VIVEKANANDHA

COLLEGE OF ARTS AND SCIENCES FOR WOMEN

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

(An ISO 9001:2015 Certified institution, 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)

A U T O N O M O U S

PG AND RESEARCH
DEPARTMENT OF MICROBIOLOGY

M.Sc., MICROBIOLOGY

PROGRAMME CODE: PMB

SYLLABUS & REGULATIONS

FOR CANDIDATES ADMITTED FROM
2022 - 2023 ONWARDS
UNDER AUTONOMOUS & OBE PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS

ANGAMMAL EDUCATIONAL TRUST

M.Sc., MICROBIOLOGY

VIVEKANANDHA COLLEGE OF ARTS AND SCIENES 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

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

3. PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

- To provide in-depth knowledge about core areas of biosciences such as biotechnology, biochemistry and microbiology.

- To make students competent in the field of biosciences and allied areas by providing them hands on experience in basic tools and techniques.
- To instil the ability for research and entrepreneurship in the students along with strong ethics and communication skills.
- To inculcate, facilitate, motivate and promote knowledge and technical skills in core areas of biological sciences including advanced tools and techniques to the young aspirants.
- To equip and motivate the students to pursue higher education and research in reputed institutes at national and international level in the field of science.
- To develop trained human resource in the field of advanced translational research.
- To provide students with an understanding of the role of science in societal development.
- To develop graduates with a strong professional ethics and moral duties that will positively affect their profession, community, society and Nation at large.

4. PROGRAM OUTCOMES (PO's)

PO.1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

PO.2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO.3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO.4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO.5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO.6. Research related skills: Will develop ability to identify problems, give justifications for solutions by lab investigations & critical analysis by using appropriate research related biological skills.

PO.7. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO.8. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

5. PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO.1. Get equipped with theoretical and practical understanding of microbiology, its significance, and appreciate the diversity of microbes inhabiting a multitude of habitats.

PSO.2. To understand fundamental principles of molecular and cellular biology, biochemistry, immunology and bioinformatics.

PSO.3. Empower the students to acquire technological knowhow and appreciate how microbiology is applied in various applications and manufacture of industrial products.

PSO.4. Recognize the importance of Bioethics, IPR, entrepreneurship, Research methodology, Bioinformatics, Biostatistics, so as to usher next generation of Indian microbiologists.

6. CONDITIONS FOR ADMISSION

6.1 ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc., degree in any Life Sciences such as Microbiology / Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Animal Science/ Applied Animal Science and Animal Biotechnology/ Biochemistry/ Bioinformatics/ Biology/Home Science/ Food Science and Nutrition/ BHMS/ BSMS/ BAMS/ BUMS/ Chemistry with Botany or Zoology as Allied Subjects of this University or any other University accepted by the Syndicate as equivalent there to shall be eligible for admission to M.Sc., Degree Course in Microbiology.

6.2 ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed, earning 90 credits and fulfilled such conditions as have been prescribed therefore.

7. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

8. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

9. SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory External marks	=	**75**	
Part A	=	**20**	**Marks (01 x 20)**
Part B	=	**25**	**Marks (05 x 05)**
Part C	=	**30**	**Marks (03 x 10)**
Internal marks	=	**25**	
Total Marks	=	**100**	
Time	=	**3 Hrs.**	

10. DURATION OF END SEMESTER EXAMINATION : 3 Hrs.

The following procedure will be followed for Internal Marks

Theory - Internal Marks

Theory best average of two tests 10 Marks

Attendance	5 Marks
Seminar	5 Marks
Assignment	5 Marks
Total	**25 Marks**

Practical - Internal Marks

Practical best average of two tests	25 Marks
Attendance	10 Marks
Observation Note	5 Marks
Total	**40 Marks**

Project- Internal Marks

Presentations [Two reviews 20+20]	40 Marks
Project Report (External marks)	60 Marks
Total	**100 Marks**

Break-up Details for Attendance

Below 75%	**No Marks**
76 to 80%	**01 Marks**
81 to 85%	**02 Marks**
86 to 90%	**03 Marks**
91 to 95%	**04 Marks**
96 to 100%	**05 Marks**

11. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS

(i) Candidates shall register their names for the first semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the first semester up to the final semester irrespective of their failure in any of the semester examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time. Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the college from time to time.

12. PASSING MINIMUM

a) There shall be no Passing Minimum for Internal.
b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
d) Grading shall be based on overall marks obtained (Internal + External)

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the first class. All other successful candidates shall be declared to have passed in second class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in first class with distinction, provided they pass all the examinations (theory papers, practical, project and viva-voce) prescribed for the course in the first appearance.

14. GRADING SYSTEM

The term grading system indicates a 7 point scale of evaluation of the performances of students in terms of marks obtained in the Internal and External examination, grade points and letter grade.

SEVEN POINT SCALE (As per UGC notification, 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
'O'= Outstanding	**5.50 – 6.00**	**75 – 100**
'A'= Very Good	**4.50 – 5.49**	**65 – 74**
'B' = Good	**3.50 – 4.49**	**55 – 64**
'C'= Average	**3.00 – 3.49**	**50 – 54**
'D'= Below Average	**1.50 – 2.99**	**35 – 49**
'E'= Poor	**0.50 – 1.49**	**25 – 34**
'F'= Fail	**0.00 – 0.49**	**00 – 24**

15. RANKING

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the first appearance will not be eligible for ranking.

16. PATTERN OF QUESTION PAPER

PART A (Objective): Answer All the Questions **01 x 20 = 20 Marks**

PART B (200 words): Answer All the Questions (Internal choice) **05 x 05 = 25 Marks**

PART C (500 words): Answer any Three Questions out of 5 **03x 10 = 30 Marks**

17. PROCEDURE IN THE EVENT OF FAILURE

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

18. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2022-2023 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2022-23 and thereafter.

19. TRANSITORY PROVISION

Candidates who were admitted to the PG course of Microbiology before 2022 – 2023 shall be permitted to appear for the examinations under those regulations for a period of two years i.e., upto and inclusive of the examination of Apr/May 2019. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

SCHEME OF CURRICULUM – M.Sc., MICROBIOLOGY
(For the candidates admitted during the academic year 2022-2023 onwards)

Sem	Subject code	Course	Subject title	Hrs/ week	Cre dit	Int. marks	Ext. marks	Tot. marks
I	22P1MB01	Core – I	Essentials of Microbiology	6	5	25	75	100
	22P1MB02	Core – II	Cell and Inheritance Biology	5	5	25	75	100
	22P1MB03	Core – III	Immunology and Immunotechnology	5	5	25	75	100
	22P1MBP01	Core Practical – I	Practical – I – Essentials of Microbiology	5	3	40	60	100
	22P1MBP02	Core Pra1ctical - II	Practical – II – Cell biology & Immunology and Immunotechnology	5	3	40	60	100
	22P1MBE01/ 22P1MBE02	Elective – I	**Advanced techniques in Microbiology/Diagnostic microbiology**	4	4	25	75	100
			Total	**30**	**25**	**180**	**420**	**600**
II	22P2MB04	Core – IV	Medical Bacteriology & Mycology	6	5	25	75	100
	22P2MB05	Core – V	Microbial Genetics & Molecular Biology	5	4	25	75	100
	22P2MB06	Core – VI	Food, Industrial and Pharmaceutical Microbiology	5	4	25	75	100
	22P2MBP03	Core Practical- III	Practical – III – Medical Bacteriology & Mycology	5	3	40	60	100
	22P2MBP04	Core Practical- IV	Practical – IV – Microbial Genetics, Molecular Biology, Food, Industrial and Pharmaceutical Microbiology	5	3	40	60	100
	22P2MBE03/ 22P2MBE 04	Elective – II	**Developmental Biology/ Poultry Microbiology**	4	4	25	75	100
	Internship Training			-	-	-	-	-
			Total	**30**	**23**	**180**	**420**	**600**
III	22P3MB07	Core – VII	Medical Virology & Parasitology	6	5	25	75	100
	22P3MB08	Core – VIII	Soil, Agricultural & Environmental microbiology	6	5	25	75	100
	22P3BTED01	EDC	Plant and Animal cell culture techniques	2	2	25	75	100
	22P3MBP05	Core Practical- V	Medical Virology & Parasitology	5	3	40	60	100
	22P3MBP06	Core Practical- VI	Soil, Agricultural & Environmental microbiology	5	3	40	60	100

	22P3MBE05/ 22P3MBE06	Elective –III	Entrepreneurship in Microbiology/ Microbial fuel cell technology and Nanotechnology	4	4	25	75	100
	22P3HR01		Human Rights	2	1	25	75	100
			Total	**30**	**23**	**205**	**495**	**700**
	22P4MB09	Core – IX	Genetic Engineering - Concepts and Applications	6	5	25	75	100
IV	22P4MB10	Core – X	Research Methodology, Bioinformatics & Biostatistics	6	5	25	75	100
	22P4MBE07/ 22P4MBE08	Elective – IV	**Bioethics, Biosafety and ipr/ Microbial Degradation and Bioremediation**	4	4	25	75	100
	22P4MBPR01	Core – XI	Project work	14	6	50	150	200
			Total	**30**	**20**	**115**	**375**	**500**
Overall Total				**120**	**91**	**720**	**1680**	**2400**

ELECTIVE PAPERS:

Semester I – 1. Advanced Techniques in Microbiology (22P1MBE01)

2. Diagnostic Microbiology (22P1MBE02)

Semester II – 1. Developmental Biology (22P2MBE03)

2. Poultry Microbiology (22P2MBE04)

Semester III – 1. Entrepreneurship in Microbiology (22P3MBE05)

2. Microbial Fuel Cell Technology and Nanotechnology (22P3MBE06)

Semester IV – 1. Bioethics, Biosafety and IPR (22P4MBE07)

2. Microbial Degradation and Bioremediation (22P4MBE08)

EXTRA DISCIPLINARY COURSE

Medical laboratory technology (22P3MBED3)

SEMESTER I

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SEMESTER – I	**CORE – I**
22P1MB01	**Total Number of Hours: 75**
Credits – 5	**6 Hours/ Week**

ESSENTIALS OF MICROBIOLOGY

Course Objectives:

- Acquire knowledge about microbial diversity, classification of microbes and its recent trends.
- Learn the basic principles and applications of the basic techniques in microbiology.
- Develop an understanding about microbial physiology and metabolism.
- Know about the growth, nutrition and microbial ecology.
- Understand the various methods of microbial control invitro and invivo.

Course Outcome:

CO1	Understand the classification of microbes and their characteristics, classification of microbes and analyze the trends in microbial profiling..
CO2	Demonstrate the basic techniques in staining, microscopy, culturing, isolation and preservation of microbes.
CO3	Understand the growth phase, influencing factors, illustrate their interaction with the environment and explain their adaptation in extreme environments.
CO4	Understand the metabolic pathways of energy utilization and conservation.
CO5	Apply the knowledge of sterilization and infer the mechanism of action of antibiotics and drug resistance.

UNIT- I Microbial Diversity **No. of Hours: 15**

Bacteria - General characteristics and classification - Bergey's classification of systemic Bacteriology - Archaebacteria - Cyanobacteria - General characteristics and classification. **Fungi:** General characteristics and classification. Actinomycetes – **Algae** - General characteristics and classification. **Virus** - General properties - Baltimore classification. Protozoa: General characteristics and classification.

UNIT-II - Microbial Growth **No. of Hours: 15**

Nutritional requirements of bacteria - Nutritional types - Autotrophs, Phototrophs, Chemotrophs, Lithotrophs, Copiotrophs, Oligotrophs. Growth curve - Batch, Continuous and Synchronous culture - Diauxic growth - Factors influencing growth - Culture media - Types - Aerobic and Anaerobic culture techniques. Pure culture techniques. Preservation of microbial culture.

