VIVEKANANDHA
COLLEGE OF ARTS AND SCIENCES FOR WOMEN

ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).
(Affiliated to Periyar University, Approved by AICTE,
Re-Accredited with 'A' Grade by NAAC)
Recognized under section 2(f) &12(B) of UGC ACT 1956,
An ISO 9001:2008 (Certificate institution)

AUTONOMOUS

DEPARTMENT OF MICROBIOLOGY

M.Sc APPLIED MICROBIOLOGY

SYLLABUS & REGULATIONS

FOR CANDIDATES ADMITTED FROM

2018 - 2019 ONWARDS

UNDER AUTONOMOUS & CBCS PATTERN

VIVEKANANDHA EDUCATIONAL INSTITUTIONS
Angammal Educational Trust

M.Sc., APPLIED MICROBIOLOGY

1. SCOPE OF MICROBIOLOGY

The Mission of the Department of Microbiology is to impart education and carry out research in various areas of Microbiology. There is an excellent combination of courses in both traditional microbiology and modern molecular biology**.** The facilities in the department are totally committed to provide highest quality of education for the rural students at Post-graduate and Research levels.

The world around us is full of organisms that are too small to be seen with the naked eye. These microbes live in a wide range of habitats from hot springs to the human body and the depths of the ocean. They affect each and every aspect of life on earth. Microbes have always affected our health, food and environment and they will play an important role in the big issues that we may face in the future: climate change, renewable energy resources; healthier lifestyles and controlling diseases.

Because microbes have such an effect on our lives, they are a major source of interest and employment to thousands of people. Microbiologists study microbes: where they occur, their survival strategies, how they can affect us and how we can exploit them. Before microbiologists can solve the problems caused by microbes, or exploit their amazing powers, they have to find out about the detailed workings of microbial cells. This basic knowledge of cell genetics, structure and function can then be used in applied microbiology as well as in other areas of biology.

Microbiology imparts knowledge about the importance of micro-organisms as experimental tools in basic research, biochemical and genetic studies. There is an increasing demand for trained microbiologists in pollution control organizations, food processing, pharmaceutical and fermentation industries, industrial effluent treatment plants and in various national and international research institutes.

2. SALIENT FEATURES

- CourseProgramme is specially designed for a higher level career placement.
- Special guest lecturers from industrialistsindustries will be arranged.
- Enables students to gain a professional degree
- Special industry orientations and training are parts of the degree programmecourse.
- Project work is included in the syllabussyllabi to enhance conceptual and deductive skills.

3. OBJECTIVES OF THE PROGRAMME COURSE

The specific objectives of the programme are:

- To equip the Postgraduate students with a sound knowledge of the fundamental principles involved in the study of microbiology.
- To produce graduates that would make impact in the diverse fields of human endeavor considering the ubiquitous nature of microorganism and the wide–ranging applications of the knowledge of microbiology.
- To provide focus for a career in various fields of Applied Science including Medicine, Pharmacy, Mining, Biotechnology, Industrial Production, Environmental Management, Agriculture and even the Computer industry.

4. CONDITIONS FOR ADMISSION

4.1 ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc., degree in any Life Sciences [Microbiology / Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Animal Science/ Applied Animal Science and Animal Biotechnology/ Biochemistry/ Bioinformatics/ Biology/ Life Sciences/ 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 Applied Microbiology.

5. 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.

6. DURATION OF THE PROGRAMME COURSE

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

7. 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.

8. SCHEME OF EXAMINATIONS

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

Theory External marks	=	**75**
Part A	**=**	**20 Marks (20 x 01) (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.**	

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 25+25]	50 Marks
Project Report	100 Marks
Viva - Voce	50 Marks
Total	**200 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**

9. 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.

10. 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)

11. 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.

12. 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**

13. 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.

14. PATTERN OF QUESTION PAPER

PART A (Objective): Answer All the Questions 20x01**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 All the Questions (Internal choice) **03 x 10 = 30 Marks**

15. 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**.**

16. COMMENCEMENT OF THESE REGULATIONS

These regulations shall take effect from the academic year 2017-18 (i.e.,) for the students who are to be admitted to the first year of the course during the academic year 2017-18 and thereafter.

17. TRANSITORY PROVISION

Candidates who were admitted to the PG course of Microbiology before 2018 – 2019 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.

Vivekanandha College

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**

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 life.

