013). IPR, Biosafety and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
4. Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.
5. Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd.

References Books

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
2. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.
4. Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi (2022).
5. Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building, 1st edition. CRC Press4 .
6. Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers.

Web Resources

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview.
Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>.
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook.
Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
3. <https://www..niehs.nih.gov/bioethics>

SEMESTER–VI
23U6MBDE11
Credits–3

ELECTIVE VI
Total Number of Hours:45
4 Hours/Week

ENTREPRENEURSHIP

OBJECTIVES:

- To know about principle and steps involved in new food product development & Marketing Strategy.
- To make the students learn the principles of Biobusiness management.
- To enable the students, understand the concepts of Bioeconomy
- To motivate the students to explore various entrepreneurial opportunities. Teaching-Learning Process

CO1	Know about principle and steps involved in new food product development & Marketing Strategy
CO2	Learn the principles of Biobusiness management.
CO3	Understand the concepts of Bioeconomy
CO4	Explore various entrepreneurial opportunities. Teaching-learning process
CO5	Get an idea about how to initiate a startup.

UNIT I

No. of Hours:09

Basic principles & concept of food product development. Cultural approach to development of dietary pattern of various groups- linguistic, regional, religious(ethic). Factors involved in food habit alteration, availability, importance & role of different research & development departments in food production industry.

UNIT II

No. of Hours:09

Steps in product development –material resources based on market demand, standardization methods involved in product development. Portion size & portion control, Calculation of nutritive value & cost of production, Shelf life & storage stability evaluation procedure of developed food products.

UNIT II**No. of Hours:09**

Formulation of new food products for infants, preschool children, adolescents, pregnant & nursing mothers, old age, sports persons. Selection & training of judges, Development of score card analysis of data. Role of advertisement & technologies in promotion of new products.

UNIT IV**No. of Hours:09**

Concept of market & marketing- Approaches of study marketing & marketing functions, market structure, marketing efficiency. Role of government in promoting agricultural marketing. Conditions for sale, license & identification & quality of processing. Studying the global market status, economic feasibility of new products.

UNIT V**No. of Hours:09**

Entrepreneurship- concept definition of entrepreneurship, Types of entrepreneurship, women entrepreneur, growth, prospects & problems. Small business: Definition & composition of small business- Economic contribution of small business. Strategic planning for small business – Steps in strategic planning.

REFERENCES :

1. Sivarama prasad.A, 1985,Agricultural Marketing in India-Mittal Publications,New Delhi.
2. Acharya.S.S,and N.L.Agarwal,1992,Agricultural Marketing in India- Oxford and IBH Publishing Pvt., Ltd., New Delhi.
3. Developing New Food Products For a Changing Market Place, 2nd Edition, 2005,Aaron, L.Brody,John B.Lord.
4. New Food Product Development, 2004,Gordon W.Fuller.
5. John Kao , Creativity & Entrepreneurship package Compatibility, toxicity, tainting and corrosion. Packaging and environment.

SEMESTER–VI
23U6MBDE12
Credits–3

ELECTIVE VI
Total Number of Hours:45
4 Hours/Week

FOOD PROCESS TECHNOLOGY

Course Objectives

1. To know the principles and methods involved in the processing of Perishable foods
2. To develop skills in the perishable food processing equipments.

Course Outcome

CO1	Gain knowledge about processing and preservation of fruits and vegetables
CO2	Gain knowledge about processing and preservation of Dairy foods
CO3	Gain knowledge about processing and preservation of Meat and Poultry
CO4	Gain knowledge about processing and preservation of Sea foods
CO5	Gain knowledge about processing and preservation of Miscellaneous perishable foods.

UNIT I

No. of Hours:09

Fruit & Vegetable Processing- Classification, Pre- Processing, Processing & Preservation- Size reduction, Mixing, Separation, Concentration, Freezing & Refrigeration, Drying & Dehydration, Chemicals, Processing by using Pulsed Light and Irradiation ; Nutritional losses during Processing, Fruit & Vegetable Intermediate moisture products, Storage.

UNIT II

No. of Hours:09

Dairy Processing- Milk Pre-Processing; Processing & Preservation - Separation, Homogenization, Pasteurization, Standardization, Sterilization (UHT), Evaporation (Spray Drying), Chilling, Freezing & Refrigeration ; Nutritional losses during Processing; Milk Product & By Products; Storage.

UNIT III**No. of Hours:09**

Fleshy Food Processing – Meat, Poultry & Egg - Pre-Processing; Processing & Preservation- Smoking, Canning, Drying, Cooling, Canning Pulsed Electric Field processing; Nutritional losses during Processing; Storage.

UNIT IV**No. of Hours:09**

Sea Food Processing – Types; Pre-Processing; Processing & Preservation- Dielectric, Ohmic and Infra-red heating- Nutritional losses during Processing; Storage.

UNIT V**No. of Hours:09**

Miscellaneous Perishable Food: Confectionery- Types Confectionery & Method of Preparation Sugarcane & Sago Technology – By-Product & Its Utilization

REFERENCES:

1. P.J.Fellows, Food Processing Technology. Principles and Practices, Second Edition, Woodland Publishing Ltd, Cambridge, England, 2002.
2. Avantina Sharma, Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP, 2006.
3. Sivasankar, Food Processing and Preservation, Prentice hall of India Pvt Ltd, New Delhi. IIIrd Printing, 2005.
4. Peter Zeuthen and Leif Bogh-Sorenson, Food Preservation Techniques, Woodland Publishing Ltd, Cambridge, England, 2005.