UNIT-IV - Microbial Physiology and Metabolism **No. of Hours: 15**

Aerobic Respiration - Bacterial photosynthesis - Oxygenic and Anoxygenic photosynthesis - CO_2 Fixation - Calvin cycle - Embden Mayer Hoff pathway - Entner Doudroff pathway -Glyoxlate pathway - Kreb's cycle - Electron Transport Chain - Oxidative and Substrate level phosphorylation. Chemolithotrophy - Sulphur - Iron - Hydrogen - Nitrogen oxidations - **Anaerobic Respiration** - Fermentation - Lactic acid, Ethanol and Mixed acid.

UNIT V - Techniques in Microbiology **No. of Hours: 15**

Microscopy: Principle and applications of Bright field, Dark field, Fluorescent, Phase contrast, Confocal, SEM and TEM. **Staining techniques:** Simple, Differential staining - Gram staining, Acid fast, Special staining - Capsular, Endospore, Metachromatic and Flagellar.

UNIT V - Control of Microorganisms **No. of Hours: 15**

Sterilization - Physical and Chemical Methods - Sterility Indicators - Testing of Disinfectants - **Antibiotic**s - Classification and Mode of action - Antibacterial and Antifungal antibiotics - Sensitivity tests - Disc diffusion - Microdilution method-Stokes method- Drug resistance mechanism.

Text Books

1. Dubey, R.C. and Maheshwari, D.K., "**A Text Book of Microbiology**", Revised Edition, S.Chand & Company Ltd., New Delhi, 2010.
2. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "**Microbiology**", Revised Edition, Tata Mc Graw Hill Publishers, New York, 2014.
3. Caldwell, D. R. 1995. **Microbial Physiology and Metabolism**. Brown Publishers.
4. Moat, A. G and Foster, J. W. 1999. **Microbial Physiology**. Wiley.

Reference Books

1. Prescott, L.M., Harvey, J.P. and Klein, D.A., "**Microbiology**", Ninth Edition, Wm. C. Brown Publications, Iowa. 2015.
2. Black, J.G., "**Microbiology: Principles and Explorations**", Eighth Edition, John Wiley and Sons, Inc, New Jersey, 2012.
3. Sullia, S.B. and Santharam, S., "**General Microbiology**", Oxford IBH Pub. Co., 2011.
4. Willey, J.M., Sherwood, L.M. and Woolverton, C.J., "**Prescott's Microbiology**", Eighth Edition, McGraw Hill, New York, 2015.

5. Tortora, J.G., Funke, R.B. and Case, C.L., "**Microbiology: An Introduction**", Twelfth Edition, Pearson Education. Inc., San Francisco, 2016.
6. Stainer, R. Y., Ingharam, J. L., WHeelis, M. L., Painter, P. R. 1986. **General Microbiology**. Macmillan Education Ltd.
7. Brun, Y. V. and Shimkets, L. J. 2000. **Prokaryotic Development**. ASM Press.

Web Sources:

1. http://www.sheffcol.ac.uk/links/Science/Biology/Microbiology
2. http://www.microbiologyonline.org.uk/links.html
3. http://www.bact.wisc.edi/Microtextbook/index.php
4. http://www.bmb.leeds.ac.uk/mbiology/ug/ugteach/elect/elect.htm
5. http://www.microbeworld.org/

SEMESTER – I **CORE – II**
22P1MB02 **Total Number of Hours: 75**
Credits – 5 **5 Hours/ Week**

CELL AND INHERITANCE BIOLOGY

Course Objectives

- Acquire knowledge about the fundamental cell biology concepts.
- Learn the basics of Cell growth, Cell cycle, Cell signaling and Cellular communication
- Develop an understanding about Mendelian principles of Inheritance and its extension.
- Know about the gene mapping methods.
- Understand the causes, types, detection of mutation and Recombination

Course Outcome

CO1	Understand the cell architecture, cellular transport. and organization and gene and chromosome
CO2	Analyse the stages of cell growth and cell cycle and know how the cell signals and communicates between them.
CO3	Understand the Mendelian principles of Inheritance, its extension and organization of genes and chromosomes.
CO4	Understand the gene mapping methods, human genetics and quantitative genetics.
CO5	Acquire knowledge of mutation, structural and numerical alterations of chromosomes and recombination.

UNIT-I - Introduction to Cell biology — No. of Hours: 15

Prokaryotic cell organisation - structure and synthesis of bacterial cell wall and other cell organelles and structures present in bacteria - **Eukaryotic cell organization:** structure, function and membrane transport, structure and functions of other cell organelles.

UNIT-II - Cell cycle and Cell signaling — No. of Hours: 15

Cell division in eukaryotes - Mitosis and Meiosis. Cell cycle and its regulation. Cell signaling: and Communication- Hormones and Receptors, Cell signaling pathways, Basics of signal transduction, Role of Second messengers and Protein kinases in signal transduction, Bacterial chemotaxis and Quorum sensing. General principles of cell communication - Cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix and integrins.

UNIT- III - Mendelian Inheritance **No. of Hours: 15**

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over.

UNIT-IV - Methods in Genetics **No. of Hours: 15**

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

UNIT- V - Mutation **No. of Hours: 15**

Mutation: Types, Causes and Detection. Mutant types – Lethal,Conditional, Biochemical, Loss of function, Gain of function, Germinal versus Somatic mutants, Insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, Duplication, Inversion, Translocation, Ploidy and their genetic implications.

Text Books

1. Becker, W. M., Kleinsmith, L.J. and Hardin, J. 2000. The world of the Cell. IV Edition. Benjamin/Cummings.
2. Hogg, S. 2005. Essential Microbiology. John Wiley and Sons, Ltd.,
3. Madigan M.T., Martinko M. J. and Jack Parker. 2003. Brock Biology of microorganisms.
4. Pearson education., New Jercy. Perry, J.J., Staley, J.T. and Lory, S. 2002. Microbial Life. Sinauer Associates, Publishers,Sunderland, Massachusetts.
5. Satyanarayana, T and Johri, B. N. 2005. Microbial Diversity – Current Perspectives and Potential Applications. I K Int. Pvt. Ltd. New Delhi.
6. York.Hartl, D.L. 1994. Genetics. Jones and Bartler Publishers, London.
7. Strickberger, M. W.1985. Genetics, 3rd Edn. Mac. Millan Pub. Co. Inc. NY.

Referrence Books

1. Holt T S, Krieq N R, Sneath PHA & Williams S T. 1994. Bergey's Manual of DeterminativeBacteriology 9th Edn. Williams & Wilkim, Baltimore
2. Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. Microbiology, International edn. 4th edn.WCB Mc Graw-Hill.

3. Stanley R. Maloy, *Microbial Genetics Second Edition*,University of Illinois, Urbana, John Cronan, Jr., University of Illinois, Urbana, David Freifelder, Late of the University of California, San Diego
4. Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington.

Web sources:

1. https://www.ncbi.nlm.nih.gov/books/NBK9944
2. https://www.nature.com/scitable/topicpage/mitosis-meiosis-and-inheritance-476/
3. https://bio.libretexts.org/Bookshelves/Human_Biology/
4. https://www.sciencelearn.org.nz/

SEMESTER – I **CORE - III**
22P1MB03 **Total Number of Hours: 75**
Credits - 5 **5 Hours/ Week**

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Objectives

- To understand cells and organs of the immune system and host parasite relationship.
- To gain knowledge about antigens, major histocompatibility complex and immunoglobulins.
- To become familiar with *in vitro* and *in vivo* antigen-antibody reactions.
- To gain knowledge about & tumor and transplantation immunology.
- To understand hypersensitivity, autoimmune diseases and immunotheraphy.

Course Outcome

CO1	The students could gain the knowledge about basics of immune responses and immunohematology
CO2	The students could learn about antigens, MHC and complement pathways
CO3	The antigen and antibody reaction were studied in detail.
CO4	The students could learn about tumour and transplantation immunology
CO5	Various types of hypersensitivity and autoimmune diseases and immunotherapy could be studied

UNIT-I - Immune system and Immunity — No. of Hours: 15

Historical background and scope of immunology - Cells of the immune system - Haematopoiesis - Organs of the immune system. Immunity - Innate, Acquired- Active and Passive, Humoral and Cell Mediated Immune responses.

UNIT-II - Antigens and Antibody — No. of Hours: 15

Antigens - Types and Properties, Haptens, Adjuvant and Super antigens. **Immunoglobulins** - Classes and functions - Theories of antibody production. Monoclonal antibodies. Complement - Classical, Alternative and Lectin pathways. **Vaccines** - Types of vaccine - whole organism vaccine, subunit vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine.

UNIT-III - Hypersensitivity and Autoimmune Diseases — No. of Hours: 15

Hypersensitivity - Type I - Anaphylaxis; Type II. Antibody Dependent Cell Cytotoxicity; Type III - Immune complex mediated reactions; Type IV- Cell mediated hypersensitivity. **Autoimmune diseases** - Primary and Secondary.

UNIT-IV- Tumor and transplantation Immunology **No. of Hours: 15**

Tumor immunology - Tumour specific antigen - Immune diagnosis of tumors. Oncogene and induction, Cancer immunotherapy. Transplantation immunology - Graft Versus Host reactions -Mechanism of graft rejection. Major Histocompatibility Complex - Structure and function of Class I, Class II and Class III molecules - HLA typing. Antigen processing and presentation, T and B cell receptors - Activation of T and B lymphocytes - Lymphokines and cytokines.

UNIT-V- Immunohaematology and Immunotechniques **No. of Hours: 15**

ABO blood grouping and Rh typing, Rh incompatibility - Blood transfusion and Transfusion reaction. Antigen and Antibody reaction - Precipitation, Agglutination, Complement fixation, Immunoelectrophoresis, Immunofluorescence, RIA, ELISA.

Text Books

1. Kindt TJ, Osborne BA and Goldsby RA (1993). **Kuby Immunology.** 6th Edition. W.H. Freeman and Company, New York.
2. Annadurai B (2008).**A Textbook of Immunology and Immunotechnology**.1st Edition. S Chand & Co. Ltd., New Delhi.
3. Riott IM (1988). **Essentials of Immunology**, ELBS and Black Well Scientific Publishers, London.

Reference Books

1. Paul WE (2012). **Fundamental Immunology**. 7th Edition. Lippincott Williams & Wilkins, Philadelphia.
2. Janeway CA, Travers P, Walport M and Shlomchik MJ (2001**). Immunobiology.** 5th Edition. Garland Science, New York.
3. Ananthanarayanan R and Panicker CK (2005). **Text Book of Microbiology.** 8th Edition. Oriental Longman Publications, Hyderabad.
4. Rao CV (2012) **Immunology**. 2nd Edition, Narosa Publishing House Pvt. Ltd.

Web sources:

1. http://www-immuno.path.cam.ac.uk/-immuno/part1.html
2. http://www.Iclark.edu/-reiness/immuno/lectures.html
3. http://www.hhmi.org/biointeractive/immunology/lectures.html

SEMESTER –I	**CORE PRACTICAL - I**
22P1MBP01	**Total Number of Hours: 45**
Credits - 3	**5 Hours/ Week**

PRACTICAL I – ESSENTIALS OF MICROBIOLOGY

1. Isolation of pure culture using spread, pour and streak plate techniques
2. Anaerobic cultivation of microorganisms
3. Staining techniques - Simple, Differential - Gram's and Acid fast staining (Ziehl neelsen method).
4. Special staining - Flagellar, Nuclear, Negative, Endospore.
5. Determination of bacterial cell size using Micrometry
6. Determination of bacterial motility - Hanging drop method and Wet mount slide method.
7. Bacterial growth curve and determination of generation time
8. Effect of temperature, Oxygen, pH, UV and Disinfectants on bacterial growth.
9. Identification of bacteria by biochemical tests - Catalase, Coagulase, Oxidase, IMViC, TSI, Urease, Sugar fermentation.
10. Staining of fungi - Lacto Phenol Cotton Blue and KOH mount.
11. Cultivation of Fungi

Reference Books

1. Aneja, K.R., 2003, "**Experiments in Microbiology and Plant Pathology**", New Age Publications, New Delhi.
2. Arora, B and D.R. Arora, 2013, **Practical Microbiology,** CBS Publishers & distributors Pvt. Ltd, New Delhi.
3. Cappuccino, J.G. and N. Sherman, 2005, "**Microbiology - A Laboratory Manual**", Seventh Edition, Benjamin and Cummings Publications, San Francisco.
4. Dubey, R.C and D.K. Maheswari, 2005, "**Practical Microbiology**", S. Chand and Company, New Delhi.
5. Gunasekaran, P., 2005, "**Laboratory Manual in Microbiology**", New Age International (P) Ltd, New Delhi.
6. Rajan, S and R. Selvi Christy, 2015, "**Experiments in Microbiology**", Anjanaa Book House, Chennai.