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

M.Sc., APPLIED MICROBIOLOGY

PROGRAMME OUTCOME:

The Master program builds consecutively on biological education and focus on research especially dedicated to the integration and consolidation of knowledge in microbiology. The course focuses on interaction between microbes, human disease and immunology that results in infectious disease and also dealt with the role of microbes in environment and ecology. To develop the technological advancement for current problem and to obtain reliable solutions through research activities.

PROGRAMME SPECIFIC OUTCOME:

1. To make the students to learn the in-depth concepts of microbiology to understand to complexity of microbiology and other biological system.
2. To explore the technique with laboratory components to obtain hands on experience to understand the application.
3. To develop the students to relate the conceptual knowledge and its application through research and scholarly activities.
4. To execute the knowledge, skills, ethics and values of microbiology into occupational pursuits.

SCHEME OF CURRICULUM – M.Sc. in APPLIED MICROBIOLOGY
(For the candidates admitted during the academic year 2018-2019 onwards)

Sem	Subject code	Course	Subject title	Hrs/ week	Credit	Int. marks	Ext. marks	Tot. marks
I	18P1AMB01	Core – I	General Microbiology	6	5	25	75	100
	18P1AMB02	Core – II	Microbial Physiology and Biochemistry	5	5	25	75	100
	18P1AMB03	Core – III	Immunology	5	5	25	75	100
	18P1AMBP01	Core Practical - I	Practical – I – General Microbiology	5	3	40	60	100
	18P1AMBP02	Core Pra1ctical - II	Practical – II – Microbial Physiology, Biochemistry &Immunology	5	3	40	60	100
	18P1AMBE01/ 18P1AMBE02	Elective – I	Should be selected from the list	4	4	25	75	100
			Total	**30**	**25**	**180**	**420**	**600**
II	18P2AMB04	Core – IV	Medical Bacteriology & Mycology	6	5	25	75	100
	18P2AMB05	Core – V	Microbial Genetics & Molecular Biology	5	5	25	75	100
	18P2AMB06	Core – VI	Food, Industrial and Pharmaceutical Microbiology	5	5	25	75	100
	18P2AMBP03	Core Practical-III	Practical – III – Medical Bacteriology & Mycology	5	3	40	60	100
	18P2AMBP04	Core Practical-IV	Practical – IV – Microbial Genetics, Molecular Biology, Food, Industrial and Pharmaceutical Microbiology	5	3	40	60	100
	18P2AMBE03/ 18P2AMBE 04	Elective – II	Should be selected from the list	4	4	25	75	100
			Total	**30**	**25**	**180**	**420**	**600**
III	18P3AMB07	Core – VII	Agricultural & Environmental Microbiology	5	5	25	75	100
	18P3AMB08	Core – VIII	Medical Virology & Parasitology	5	5	25	75	100
	18P3AMB09	Core – IX	Genetic Engineering: Concepts and applications	5	5	25	75	100

	18P3AMBP05	Core Practical-V	Practical – V – Agricultural & Environmental Microbiology	5	3	40	60	100
	18P3AMBP06	Core Practical-VI	Practical – VI – Medical Virology, Parasitology, Genetic Engineering & Gene Technology	5	3	40	60	100
	18P3AMBE05/ 06	Elective –III	Should be selected from the list	4	4	25	75	100
	18PHR01		Human rights	1	1	25	75	100
			Total	**30**	**26**	**205**	**495**	**700**
IV	18P4AMB010	Core – X	Research Methodology & Biostatistics	5	5	25	75	100
	18P4AMBE07/ 18P4AMBE 08	Elective – IV	Should be selected from the list	4	4	25	75	100
	18P4AMBPR01	Core – VII	Project work	10	5	50	150	200
	18P4BTED01	EDC	Plant and Animal cell culture techniques	2	1	25	75	100
			Project review	9	-	-	-	-
			Total	**30**	**15**	**125**	**375**	**500**
Overall Total				**120**	**91**	**625**	**1710**	**2400**

Electives:

Semester I – 1. Advanced techniques in Microbiology (18P1AMBE01)
2. Microbial Quality control in Food & Pharmaceutical (18P1AMBE02)

Semester II – 1. Diagnostic Microbiology (18P2AMBE03)
2. Poultry Microbiology (18P2AMBE04)

Semester III – 1. Genomics & Proteomics (18P3AMBE05)
2. Microbial Fuel cell Technology & Nanotechnology (18P3AMBE06)

Semester IV – 1. Bioethics, Biosafety and IPR (18P4AMBE07)
2. Entrepreneurship in Microbiology (18P4AMBE08)