SEMESTER –I	**COREPRACTICAL-II**
22P1MBP02	**Total Number of Hours: 45**
Credits - 3	**5 Hours/ Week**

PRACTICAL II - CELL AND INHERITANCE BIOLOGY & IMMUNOLOGY AND IMMUNOTECHNOLOGY

1. Blood smear preparation and differential staining of blood cells.
2. Identification of human ABO blood group and Rh typing .
3. Observation of stages of mitosis and meiosis by Onion root tip test
4. Separation and preservation of serum and plasma.
5. Flocculation test - RPR test.
6. Immunodiffusion: Radial Immunodiffusion and Ouchterlony Double Diffusion.
7. Immunoelectrophoresis: Counter current and Rocket immunoelectrophoresis.
8. Agglutination test – RA test, CRP test, ASO test.
9. Widal - Slide and Tube agglutination test.
10. ELISA for identification of HIV and HBs Ag.

References:

1. Sambrook J and Russell DW (2001). **Molecular Cloning** – **A laboratory manual.** 3rd Edition. Cold Spring Laboratory Press, New York.
2. Surzycki S (2000). **Basic Techniques in Molecular Biology**. Springer-Verlag, New York.
3. Roitt IM (1988). **Essentials of Immunology**, ELBS and Black Well Scientific Publishers, London.
4. Kindt TJ, Goldsby RA, Osborne BA and Janis Kuby (2007). **Kuby Immunology.** WH Freeman and Company, New York.
5. Chapel H and Halbey M (1986). **Essentials of Clinical Immunology**. ELBS, London.
6. Weir DM, Steward J (1993). **Immunology**. 7th Edition. ELBS, London.

SEMESTER – I **ELECTIVE – I**
22P1MBE01 **Total Number of Hours: 60**
Credits – 4 **4 Hours/Week**

ADVANCED TECHNIQUES IN MICROBIOLOGY

Course Objectives:

- To gain the knowledge on Electrophoresis techniques
- To get aware on Chromatographic methods
- To impart the knowledge on Spectroscopy
- To know the analytical methods of Hybridization techniques
- To get the knowledge on radioisotopic techniques

Course Outcome:

CO1	They could perform electrophoresis
CO2	They could able to separate the macromolecules like proteins by chromatography
CO3	To analyze and quantify the components using spectroscopy
CO4	They gained knowledge on the separation of macromolecules like nucleic acid, proteins with hybridization and blotting techniques
CO5	They could know to prepare the probes and its role as markers using radio labeled isotopes and biosensors

UNIT-I - Electrophoresis — No. of Hours: 12

Electrophoresis-Concept - Types and uses-Buffers and supportive media. Principle - procedure, Detection, Quantification and Applications of Gel electrophoresis - Agarose, PAGE, SDS-PAGE, PFGE, 2D gel electrophoresis.

UNIT-II - Chromatographic techniques — No. of Hours: 12

Basic Principles and Types - Paper chromatography, Thin layer chromatography (TLC), Column chromatography (CC), Gas Chromatography - Mass Spectroscopy (GC-MS), Matrix Assisted Laser Desorption/Ionization - Time of Flight (MALDI-TOF) mass spectrometry, Optimum Performance Laminar Chromatography (OPLC).

UNIT-III - Spectroscopy — No. of Hours: 12

Basic principles - Molecular vibration and its types. Principles, procedure, interpretation and applications of Absorption spectroscopy - Fourier Transmission Infra Red spectroscopy (FTIR) Nuclear Magnetic Resonance spectroscopy (NMR). Emission spectroscopy - Energy Dispersive X-ray

spectroscopy and Inductively Coupled Plasma Spectroscopy - Scattering spectroscopy - Raman Spectroscopy.

UNIT-IV- Blotting, DNA Microarray and DNA chips **No. of Hours: 12**

Nucleotide probes - Types and Labelling. Blotting techniques - Southern, Northern, Western and Dot blotting. DNA microarrays - DNA chips - Types and applications.

UNIT-V- Radiotracer Techniques and Biosensors **No. of Hours: 12**

Radioactive tracer isotopes - Radioactive Tracer Techniques - Principle and application and Measurement of radioactivity - Geiger Muller (GM) and Scintillation counters - Autoradiography and its applications - Dosimetry. Biosensors: Definition - Types - Principle, Production methods and applications.

Text books

1. Upadhyay, A., Upadhyay, K., and Nath, N. (2016). **Biophysical Chemistry**. Himalaya Publshing House.
2. Boyer, R. F., (2001). **Modern experimental Biology**. 3rd Edition, Hope College
3. Miller, J. (1998). **Chromatography: Concepts and Contrasts.** John Wiley and Sons. Inc., New York.

Reference books

1. D.A. Skoog, F. J. Holler, S. R. Crouch. (2016). Instrumental **methods of analysis**. 7th Edition.
2. H.H. Willard, L.L. Merritt Jr. and others. (1986). **Instrumental Methods of Analysis**. 6th Edition. CBS Publishers and Distributors.
3. Cotterill, R. M. J. (2002). **Biophysics: An Introduction**. John Wiley & Sons, England.

Nölting, B. (2006). **Methods in modern biophysics**. Second Edition. Springer, Germany.

Web sources:

1. https://microbiologynotes.org/
2. https://www.smithers.com/
3. https://www.labmanager.com/
4. https://www.elprocus.com/

SEMESTER – I **ELECTIVE – I**
22P1MBE02 **Total Number of Hours: 60**
Credits – 4 **4 Hours / Week**

DIAGNOSTIC MICROBIOLOGY

Course Objectives:

- To gain knowledge on Clinical sample collection
- To get aware on microbial pathogenicity
- To impart the knowledge on clinical epidemiology
- To know the analytical methods on clinical microbiology

Course Outcome:

CO1	They could impact knowledge on microbial sample collection
CO2	They could study the pathogenicity of microorganisms with relevant to dose
CO3	They could able to aware the molecular epidemiology of microorganisms
CO4	They could able to gain knowledge of diagnostic techniques of microorganisms
CO5	To comprehend with the study of diagnostic technique of parasites

UNIT- I **No. of Hours: 10**

Collection and Transport of Clinical Specimens - Blood, Urine, Pus, Sputum, Body fluids, Stool.

UNIT-II **No. of Hours: 13**

Laboratory diagnosis of Bacterial diseases - Enteric fever - *Salmonella typhi*, Urinary tract infection - *Escherichia coli*, *Klebsiella aerogenes*, Wound infections - *Staphylococcus aureus*, *Pseudomonas aeruginosa* - Tuberculosis - *Mycobacterium tubercle*, Respiratory infection -*Streptococcus pneumoniae*, Meningitis - *Neisseria meningitidis*, Diarrhoea - *Salmonella gastroenteritis*, *Vibrio* sp - Antibacterial Susceptibility Tests.

UNIT-III **No. of Hours: 13**

Laboratory Diagnosis of Viral diseases - Laboratory methods in basic Virology - Detection of viral antigens (Fluorescent Antibody and Solid Phase Immunoassays). Viral Serology - Hepatitis B and HIV, Covid - 2, Marburg, Monkey pox.

UNIT- IV **No. of Hours: 12**

Laboratory Diagnosis of Parasitic and Mycotic diseases - Parasitic diseases - *Entamoeba histolytica, Giardia lamblia, Taenia solium, Plasmodium vivax, Wuchereria bancrofti.* Mycology: Direct Microscopic examination and Culture - Superficial mycoses - Dermatophytes; Subcutaneous mycoses - *Madura madurae*, Systemic mycoses - *Histoplasma capsulatum*, Opportunistic mycoses - *Candida albicans* - Antifungal susceptibility testing.

UNIT-V **No. of Hours: 12**

Molecular Diagnosis - Biochemical and Immunological tools - Biotyping, Serotyping, Phage typing, Protein profiling, Multi locus Enzyme Electrophoresis (MLEE); Molecular typing- RFLP, RAPD, PFGE, AFLP, MLST, MVLST, VNTR, SNP, RT-PCR.

Text Books

1. Jawetz, Melnick, & Adelberg's (2004). **Medical Microbiology by Brooks GF**, Butel JS, Morse SA, Melnick JL, Jawetz E, Adelberg EA. 23rd edition. Lange Publication.
2. Cossart P, Boquet P, Normark S, Rappuoli R. (2005). **Cellular Microbiology.** 2nd edition.American Society for Microbiology Press.
3. Salyers AA and Whitt DD eds. **Bacterial Pathogenesis: A molecular approach.** (2002). American Society for Microbiology Press, Washington, DC USA.

Reference Books

1. Hacker J and Dorbindt U. (2006). **Pathogenomics: Genome analysis of pathogenic microbes**. Ed.Wiley-VCH.
2. Persing DH, Tenover FC, Versalovic J, Tang Y, Unger ER, Relman DA, White TJ. (2004).**Molecular Microbiology: Diagnostic Principles and Practice**. American Society for Microbiology Press.
3. Nelson KE, Williams CM, Graham NMH. (2001). **Infectious Disease Epidemiology: Theory and Practice.** An Aspen Publication.

Web sources

1. http:// www.microbiologyonline.org.uk/sgmprac.htm
2. http:// www.cvm.uiuc.edu/vdl/AppenA_man.html
3. http:// www.microbes.info/resources/education_and learning
4. http://infohost.nmt.edu/-nmtlib/subj/boil.html
5. http:// www.hoflink.com/%7Ehouse/microbio.html

SEMESTER II

SEMESTER – II	**CORE – IV**
22P2MB04	**Total Number of Hours: 75**
Credits – 5	**6 Hours/ Week**

MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

- To study the pathogenesis, laboratory diagnosis and antimicrobial sensitivity testing.
- To gain knowledge about the diseases caused by Gram positive and Gram negative Cocci.
- To impart knowledge on the diseases caused by Gram positive and Gram negative bacilli.
- To understand the fungal classification, diagnosis, cultivation and antifungal agents.
- To study the superficial, cutaneous, subcutaneous, systemic and opportunistic mycoses.

Course Outcome:

CO1	Identify and examine the bacterial and fungal pathogens of clinical importance
CO2	Comprehend the scientific method as it is used for classification of bacteria and fungi
CO3	Understand the morphology, life cycle, symptoms, diagnosis and treatment method for some important bacterial and fungal pathogens
CO4	Classify the antibacterial and antifungal agents based on their mode of action
CO5	Acquire knowledge on fungal diseases in human.

UNIT-I – Bacteria Introduction — No. of Hours: 15

Normal microbial flora of human body - Infection - Types, Source, Modes of Transmission, Mechanism of Bacterial pathogenesis - Laboratory diagnosis of infectious diseases - Antibiotic Sensitivity Test, Antibacterial drugs - mechanism of action and resistance.

UNIT-II – Gram Positive Bacteria — No. of Hours: 15

Staphylococcus aureus, Streptococcus pneumoniae, Neisseria gonorrhoeae, Corynebacterium diphtheriae, Bacillus anthracis, Clostridium perfringens and *Clostridium tetani, Mycobacterium tuberculosis, Mycobacterium leprae*.

UNIT-III – Gram Negative Bacteria — No. of Hours: 15

Salmonella typhi, Shigella dysenteriae, Vibrio cholera, Escherichia coli, Klebsiella pneumoniae, Spirochaetes - *Treponema pallidum* and *Leptospira sps*. Obligate intra cellular parasites -*Mycoplasma pneumoniae, Chlamydia* and *Rickettsiae.*

UNIT-IV- General characters of Fungus **No. of Hours: 15**

Classification of Medically important Fungi - Laboratory diagnosis of fungal diseases - Collection and examination of fungal specimens - Isolation and identification of fungi - Staining of fungi - KOH, LCB, PAS, H&E, GMS - Cultivation of fungi - Antifungal drugs - Antifungal susceptibility test.

UNIT-V- Fungal Infection **No. of Hours: 15**

Classification of Mycoses - White and Black Piedra, Coccidiodomycoses, Dermatophytoses, Mycetoma, Histoplasmosis, Cryptococcosis, Candidiasis and Aspergillosis. Mycotoxicoses..

Text Books

1. Arti Kapil (2013). **Ananthanarayan & Jayaram Paniker's Text book of Microbiology**. 9th edition, Orient Longman Limited, Chennai.
2. Jagdish Chander (2012). **Text book of Medical Mycology**.3rdedition.Mehta Publishers, New Delhi.

Reference Books

1. Jawetz E and JL Melnic (2001). **Medical Microbiology**, 22nd edition, Tata McGraw-Hill, New Delhi.
2. David Greenwood CB and Richard (2002). **Medical Microbiology**. 22nd edition, Tata McGraw-Hill, New Delhi.
3. Monica Cheesbrough (2003). **District Laboratory Practice in Tropical Countries**. Part 1 and 2. Low-Price edition, Cambrige University Press.
4. Chakraborty P (2003). **A Text book of Microbiology.** 2nd edition, Published by New Central Book Agency (P) Ltd., Kolkata.

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1. http:// www.bact.wisc.edu/bact330
2. http:// www-micro.msb.le.ac.uk/224
3. http:// www.cellsalive.com/ecoli.htm
4. http:// www.bact.wise.edu/microtextbook/
5. http:// www. Pitt.edu/-super1/lecture/lec4771/

SEMESTER – II	**CORE – V**
22P2MB05	**Total Number of Hours: 60**
Credits – 4	**5 Hours/ Week**

MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Course Objectives:

- To gain the knowledge about the structure of nucleic acid
- To understand the basic mechanisms of replication, transcription, and translation
- To understand the genetic consequences and molecular mechanisms of several prokaryotic and eukaryotic gene regulation systems
- To understand the structure and organization of the prokaryotic and eukaryotic chromosomes

Course Outcome:

CO1	They students could learn the genetic material and its structure
CO2	Could obtain basic knowledge of replication, DNA repair mechanism
CO3	They could acquire knowledge on prokaryotic and eukaryotic molecular mechanism of gene regulation systems
CO4	They could differentiate the prokaryotic and eukaryotic structure and organization of chromosomes
CO5	They could obtain knowledge on vector and gene transfer mechanisms

UNIT- I - Genetic material DNA and RNA — No. of Hours: 12

DNA as genetic material - Structure of DNA - Physical and Chemical properties of DNA, Types, Forms and functions of DNA - **RNA as genetic material** - Structure, Types and functions of RNA. Genome Organization in Prokaryotes, Eukaryotes and Virus.

UNIT-II - DNA replication and Repair mechanisms — No. of Hours: 12

DNA replication – Semi - conservative, bidirectional and rolling circle model - Mechanism and Enzymology of DNA replication - Prokaryotic and Eukaryotic DNA polymerases, Types and function - Inhibitors of DNA replication - DNA recombination - DNA repair mechanism -Genetic code - Wobble hypothesis.

UNIT-III -Transcription and Translation — No. of Hours: 12

Transcription - Structure and function of RNA polymerase. Mechanism of transcription - Post transcriptional modifications - **Translation** - Post translational modification. Gene regulation in bacteria - *lac*, *trp* and *ara* operons.

UNIT-IV- Mutagenesis **No. of Hours: 12**

Mutation - Types – Spontaneous and Induced mutation, Mutagens - Molecular basis of mutation, Detection and Isolation of mutants, Mutant selection - Detection of Nutritional mutants in *Neurospora*. Carcinogenicity testing.

UNIT-V- Plasmid and Gene transfer methods **No. of Hours: 12**

Plasmid – Types, Properties and functions – Gene transfer in bacteria – Conjugation, Transformation – Transduction – Lytic and Lysogenic cycle of phage – Generalized and Specialized transduction. Insertion Sequences – Mechanism of Transposition- complex and compound Transposons – T10, T5 and Retroposon and Composite.

Text Books

1. Watson, JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AAM. (1998). **Molecular Biology of the Gene.** The Benjamin/Cummings publishing company.
2. Freifelder D. (2012). **Molecular Biology**, 2nd edition, Narosa Publishing Home.
3. R.S. Old and S.B. Primrose. (2001). **Principles of Gene Manipulation**, 6th Ed., Black well Scientific Publications, London.

Reference Books

1. Maloy SR, Cronan Jr.JE and Freifelder D. (1994). **Microbial Genetics**. Jones and Bartlett Publishers.
2. Frieldberg EC, Walker GC, and Siede W. (2006). **DNA repair and Mutagenesis**, 2nd edition, ASM press.
3. Gardner EJ, Simmons MJ and Snustad DP, (2006). **Principles of Genetics**, 8th edition, John Wiley and Sons.
4. Singer M and Berg P. (1991). **Genes and Genomes**. University Science Books.

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1. www.en.wikipedia.org/wiki/Microbial_genetics

2. www.microbiologyprocedure.com/genetics/microbial-genetics/microbial-genetics.htm
3. www.bestwebbuys.com/Microbiology-N_10038066-books.html
4. www.en.wikipedia.org/wiki/Molecular_biology
5. www.web-books.com/MoBio/

SEMESTER – II	**CORE-VI**
22P2MB06	**Total Number of Hours: 60**
Credits - 4	**5 Hours/ Week**

FOOD, INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Course Objectives:

- Understand the principles of food preservation and spoilage
- Learn the food and milk borne diseases
- Aware the Government regulatory practices and policies
- Be familiar with the upstream and downstream processes
- Know standards in pharmaceuticals sterilization

Course Outcome:

CO1	They could understand the principles of food preservation and spoilage techniques
CO2	They could obtain food and milk borne diseases
CO3	Could comprehend the knowledge on Government Regulatory Practices and Policies
CO4	They could familiar with the industrial production of some products
CO5	Could gather the pharmaceutical sterilization and its standards

UNIT- I **No. of Hours: 12**

Food Microbiology: Micro - organisms and their importance in food microbiology - Molds, Yeast, Bacteria, Factors influencing microbial growth in food - Principles and Methods of food preservation, Contamination, Spoilage and Prevention of foods - Cereals, Meat and Meat products Egg, Vegetables and Fruits, Canned foods.

UNIT- II **No. of Hours: 12**

Fermented foods - Types and Classification. Production of Bread, Cheese, Yogurt, Sauerkraut, Kefir, Koumiss. Fermented drink - Kombucha. Microbial quality testing of milk. - MBRT, Rezasurin test. Food safety standards and control agencies - FSSAI, FDA, ISI and HACCP.

UNIT-III **No. of Hours: 12**

Introduction to Bioprocess - Fermentor designing, Components and Types. Industrially important strains - Screening, Strain Improvement, Inoculum Development. Upstream processing - Media formulation, Sterilization and Optimization. Downstream processing - Recovery and purification of extracellular & intracellular products.

UNIT – IV **No. of Hours: 12**

Industrial production of Microbial products - Antibiotics - Penicillin, Streptomycin - Organic acids - Citric acid, Acetic acid, Vitamin - B_{12}, Enzymes - Amylase, Protease - Alcoholic beverages - Beer and Wine. Hormones - Insulin, Somatotrophin, Single Cell Protein. Microbial transformations: Steroids and Alkaloids.Vaccines - Recombinant vaccines.

UNIT – V **No. of Hours: 12**

Microbial spoilage of Pharmaceutical products and their sterilization - Quality assurance and Quality management in Pharmaceuticals - ISO, WHO and US certification. Sterilization control and Sterility testing.

Text Books

1. Frazier, W.C. and D.C. Westhoff, (2008), "**Food Microbiology**", Sixth Edition, Tata McGraw Hill Publications Co. Ltd., New Delhi.
2. Adams, M.R. and M.O. Moss, (2007), "**Food Microbiology**", New Age International (P) Ltd., New Delhi.
3. Patel, A.H., (2003), "**Industrial Microbiology**", Eighth Edition, McMillan Publishers, New Delhi.

Reference Books

1. Mukhopadhyay, S.N., (2010), "**Process Biotechnology fundamentals**", Third Edition, Viva Books, Chennai.
2. Modi, H.A., (2007), "**Dairy Microbiology**", First Edition, Sheetal printers, Jaipur.
3. Bamforth, C. W., (2005), "**Food, Fermentation and Microorganisms**", Blackwell Science Ltd., London.
4. **Pharmaceutical Microbiology**, W.B.Hugo & A.D.Russell Sixth edition. Blackwell scientific Publications.

5. **Analytical Microbiology** - Edt by Frederick Kavanagh Volume I & II. Academic Press New York. Fernandes, R., (2009), "**Microbiology Handbook - Dairy Products**", Leatherhead Food International Ltd, London.
6. Jain, N., Singh, V., and A. Sharma, (2011), "**Instant Notes in food Biotechnology**", CBS. Publishers and Distributors Pvt. Ltd. New Delhi.

Web sources:

1. http://www.microbes.info
2. http://www.fsis.usda.gov/
3. http://www.cdc.gov/
4. http://web.indstate.edu/thcme/mwking/
5. http://lifesciences.asu.edu/text/classesbk.html

SEMESTER – II	**CORE PRACTICAL – III**
22P2MBP03	**Total Number of Hours: 45**
Credits – 3	**5 Hours/ Week**

PRACTICAL - III - MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

- To learn the Identification and culture of unknown bacterial pathogens
- To perform Antibiogram of isolated bacterial pathogens
- To gain hands on experience with identification and culture of fungal pathogens by performing fungal staining and slide culture techniques
- To gain skills on isolation and identification of Yeast

Course Outcome:

CO1	Understand the Identification and culture of unknown bacterial pathogens
CO2	Acquire knowledge about performing Antibiogram of isolated bacterial pathogens
CO3	Gain knowledge about identification and cultivation of fungal pathogens and apply the gained skills to perform staining and cultivation of fungi
CO4	Comprehend and apply the techniques for the isolation and identification of Yeast

1. Isolation, Identification and Antibiogram of following Bacterial pathogens.
   Staphylococcus sp., *Streptococcus* sp., *Bacillus* sp., *Escherichia* sp., *Klebsiella* sp., *Proteus* sp., *Salmonella* sp., *Pseudomonas* sp.,
2. Isolation and Identification of Fungal Specimens - KOH and Lacto Phenol Cotton blue mount and Slide culture technique
3. Cultivation and identification of fungal pathogens from clinical specimens
   Dermatophytes, *Aspergillus* sp.
4. Isolation and Identification of Yeast - Germ tube, Gram staining and Negative staining
   Candida sp., *Cryptococcus* sp.

Reference Books

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

SEMESTER – II	**CORE PRACTICAL – IV**
22P2MBP04	**Total Number of Hours: 45**
Credits – 3	**5 Hours/ Week**

PRACTICAL IV – MICROBIAL GENETICS, MOLECULAR BIOLOGY, FOOD, INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Course Objectives:

- To learn about the basic molecular techniques
- To understand the Bacterial Transformation mechanisms
- To be aware of Enumeration of microorganisms in food samples
- To adequate knowledge about mutagens
- To study about industrial product derived from microbes

Course Outcome:

CO1	To isolate, estimate and visualize the genetic material from bacterial cells
CO2	To impart knowledge on physical and chemical mutagens
CO3	To gain knowledge of the milk quality
CO4	To obtain the industrial production aspects with some commercial products
CO5	To gain knowledge of sterility test of food products

1. Isolation of Chromosomal and Plasmid DNA from bacteria and visualization of DNA by Agarose gel Electrophoresis.
2. Quantitative estimation of DNA by Diphenylamine test.
3. Effect of Physical mutagen (UV radiations) on the survival pattern of *E. coli.*
4. Effect of Chemical mutagens on bacterial cells.
5. Isolation of antibiotic resistant mutants by gradient plate technique.
6. Isolation of Coli phage from sewage.
7. Demonstration of Bacterial Transformation, Conjugation and Transduction.
8. Enumeration of Bacteria and Fungi in food samples by SPC method.
9. Isolation of Fungi from spoiled food.
10. Methylene Blue Reduction Test (MBRT) and Resazurin test in milk.
11. Counting of bacteria in milk by Breed's count method.
12. Wine production using grape juice and estimation of total acidity, volatile acidity and Ethanol from wine.
13. Sterility test in pharmaceutical products.

Reference Books

1. Benson, J.H., (2001), "**Microbiological Applications: A Laboratory Manual in General Microbiology**", Eighth Edition, McGraw-Hill, New York.
2. Cappuccino, J.G. and N. Sherman, (2005), "**Microbiology - A Laboratory Manual**", Seventh Edition, Benjamin and Cummings Publications, San Francisco.
3. Gunasekaran, P., (2005), "**Laboratory Manual in Microbiology**", New Age International (P) Ltd, New Delhi.
4. Kannan, N., (2003), "**Laboratory Manual in General Microbiology**", Fourth Edition, Palani Paramount Publications, Palani.

SEMESTER – II **ELECTIVE – II**
22P2MBE03 **Total Number of Hours: 60**
Credits – 4 **4 Hours/Week**

DEVELOPMENTAL BIOLOGY

Course Objectives:

- The learner will acquire knowledge about developmental biology.
- The learner will learn the basic principles and development of organs.
- The learner will develop an understanding about morphogenesis and organogenesis.
- The learner will understand of the processes of early embryonic development and germination.
- The learner will learn the gene concept their activation.

Course Outcome:

CO1	Understand the origin of developmental biology
CO2	Acquire knowledge on the Morphogenesis and Organogenesis in animals
CO3	Acquire knowledge on the Morphogenesis and Organogenesis in plants
CO4	Gain in-depth detail about gametogenesis and fertilization
CO5	Analyse the role of genes in development.

UNIT- I No. of Hours: 12

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenic analysis of development.

UNIT- II No. of Hours: 12

Morphogenesis and Organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; Axes and Pattern formation in *Drosophila*, Amphibia and Chick; Organogenesis - Vulva formation in *Caenorhabditis elegans*, Eye lens induction, Limb development and regeneration in vertebrates; Differentiation of neurons, Post - embryonic development - Larval formation, Metamorphosis; Environmental regulation of normal development; Sex determination.

UNIT-III **No. of Hours: 12**

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; Shoot and root development; Leaf development and Phyllotaxy; Transition to flowering, Floral meristems and Floral development in *Arabidopsis* and *Antirrhinum*.

UNIT-IV **No. of Hours: 12**

Gametogenesis, fertilization and early development - Production of gametes, Cell surface molecules in sperm - egg recognition in animals; Embryo sac development and Double fertilization in plants; Zygote formation, Cleavage, Blastula formation, Embryonic fields, Gastrulation and formation of germ layers in animals; Embryogenesis, Establishment of symmetry in plants; seed formation and germination.

UNIT-V **No. of Hours: 12**

Genes and development - Nuclear transplantation, Differential gene activation, Developmental genetic defects, Role of cell death in development, Factors involved in Teratogenesis Programmed cell death, Ageing and Senescence.

Text Books:

1. Gilbert.S. F & Knisely. K. (2009). *Developmental Biology*: Sinauer Associates, Inc.
2. Hake, S & Wilt, F. (2003). *Principles of Developmental Biology*: W.W. Norton & Co.
3. Hodge, R. (2009). *Developmental Biology (Genetics and Evolution)*: Facts on File.
4. Subramanian, M.A. (2012). *Developmental Biology*: MJP Publications.

Reference Books:

1. Wolpert, L., Beddington, R., Jessell, T., Lawrence, P., Mayerowitz, E. & Smith, J. (2002). *Principles of development*. UK: Oxford University Press.
2. Jonathan M. W. Slack, (2006). *Essential Developmental Biology*: Blackwell Publishing Ltd.
3. Minelli, A. (2009). *Forms of Becoming: The Evolutionary Biology of Development*: Princeton ,University Press.

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2. https://www.britannica.com/
3. https://www.studocu.com/
4. https://scialert.net/

SEMESTER – II **ELECTIVE – II**
22P2MBE04 **Total Number of Hours: 60**
Credits – 4 **4 Hours/ Week**

POULTRY MICROBIOLOGY

Course Objectives:

- To gain the knowledge on poultry rearing and its products
- To understand about the poultry feed and its significance
- To impart knowledge about the health care and waste management of Poultry
- To acquire knowledge about common viral diseases affecting poultry
- To acquire knowledge about common bacterial, fungal and protozoan diseases affecting poultry

Course Outcome:

CO1	Gain the knowledge on poultry rearing and its products
CO2	Understand about the poultry feed and its significance
CO3	Acquire knowledge about the health care and waste management of Poultry
CO4	Acquire knowledge about common viral diseases affecting poultry
CO5	Acquire knowledge about common bacterial, fungal and protozoan diseases affecting poultry.

UNIT- I Basic tenets of Poultry farming and housing — No. of Hours: 12

Poultry houses - Types. Poultry rearing - Methods - advantages and disadvantages. Brooding: Types of brooders; Breeding organization. Classification of poultry with respect to production characters. Cage management - Different types; Advantages and disadvantages.

UNIT-II Poultry Nutrition and Feeding — No. of Hours: 12

Poultry nutrition and feeding - Nutrient requirements and feed formulations - Factors influencing nutrient requirements - Feed consumption - Feeding systems - Additives, pre and probiotics - supplements. Nutritional and Metabolic disorders - Rickets, Osteomalacia, Vitamin A deficiency, Vitamin E deficiency.

UNIT-III Poultry Diseases - Viral — No. of Hours: 12

Newcastle disease - fowl pox - EDS - 76 (Egg Drop Syndrome) - Infectious bursal diseases (Gumboro diseases) - Infectious bronchitis - Infectious Laryngo tranchitis - Inclusion body hepatitis - Avian encephalomyelitis - Reo viral arthritis - Marek's disease - Avian lymphoid leukosis.

UNIT-IV Poultry diseases-Bacterial, Fungal and Parasitic **No. of Hours: 12**

Salmonellosis - Avian coliform infection - *Staphylococci* - Avian tuberculosis - Infectious coryza - Avian streptococcal infection - Avian pasteurellosis, Psittacosis. Fungal diseases - Aspergillosis, Aflatoxicosis - Parasitic diseases - Coccidiosis, *Ascardia galli*, Tape worms. External parasites - Fowl ticks, Lice, Mites.

UNIT-V Poultry Health and Waste Management **No. of Hours: 12**

Formation of egg in fowl - Egg structure - Physical and chemical composition. Bio-security and Principles of Disease Prevention and Management. Health care for common poultry diseases - Principles of Poultry Medication. Poultry Waste Management - Disposal of hatchery waste.

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. W and 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 of poultry.** 10th Ed., Iowa state university. Ames, Iowa. USA.
3. Reena Kandwal, (2013). **Nutrient Requirements of Poultry**. 3rd Edition.
4. Bell D. Donald and Weaver D. William Jr., (2007). **Commercial Chicken Meat and Egg Production**. 5th Edition. Springer India Pvt. Ltd., Noida.
5. Reddy Ramasubba V., and Bhosale T. Dinesh, (2004). **Handbook of Poultry Nutrition**. 1st Edition. International Book Distribution Co., Lucknow, India.

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

SEMESTER III

SEMESTER – III	**CORE – VII**
22P3MB07	**Total Number of Hours: 75**
Credits – 5	**6 Hours/ Week**

MEDICAL VIROLOGY AND PARASITOLOGY

Course Objectives

- To gain knowledge about general properties of viruses.
- To understand the diseases caused by arthropod borne and rodent borne viruses.
- To gain knowledge about the diseases caused by pox, adeno, herpes and hepatitis viruses.
- To understand protozoan diseases.
- To gain knowledge about diseases caused
- tiuby helminthes.

Course Outcome:

CO1	The students could understand the basic concepts in medical virology
CO2	Could gain the knowledge on DNA viruses.
CO3	Could explain about RNA and Retro virus.
CO4	They could understand the basic concepts in medical parasitology and few protozoan diseases and its control
CO5	Could understand the concepts in helminthes diseases and its control

UNIT - I — No. of Hours: 15

General Properties of viruses and virus multiplication. Methods of cultivation of viruses. Laboratory diagnosis of viral infection. Antiviral agents, Viral Vaccines - Immunization schedule and Interferons.

UNIT - II — No. of Hours: 15

DNA viruses - *Poxviridae: Variola and Vaccinia, Monkey pox,* Herpes *viridae - Herpes simplex, Varicella Zoster, CMV, EB virus - Adenoviridae: Human adeno viruses. Papovaviridae - Human papilloma virus (HPV), Hepadnaviridae - Hepatitis B virus.*

UNIT - III — No. of Hours: 15

RNA and Retro virus - *Picornaviridae - Polio virus, Reoviridae - Rotavirus, Rhabdoviridae*: *Rabies virus*. *Flaviviridae: Dengue* and *Zika virus*. *Orthomyxoviridae*: *Influenza. Paramyxoviridae*: M*easles, Mumps, Nipahvirus. Filoviridae: Ebola* and *Marburg virus*. *Coronoviridae - SARS-CoV* and *SARS-*

CoV-2. *Matonaviridae: Rubella, Togaviridae-Chickungunya virus, Retroviridae: Human Immunodeficiency virus*.

UNIT – IV **No. of Hours: 15**

Classification of medically important parasites. Laboratory diagnosis of parasitic infections. Intestinal protozoans: *Entamoeba histolytica*, *Giardia lamblia*, Genital protozoan - *Trichomonas vaginalis*; Blood and tissue protozoa: *Trypanosoma bruceii; Leishmania donovani*, *Plasmodium falciparum* and *vivax.*

UNIT – V **No. of Hours: 15**

Intestinal helminths: *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale* (hookworm), *Taenia solium* (Pork Tapeworm), *Enterobius vermicularis* (Pinworm), *Trichiuris trichura* (whipworm), **Liver fluke** - *Fasciola hepatica,* **Lung fluke** - *Paragonimus westermanii.* Blood fluke: *Schistosoma haematobium* Microfilaria: *Wuchereria bancrofti*.

Text Books

1. Saravanan P (2006). **Virology**. 1st Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.
2. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**.9th Edition, Orient Blackswan Private Limited.
3. Chakraborty P (2015). **A Text Book of Microbiology**. New Central Book Agency (P) Ltd., Kolkata.
4. Subhash Chandra Parija (2004). **Text Book of Medical Parasitology**. 2nd Edition, All India Publishers and Distributors, New Delhi.

Reference Books

1. Dimmock NJ and Primrose SB (1994). **Introduction to Modern Virology**. 4th Edition, Blackwell scientific Publications, Oxford.
2. Jawetz, Melnick and Adelberg, (2010**). Medical Microbiology** (25th edition) McGraw Hill Publications.
3. Flint JS and Skalka AM, Enquist LW and Racaniello VR (2015). **Principles of Virology**. 4rd Edition, ASM Press, New York.
4. Chatterjee KD (2009). **Medical Parasitology**. 13th Edition, CBS Publishers and Distributors Pvt Ltd., New Delhi.

Web sources:

1. https://www.atsu.edu/
2. https://www.ncbi.nlm.nih.gov/
3. https://www.cdc.gov/

4.

SEMESTER – III	**CORE – VIII**
22P3MB08	**Total Number of Hours: 75**
Credits – 5	**6 Hours/ Week**

SOIL, AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives

- The soil microbial distribution, interaction and their significance.
- Learn the microbial diseases of crops and to understand the production of biofertilizer and biopesticides.
- Be familiar with airborne microbes.
- Be aware of potable and waste water treatment system and disposal.
- Acquire knowledge on microbial action in the environment

Course Outcome:

CO1	Gain knowledge on basis of soil environment, microbial distribution in soil and the interaction between soil and microbes
CO2	Understand the interaction of microbes with plants, the various diseases in plants and the preparation of various biofertilizers, biopesticides and bioherbicides
CO3	Get information on microbial load in air, air sampling devices and the types of airborne diseases and its control measures
CO4	Gain knowledge on waterborne diseases, waste water treatment and its disposal
CO5	Understand the various microbial actions in different aspects viz., bioenergy, biodiesel, biogas, etc.

UNIT - I Soil Microbiology — No. of Hours: 15

Soil formation. Physical and chemical characteristics of soil. Soil atmosphere-water, pH and temperature. Soil microflora - Bacteria, Actinomycetes, Fungi, Algae, Protozoa and Virus. Role of microbes in humus formation. Biogeochemical Cycles - C, N, P, and S.

UNIT - II Microbial Interactions — No. of Hours: 15

Plant microbial interaction - Phyllosphere and Rhizosphere. Actinorrhizae, Mycorrhizal and Lichen association. N_2 fixation (Symbiotic and Free living) - *nif* genes - Phosphate and Potassium solubilisation. Plant diseases - Citrus canker (*Xanthomonas campestris*), Tikka disease of ground nut *(Cercospora sps)*. Blast of Rice *(Pyricularia oryzae)*, Tobacco Mosaic Virus (TMV). Biofertilizers - Types, Mass production and Application - *Rhizobium, Azolla, Azotobacter, Azospirillum* and Cyanobacteria. Biopesticides: Bacterial and Fungal.

UNIT - III Aerobiology **No. of Hours: 15**

Composition of air - Microflora in air - Indoor and Outdoor. Source of contamination - Aerosols, Droplet nuclei - Airborne diseases and its control measures. Enumeration and assessment of microbes in Air - Air sampling techniques.

UNIT - IV Aquatic Microbiology **No. of Hours: 15**

Microbiology of water - Water borne diseases - Indicator microorganisms - Drinking water treatment, Detection of water borne pathogens - Membrane filtration technique - Most Probable Number (MPN) test, DO, BOD and COD. Sewage Treatment - Characteristics of sewage - Primary, Secondary and Tertiary, Sludge treatment and Disposal of Treated Sewage - Membrane technology.

UNIT- V Bioremediation **No. of Hours: 15**

Biomining – Types - Microorganisms in Biomining - Biomining recovery - Biomining of Copper, Gold, Microbially Enhanced Oil Recovery (MEOR) - Bioleaching of metals - Lead, Arsenic and Chromium. Bioaccumulation of heavy metals by microbes. Bioenergy - Biodiesel and Biogas. Bioplastics, Bioconcrete, Biofilters and Bioscrubbers.

Text Books

1. Rangaswami, G. and D.J. Bagyaraj, (2001). "**Agricultural Microbiology**", 2nd Edition, Prentice-Hall of Private Limited, New Delhi.
2. Subbarao, N.S., (2001). "**Recent Advances in Biological Nitrogen Fixation**", Oxford and IBH, New Delhi.
3. Subbarao, N.S., (1995). "**Soil Microorganisms and Plant Growth**", 4th Edition, Oxford and IBH, New Delhi.

Reference Books

1. Agrios, G.N., (2005). "**Plant Patho**logy", Elsevier Academic Press, Burlington.
2. Paul, A., (2014). "**Soil Microbiology**, Ecology and Biochemistry", Fourth Edition, Academic Press Inc., New York.
3. Lowenfels, J. and W. Lewis, (2010). "Teaming **with Microbes: The Organic Gardener's Guide to the Soil Food Web**", Timber Press, Portland.
4. Sylvia, D.M., Fuhrmann, J.J., Hartel, P.G. and D.A. Zuberer, (2005). "**Principles and applications of soil microbiology**", Second Edition, Pearson, London.
5. Barton, L.L. and Northup, D.E., (2011). "**Microbial Ecology**", John Wiley & Sons, Inc., New Jersey.

6. Lebaron, P., Matheron, R., Normand, P. and Sime-Ngando, T., (2015). "**Environmental Microbiology: Fundamentals and Applications**", Springer, New York.
7. Mitchell, R. and Gu, J.D., (2010). "**Environmental Microbiology**", 2nd Edition, John Wiley & Sons, Inc., New Jersey.
8. Pepper, I.L., Gerba, C.P. and Gentry, T.J, (2015). "**Environmental Microbiology**", 3rd Edition, Elsevier, New York.
9. Ronald, A.M. and Bhartha, R., (2000). **"Microbial Ecology"**, 4th Edition. Benjiman/Cummings Publications, California.

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1. https://www.britannica.com/
2. https://www.onlinebiologynotes.com/
3. https://microbenotes.com/
4. https://www.biologydiscussion.com/
5. https://www.studocu.com/
6. https://microbenotes.com/
7. https://microbewiki.kenyon.edu/

SEMESTER – III **CORE PRACTICAL - V**
22P3MBP05 **Total Number of Hours: 45**
Credits - 3 **5 Hours/ Week**

PRACTICAL – V - MEDICAL VIROLOGY, PARASITOLOGY

Course Objectives:

- To gain knowledge about techniques in medical virology and parasitology
- To understand the different methods of cultivation of viruses
- To gain skills about the lab diagnosis of viral diseases by serological tests
- To enable them to perform techniques for the identification of parasites in stool
- To know to identify the malaria parasite in blood

Course Outcome:

CO1	Understand and apply the techniques in medical virology and parasitology.
CO2	Gain knowledge about different methods of cultivation of viruses
CO3	Perform techniques for the identification of parasites in stool
CO4	Apply the knowledge and perform techniques for the identification of parasites in stool
CO5	Identify the malaria parasite in blood

1. Cultivation of viruses

- Egg inoculation methods (All routes)
- Animal Tissue culture (Demonstration)

2. Serological tests: Serodiagnosis of various viral diseases.

- ELISA – HBV and HIV.
- Complement fixation test.
- Haemagglutination and Haemagglutination Inhibition Test.

3. Identification of parasites:

- Saline and Iodine wet mount
- Sedimentation and Floatation techniques

4. **Blood smear examination for Malarial parasit**e

Reference Manuals

1. Dubey RC and Maheshwari DK (2012). **Practical Microbiology.** 3rd Edition. S. Chand & Company Ltd., New Delhi.
2. Aneja KR (2010). **Experiments in Microbiology, Plant pathology and Biotechnology**. 4th Edition, New age International publishers, Chennai.

SEMESTER – III	**CORE PRACTICAL - VI**
22P3MBP06	**Total Number of Hours: 45**
Credits - 3	**5 Hours/ Week**

PRACTICAL – VI - SOIL, AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives

- Gain insights in the isolation of different soil microbes
- Acquire skills on isolation of Phosphate solubilising bacteria from soil
- Be familiar with nitrogen fixing bacteria
- Be aware of waste quality analysis
- Acquire knowledge on isolation of microbes from soil samples

Course Outcome:

CO1	Understand the isolation of various microbes from different soil, root nodule and diseased plants
CO2	Perform the skills gained in the isolation of microbes from diseased plants.
CO3	Know how to determine BOD,COD of wastewater
CO4	Acquire knowledge about the different methods used in water quality analysis.
CO5	Apply the gained skills in the enumeration and isolation of microbes from air

1. Isolation of Rhizosphere microorganisms from soil.
2. Isolation of *Rhizobium* sp from root nodule.
3. Isolation of *Azotobacter* sp from soil.
4. Isolation of *Azospirillum* sp from soil/root.
5. Isolation of Cyanobacteria from paddy field.
6. Isolation of phosphate solubilizing bacteria from soil.
7. Isolation of bacterial and fungal pathogens from diseased plants.
10. Determination of Biological Oxygen Demand (BOD) of waste water.
11. Determination of Chemical Oxygen Demand (COD) of waste water.
11. Water analysis by Most probable Number (MPN) technique.
12. Detection of *Coliforms* by Membrane filter technique.
13. Isolation of *E.coli* from sewage water samples using EMB agar.
14. Enumeration and Isolation of microorganism from air by settle plate method.

Reference Books

1. Aneja, K.R., "**Experiments in Microbiology and Plant Pathology**", New Age Publications, New Delhi, 2003.
2. Benson, J.H., "**Microbiological Applications: A Laboratory Manual in General Microbiology**", Eighth Edition, McGraw-Hill, New York, 2001.
3. Cappuccino, J.G. and Sherman, N., "**Microbiology - A Laboratory Manual**", Eleventh Edition, Benjamin and Cummings Publications, San Francisco, 2017.
4. Dubey, R.C. and Maheswari, D.K., "**Practical Microbiology**", New Age Publications, New Delhi, 2002.
5. Kannan, N., "**Laboratory Manual in General Microbiology**", Fourth Edition, Palani Paramount

SEMESTER –III	**ELECTIVE - III**
22P3MBE05	**Total Number of Hours: 60**
Credits - 4	**4 Hours/ Week**

ENTREPRENEURSHIP IN MICROBIOLOGY

Course Objectives

- To understand the fundamental concepts of entrepreneurship.
- To comprehend the procedure in starting an entrepreneurial career.
- To keep abreast of the institutional support in the field of entrepreneurship.
- To know the role of microbes in environmental management.
- To learn the applications of microbiology.

Course Outcome:

CO1	The students enhanced self well group for entrepreneurship
CO2	To gain knowledge about microbiology and its applications
CO3	To be aware of Institutions and schemes of Government of India
CO4	To obtain knowledge about Skills for entrepreneur
CO5	To obtain knowledge on Composting of domestic, agricultural and industrial wastes

UNIT - I - Introduction to Entrepreneurship — No. of Hours: 12

Entrepreneurship: evolution concepts of entrepreneur - entrepreneurship: Definitions - Meaning - characteristics - types of entrepreneurs - qualities - functions of an entrepreneur. Development - need - role of source, talent and spirit - Process of entrepreneurship to socio - economic gains. Starting a business: Forms of ownership - Product selection - licensing procedures.

UNIT - II - Project Generation — No. of Hours: 12

Project analysis: Idea generation - sources of idea generation - Trade fairs and Exhibitions - Project identification and selection - classification - project formulation - project appraisal - feasibility analysis - market, production, technical and social.

UNIT - III - Financial Assistance — No. of Hours: 12

Institutions and schemes of Government of India. Schemes and Programmes, Department of Science and Technology schemes, nationalized banks - other financial institutions - support for entrepreneurs: APEDA, DIC, TIIC, SISI, NABARD and commercial banks. Entrepreneurial development programmes.

UNIT – IV- Entrepreneurial skills **No. of Hours: 12**

Skills for entrepreneur - communication skills, problem solving skills; Business plan development; Market need - Market research, SWOT analysis, identifying competitors. Financial plan - Financial support for business, business insurance, Marketing - mix-product, distribution, price, promotion and market goal setting.

UNIT - V- Biology in Entrepreneurship **No. of Hours: 12**

Composting of domestic, agricultural and industrial wastes. Vermicomposting, Spirulina and mushroom cultivation (brief account only). Production of teaching kits (plasmid DNA isolation, electrophoresis) and diagnostic kits (Widal test kit and ABO blood grouping kit). Designing and execution of clinical laboratory, quality control lab and research laboratory.

Text Book

1. Bhatia, B.S. and G.S. Batra, 2003, "**Entrepreneurship and small business management**", Deep and Deep Publications, New Delhi.
2. Desai, V., 2001, "**Dynamics of Entrepreneurial Development and Manage**ment", Fourth Edition, Himalaya Publishing House Mumbai.
3. Gupta, C.B. and N.P. Srinivasan, 2003, "**Entrepreneurial Development**", Reprint, Sultan Chand and Sons, New Delhi.
4. Gordon, E. and K. Natarajan, 2009, "**Enterpreneur Development**", Third Edition, Himalaya Publishing House, Mumbai.

Reference Books

1. Hisrich, D.R., 2008, "**Entrepreneurship**", Sixth Edition, Tata McGraw Hill Private Limited, New Delhi.
2. Mohanty, S.K., 2005, "**Fundamentals of Entrepreneurship**", Sixth Edition, Prentice Hall India Private Limited, New Delhi.
3. Nagendra, S., 2008, "**Entrepreneurship and Management**", Sanguine technical Publishers, New Delhi.
4. Naidu, V.V.R., 2008, "**Management and Entrepreneurship**", I.K. International Pvt. Ltd, New Delhi.
5. Saxena, S., 2015, "**Applied Microbiology**", Springer, New York.

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1. www.orgs.tigweb.org/33065
2. www.womensjoblist.com/resumes/18143-Microbiologist.html
3. www.entretechforum.org/mm_May19_2009.htm
4. www.linkedin.com/pub/dir/george/hlass.

SEMESTER –III	**ELECTIVE - III**
22P3MBE06	**Total Number of Hours: 60**
Credits - 4	**4 Hours/ Week**

MICROBIAL FUEL CELL TECHNOLOGY AND NANOTECHNOLOGY

Course Objectives

- Acquire the knowledge on nanotechnology.
- Learn the methods of nanoparticle synthesis.
- Study the applications of nanotechnology.
- Know the microbial fuel cell technology and its types.
- Understand the mechanism of microbial fuel cell.

Course Outcome:

CO1	The students gain knowledge about nanotechnology
CO2	To be aware of nanotechnology and its applications
CO3	To obtain knowledge on microbial fuel cell technology
CO4	To be aware of nanoparticle characterization
CO5	To understating the mechanism of microbial fuel cell technology

UNIT – I — No. of Hours: 12

Microbial fuel cell - Definition and history. Types of MFC - mediator microbial fuel cell, free microbial fuel cell, microbial electrolysis cell, soil based microbial fuel cell - designing of microbial fuel cell-materials used for construction of MFC.

UNIT – II — No. of Hours: 12

Fuel cell reaction kinetics - electrode kinetics, over voltages, Tafel equation, charge transfer reaction, exchange currents, electro catalyses - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte. Applications - power generation, and water treatment.

UNIT – III — No. of Hours: 12

History and scope of nanotechnology. Techniques used in nanotechnology: Bottom-up techniques - top down approaches. Methods of nanoparticle synthesis - Physical methods (ball milling and laser ablation) - chemical methods (sol-gel methods and microwave synthesis) - Biological methods (bacteria, fungi and plants).

UNIT – IV **No. of Hours: 12**

Nanoparticle characterization - UV Spectrophotometer, XRD, FTIR, EDAX, SEM, TEM and DLS. Antimicrobial activity of nanoparticles-mechanism of activity. Nanodrug delivery - liposomes, dentrimers, polymeric micelles, nanocapsules, nanotubes- advantages of nanodrug delivery.

UNIT –V **No. of Hours: 12**

Applications of Nanotechnology - Nanotechnology in agriculture. Nanotechnology in food industry. Nanotechnology in textiles. Environmental risks of nanoparticles. Ethical considerations in the advance of nanotechnology. IPR in nanotechnology.

Reference Books

1. Fuel Cell Systems Explained, J. Larminie and A. Dicks (John Wiley & Sons, 2003, USA)
2. Fuel Cell Fundamentals, R. O'Hayre, S-W. Cha, W. Colella, F. B. Prinz (John Wiley and Sons, 2005, USA)
3. Fuel Cell Engines, M. M. Mench (John Wiley and Sons, 2008, USA)
4. Fuel Cells: From Fundamental to Applications, S. Srinivasan (Springer, 2006, USA)
5. Principles of Fuel Cells, X. Li (CRC Press, 2005, USA)
6. Fuel Cells: Principles and Applications, B. Viswanathan and M. A. Scibioh (Universities Press, 2006, India)
7. PEM Fuel Cells: Theory and practice, F. Barbir (Elsevier Academic Press, 2005, USA)
8. High-Temperature Solid Oxide Fuel Cells: Fundamental, Design and Applications, S. C. Singhal, K. Kendall (Elsevier Science, 2004, USA)
9. Transport Phenomena in Fuel cells, Ed. B. Sunden and M. Faghri (WIT Press, 2005, UK) 10. Fundamentals of Electrochemistry, V. S. Bagotsky (John Wiley & Sons, 2006, USA)

Additional Reading:

1. M.M. MENCH, Fuel Cell Engines, Wiley, 2008.
2. M.T .M. Koper (ed.), Fuel Cell Catalysis, Wiley, 2009.
3. J.O'M. Bockris, A.K.N. Reddy, Modern Electrochemistry, Springer 1998.
4. Larminie J., Dick A., Fuel Cell Systems Explained, 2nd Ed. Wiley, 2003.

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1. https://en.wikipedia.org/
2. https://onlinelibrary.wiley.com/
3. https://nanografi.com/
4. https://www.iberdrola.com/

SEMESTER IV

SEMESTER – IV **CORE - IX**
22P4MB09 **Total Number of Hours: 75**
Credits - 5 **6 Hours/ Week**

GENETIC ENGINEERING - CONCEPTS AND APPLICATIONS

Course Objectives

- Acquire knowledge on concepts of Biotechnology.
- Understand the molecular biology of cloning vectors.
- Familiarise with the gene cloning techniques.
- Understand the concept of transgenic technology.
- Gain insights on the applications of genetic engineering

Course Outcome:

CO1	Acquire knowledge on Restriction and DNA modifying enzymes
CO2	Understand the different types and properties of cloning vectors
CO3	Gain knowledge about Cloning strategies, Genomic and cDNA library, Gene transfer and Gene expression methods
CO4	Understand about the applications of Transgenic plants and animals
CO5	Understand about the applications of genetic engineering in medicine and environment

UNIT-I Concepts on Gene biotechnology — No. of Hours: 15

Enzymology of Genetic Engineering - restriction enzyme: Types and properties. DNA modifying enzymes: Ligase, Kinase, Phosphatase, S_1 Nuclease, Exonuclease, Terminal transferase, RNAses, DNA Polymerase enzymes (*Taq*, *Pfu*, T_4) and Reverse transcriptase.

UNIT–II Cloning Vectors — No. of Hours: 15

Cloning Vectors - Types and properties - Plasmid vector - pBR322, pUC19 and Ti plasmids. Phage vectors- λ and M13 vectors. Cosmid and Phasmid vectors, Expression vector and Shuttle vector. Artificial chromosomes-YAC, BAC, PAC and HAC.

UNIT – III Gene Cloning strategies — No. of Hours: 15

Gene Cloning strategies - Host selection, Vector selection and Target selection. Genomic libraries and cDNA libraries. Library screening: Nucleic acid hybridization, Immunological and Screening by function. Gene Transfer techniques: Physical, Chemical and Biological transfer techniques. Expression of cloned genes: Minicel, Maxicel, Fused and Unfused.

UNIT – IV Transgenic plants and animals **No. of Hours: 15**

Transgenic and Gene knockout technologies - Targeted gene replacement, Gene augmentation and Gene silencing. DNA sequencing: Enzymatic, Chemical and Pyro sequencing. Transgenic plants - Development of disease resistant, herbicide tolerance, nutritional quality (Gold Rice) transgenic plants. Transgenic animals for Disease resistance - Transgenic mouse, Cow, Pig, Rabbit, Monkey and Fish.

UNIT – V Applications of Genetic engineering **No. of Hours: 15**

Production of Hormone: Insulin, Human growth hormone (Somatotropin), Interferon and Recombinant vaccines. Environment - Microbial Biosensors - Immobilization of microorganisms, Types. Genetically Modified Organism: *Pseudomonas putida* (super bug).

Text Book

1. Dubey, R.C., "**A Text Book of Biotechnology**", S. Chand and Company, New Delhi, 2000.
2. Freifelder, D, "**Molecular Biology**", Narosa Publishing House, New Delhi, 1991.
3. Glick, B.R. and *Pasternak, J.J.,* "**Molecular Biotechnology**", A.S.M. Press, London, 2001.

Reference Books

1. Brown, T.A., "**Gene Cloning and DNA Analysis: An Introduction**", Sixth Edition, Wiley-Blackwell Publishing Ltd., Oxford, 2010.
2. Cooper, G.M. and Hausman R.E., "**The Cell: A Molecular Approach**", Fifth Edition, Sinauer Associates Inc., New York, 2009.
3. Dale, J.W., Schantz von M. and Plant, M., "**From Genes to Genomes: Concepts and Applications of DNA Technology**", Third Edition, John Wiley & Sons Ltd., Chichester, 2012.
4. Karp, G., "**Cell and Molecular Biology: Concepts and Experiments**", Sixth Edition, John Wiley & Sons Inc., New York, 2010.
5. Primrose, S.B. and Twyman, R.M., "**Principles of Gene Manipulation and Genomics**", Seventh Edition, Blackwell Science Publishing, Oxford, 2006.

Web sources

1. https://opentextbc.ca/
2. https://www.goldbio.com/
3. https://www.sfu.ca/
4. https://byjus.com/

SEMESTER – IV	**CORE - X**
22P4MB10	**Total Number of Hours: 75**
Credits - 5	**6 Hours/ Week**

RESEARCH METHODOLOGY, BIOINFORMATICS AND BIOSTATISTICS

Course Objectives

- Acquire knowledge about methods in research.
- Understand the various data collection, analysis and interpretation methods.
- Gain adequate knowledge on principles and practice of Biostatistics.
- Learn the various different statistical measures.
- Know about the bioinformatics tools in research.

Course Outcome

CO1	Choose appropriate research design, identify the problem for research, undertake research and prepare a research report..
CO2	Identify the data collection tools and know how to represent the data graphically
CO3	Understand the importance of statistics and apply the statistical measures to analyse and interpret the data
CO4	Gain knowledge about the applications of bioinformatics in research
CO5	Utilize the various bioinformatics tools and software's

UNIT-I Research Methodology — No. of hours: 15

Research Methodology - Types of research, Research tools, Qualities of a good researcher. Research process, Research designs - Experimental and non - experimental. Problem selection, Problem Statement,Review of literature - Preparation of research report. Synopsis and Thesis writing and presentation - Guidelines for preparation of a Review, Research article for publication and writing research proposals for grant of funds.

UNIT-II Data Collection — No. of hours: 15

Data - collection methods, source, types, tabulation - Diagrammatic representation of data (One, two, three dimensional, Pictograms and cartograms) - Graphicalrepresentation of data (Histogram, Frequency Polygon, Frequency curve, Ogive, Lorenz curve) - Web Resources for Microbiology - Use of Digital Library.

UNIT-III Biostatistics **No. of hours: 15**

Principles and practice of statistical methods in biological research; Measures of central tendency - Mean, Median, Mode; Measures of dispersion - Range, Mean deviation and Coefficient of variation, Probability. ANOVA (one way and two way), Chi square test, Standard deviation, Standard error; Correlation and regression; Statistical inference - Hypothesis testing, Significance level, Test of significance for large and small samples; Parametric tests; Non parametric tests; Experimental design; Use of common biostatistical softwares.

UNIT-IV Bioinformatics in Research **No. of hours: 15**

Bioinformatics basics; Application in research; Databases - Sequence databases (DDBJ, Gen Bank, EMBL) - Protein database (PIR, PIR-PSD, SWISS PROT, TrEMBL), Information retrieval system (Entrez and SRS), Structure databases (MSD,NSD,3DSeq) - Sequence file format, Protein structure database (PDB) , Pathway databases (KEGG, ExPASy). Reactome).

UNIT-V Bioinformatics tools **No. of hours: 15**

Data analysis tools - Nucleotide sequence analysis and Protein sequence analysis tools (BLAST and FASTA), Prediction tools - Multiple Nucleotide Alignment, Phylogenetic tree, Gene prediction, Protein structure and Function prediction; Modeling tools - 2D and 3D protein modeling.

Text Books

1. Jeffrey A. Witmer Myra L. Samuels, 2002. Prentice HallStatistics for the Life Sciences (3rdEdition).
2. Gurumani. N., 2006. Research methodology for biological sciences.1st edition, MJP Publishers. A unit of TamilnaduBook House, Chennai.
3. Rastogi. S. C, N. Mendiratta and P. Rastogi, 2008. Bioinformatics- Methods and Applications Genomics,Proteomics and Drug Discovery 3rd edition.

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1. Balagurusamy. E, 1992, Programming in ANSIC, TataMcgrawHill.
2. Bernard Rosner, 1999, Fundamentals of Biostatistics,DuxburyPress.
3. Attwood T.K. and D.J. Parry-Smith, 2001. Introduction toBioinformatics, Pearson Education Asia.
4. Wayne W. Daniel, 2006. Biostatistics- A foundation for analysis in the Health Sciences. 7th edition. Wiley Indiapublication.
5. Harvey Motulsky, 1995, Intuitive Biostatistics, Oxford UniversityPress.

6. Marcello Pagano Kimberlee Gauvreau, 2000. Principlesof Biostatistics, 2nd Edition, Brooks Cole.
7. Higginns. D and W. Taylor (Eds.) 2000. Bioinformatics. Sequence, Structure and databanks- A Practical Approach byOxford University Press.

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2. https://research-methodology.net/
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SEMESTER – IV	**ELECTIVE - IV**
22P4MBE07	**Total Number of Hours: 60**
Credits - 4	**4 Hours/ Week**

BIOETHICS, BIOSAFETY AND IPR

Course Objectives:

- Acquire in-depth knowledge on Biosafety ,GLP,GMP
- Gain adequate knowledge on Bioethics
- Understand the types and functions of Intellectual property rights
- Know about the agreements, acts, treaties and conventions on IPR
- Gain more insights into the types and applications of Patents..

Course Outcome:

CO1	Understand, Analyze the biohazards ,assess the risk and implement the biosafety levels and Perform all the good laboratory practices and manufacturing practices and follow the guidelines for Recombinant DNA Research
CO2	Analyze the Bioethical issues and apply the guidelines necessary for rDNA research, use of Animal models and embryonic stem cell cloning.
CO3	Know to select the forms of protection of intellectual property and it's importance in research
CO4	Apply the agreements, acts, treaties and conventions on IPR
CO5	Know the process of patenting and agencies involved in patenting.

UNIT-I Biosafety **No. of Hours: 12**

Biosafety - Introduction - Biohazard Risk assessment and management - Levels of Biosafety - Guidelines for Recombinant DNA Research. Containments - Types - Basic and Maximum Containment in microbiology research. Good Laboratory Practices (GLP) - Good Manufacturing Practice (GMP).

UNIT-II Bioethics **No. of Hours: 12**

Bioethics - Definition - Principles of Bioethics - Ethical Issues related to Environmental release of Genetically Modified Microorganisms. Ethical Issues Related to the use of Animals in research - Animal ethics Norms in India - Ethical Clearance norms for conducting Studies on Human Subjects. Ethical Issues related to research in Embryonic Stem Cell Cloning.

UNIT-III IPR - Types and Functions **No. of Hours: 12**

Introduction to Intellectual Property - Intellectual Property Rights (IPR) - Definition - Types: Patents, Trademarks, Trade secret, Copyright and Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R and D; IPRs of relevance to Microbiology / Biotechnology and few Case Studies.

UNIT-IV Agreements, Acts and Treaties **No. of Hours: 12**

GATT - History, Structure, Objectives and functions. WTO, TRIPS. Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; Berne and Paris convention, PCT; Indian Patent Act 1970 and Recent Amendments.

UNIT-V Types and Applications of Patents **No. of Hours: 12**

Introduction to Patents - Types of Patent Applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and Complete; Process of Patenting, Patenting of biological material. Indian and International Agencies involved in IPR & Patenting, Global Scenario of Patents and India's Position.

Text books

1. Sateesh, M.K., Bioethics and Biosafety, IK International Publishers (2008)
2. Singh I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).
3. Srinivasan, K. and Awasthi, H.K., Law of Patents, Jain Book Agency (1997)

Reference Books

1. Jonathan, Y.R., Anthology of Biosafety (Vols. 1-4), American Biological Safety Association (2005).
2. Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons Inc. (2005).
3. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804, 9781555811808.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,

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SEMESTER – IV	**ELECTIVE - IV**
22P4MBE08	**Total Number of Hours: 60**
Credits - 4	**4 Hours/ Week**

MICROBIAL DEGRADATIONAND BIOREMIDIATION

Course Objectives:

- Acquire in-depth knowledge on Biodegradation of natural polymers.
- Gain adequate knowledge on enhancement of biodegradation.
- Understand the Bioleaching and Biomagnifications.
- Know about the Bioremediation and Bioaugmentation.
- Gain more insights into production of eco-friendly biodegradable products.

Course Outcome:

CO1	Understand and Analyze the biodegradation of natural polymers and xenobiotic compounds
CO2	Analyze on how the biodegradation process can be enhanced.
CO3	Know how to recover metals from ores and remove heavy metals from effluents
CO4	Gain information about the different types of Bioremediation, bioreactors and biopackages used in Bioremediation.
CO5	Apply the gained knowledge to develop eco friendly bioproducts

UNIT- I — No. of Hours: 12

Biodegradation and heterotrophic microbial population in aquatic, terrestrial and arid ecosystems - Degradation of natural polymers (Cellulose, lignin and hemicelluloses).

UNIT- II — No. of Hours: 12

Microbial degradation of paper, paints, metals, concrete, textiles and leather goods - Biodegradation enhancement - Stimulation of Oil spills for degradation - Surface and subsurface degradation.

UNIT- III — No. of Hours: 12

Bioleaching - Recovery of metals from ores - oxidation of minerals - testing for biodegradability - Biomagnifications - Removal of heavy metals and radionuclide from effluents - Preparation of metal sulfides.

UNIT- IV **No. of Hours: 12**

Bioremediation - Case histories - Constraints and priorities - Types of bioremediation - insitu bioremediation, exsitu bioremediation – Bioaugumentation - Bioreactors for bioremediation process - Biopackages for biodegradation.

UNIT- V **No. of Hours: 12**

Biodegradation of xenobiotic compounds: organic contaminants Hydrocarbon halogenated organic solvents, herbicides, pesticides – Treatment of solid and liquid wastes - Vermicomposting - Aiming for eco-friendly biodegaradable products - Bioplastics.

Text Books

1. Biotechnology: B.D.Singh
2. Environmental Biotechnology by Allan Scragg, 2nd Edn
3. A textbook of Biotechnology: R.C.Dubey

Reference Books

1. Principles and Applications by Ronald LCrawford and Don L Crawford
2. Morris, C. E. and Monier, J. M. 2003.The ecological significance of biofilm formation by plant-associated bacteria. Annu. Rev. Phytopathol. 41:429–53

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2. https://www.angloamerican.com/
3. https://academic.oup.com/

SEMESTER – IV	**Extra Disciplinary Course – I**
22P3MBED01	**Total Number of Hours: 30**
Credits - 2	**2 Hours/ Week**

MEDICAL LABORATORY TECHNOLOGY

Course Objectives

- Understand the fundamental concepts of laboratory.
- Comprehend the procedure on inoculation and preservation methods.
- Acquire knowledge about the blood composition and grouping.
- Gain knowledge on collection and examination of clinical specimens.
- Understand the antibody - antigen reactions and blotting techniques.

Course Outcome:

CO1	Understand and analyze the basic lab principles and procedures
CO2	Apply the knowledge on identification of microorganism by staining
CO3	Know how to perform blood grouping and complete blood count
CO4	Gain information about test collection and examination of clinical specimens and perform antibiotic sensitivity test.
CO5	Acquire the knowledge to differentiate the antigen-antibody reactions and blotting techniques

UNIT - I — No. of Hours: 6

Basic lab principles and procedures - lab accidents – causes and prevention lab safety rules and regulations - Preparation of glasswares - Sterilization - principles and methods - quality control in sterilization

UNIT - II — No. of Hours: 6

Inoculation methods and preservation of cultures - Staining techniques and methods – Simple, Differential and Special staining- Gram's staining, AFB staining, Capsular, Endospore and Metachromatic staining - Identification of bacteria by biochemical test- Lab methods of diagnosing fungal infections - KOH and LCB mount.

UNIT - III — No. of Hours: 6

Introduction - Blood composition - Anticoagulant - Complete Blood Count - ABO Blood grouping & Rh typing - Rh type incompatability - Transfusion reaction.

UNIT - IV **No. of Hours: 6**

Collection and Examination of Clinical specimens - Urine, Blood, Faeces, CSF - Concentration techniques in stool - Examination of blood for malaria -.Antibiotic Sensitivity test- Microdilution, Kirby bauer and Stokes diffusion method.

UNIT - V **No. of Hours: 6**

Antigen-Antibody reaction – General features and types - Precipitation, Immunoelectrophoresis Immunofluroscence - RIA, ELISA, Agglutination-Direct and Indirect - Immunoblotting technique - Western blot.

Text Books

1. Mukerjee KL and Ghosh S (2010). **Medical Laboratory Technology: Procedure Manual for Routine Diagnostic Tests.** Volume 1. 2nd Edition. Tata McGraw Hill Education Pvt Ltd., New Delhi.
2. Chakraborty P (2015). **A Text Book of Microbiology**. 2nd Edition, Published by New Central Book Agency (P) Ltd., Kolkata.
3. Dubey RC and Maheswari DK (2013). **A Text Book of Microbiology**, 3rd Edition. S. Chand Publishing, New Delhi.

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1. Arti Kapil (2013). **Ananthanarayan and Paniker's Text Book of Microbiology**, 9th Edition, Orient Blackswan Private Limited.
2. Godkar PB and Godkar DP (2008). **Text Book of Medical Laboratory Technology**, 2nd Edition, Bhalani Publishing House, New Delhi.
3. Cheesbrough M (2006). **District Laboratory Practice in Trolical Countries**, Part 1 & 2. 2nd Edition, Cambridge University Press, Cambridge.

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2. https://www.biologydiscussion.com/
3. https://www.britannica.com/
4. https://www.labcorp.com/
5. https://microbenotes.com/