EXTRA DISCIPLINARY COURSE

1. Medical laboratory technology (18P4AMBED3)

SEMESTER I

SEMESTER – I	**CORE – I**
18P1AMB01	**Total Number of Hours: 75**
Credits – 6	**6 Hours/ Week**

GENERAL MICROBIOLOGY

Course Objectives:

- To study the early development of microbiology and to practice the microscopic and staining techniques
- To learn the microbial culture techniques and familiar with the bacterial taxonomy
- To acquire knowledge on algae, fungi and protozoa
- The microorganisms that grow at some extreme conditions were to be introduced

Course Outcome:

CO1	The students could understand the origin of Microbiology field, Microscopy & Staining techniques
CO2	The art of cultivating the Microorganisms, storing methods and removal of pathogenic organisms were taught
CO3	The students could learn in detail about the Bacteria & Viruses
CO4	The students could learn in detail about the Fungi, Algae & Protozoa
CO5	The Adaptations & applications of the extremophiles were studied

UNIT I – Basics in Microbiology **No. of Hours: 15**

History, Microscopy & Staining techniques: History and scope of microbiology. Spontaneous and germ theory. Contribution of Leeuwenhoek – Robert Koch – Louis Pasteur – Edward Jenner. Microscopy: Principle and applications of Bright field, Dark field, Phase contrast, Confocal, SEM and TEM.and fluorescent microscope. Staining techniques: Simple, Differential staining - Gram staining, acid fast, Special staining - capsular, endospore, metachromatic and flagellar.

UNIT II – Sterilization, Cultivation & Preservation methods **No. of Hours: 15**

Sterilization and disinfection methods. Media preparation-Types of media. Aerobic and Anaerobic culture techniques. Pure culture techniques. Preservation of microbial culture. Phototrophs, autotrophs, chemotrophs, lithotrophs. Nutritional requirements of bacteria. Growth curve – batch, continuous and synchronous culture – factors influencing growth.

UNIT III – Introduction to Bacteria & Viruses **No. of Hours: 15**

Bacteria: Microbial Taxonomy - Definition and systematic, Nomenclatural rules and identification. Haeckel's three kingdom classification, Whittaker's five kingdom approach - Woese domain system. **Bacteria:** General characteristics & classification – Bergey's manual classification of systemic Bacteriology. Classification – traditional approaches – Major characteristics used in bacterial taxonomyModern approaches-Numerical taxonomy. Reproduction of bacteria. Economic importance

of bacteria.**Virus:** General properties of virus – Baltimore classification of virus.General characteristics of TMV, HIV and Virions, Prions - Lytic and lysogenic cycle.

UNIT IV – **Introduction to Fungi, Algae & Protozoa** **No. of Hours: 15**

Fungi: General characteristics & classification. General account on vegetative, asexual and sexual reproduction in fungi and yeasts. **Algae:** General characteristics & classification. Reproduction in algae. Symbiotic relationship of fungi: Lichens – Mycorrhiza. Economic importance of algae and fungi. **Protozoa:** General characteristics and classification of Protozoa.

UNIT V– Introduction to Extremophiles **No. of Hours: 15**

Extremophiles: Definition and types. General characteristics of Arachea. Adaptations and applications of Thermophiles, Hyperthermophiles, Halophiles, Acidophiles, Alkalophiles, Mesophiles, Psychrophiles, Barophiles, Metal tolerant microbes, Sulfur reducing organisms and methanogens.

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.

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.

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**
18P1AMB02	**Total Number of Hours: 75**
Credits – 5	**5 Hours/ Week**

MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Course Objective:

- To gain the knowledge on bioenergetics.
- To impart knowledge on carbohydrate anabolism and metabolismCatabolism
- To impart the knowledge on respiratory metabolism.
- To know the knowledge on nitrogen cycle.
- To get the knowledge on enzyme

Course Outcome:

CO1	The students can recognize the importance and types of photosynthesis and ATP formation
CO2	The students could learn the basic about buffers, pH, pigments and bonds between macromolecules
CO3	They can able to identify the assimilation patterns of Nitrogen
CO4	They could understand the different kinds of metabolic pathways
CO5	It will provide a good idea of using enzymes as biocatalysts

UNIT I **No. of Hours: 15**

CarbohydratesPrinciples of metabolism– Catabolism-anabolism – autotrophy – oxygenic and anoxygenic photosynthesis – autotrophic generation of ATP; Fixation of CO_2 – Calvin cycle – C3-C4 pathway. Chemolithotrophy – sulphur – iron – hydrogen – nitrogen oxidations – luminescence.

UNIT II **No. of Hours: 15**

Microbial metabolism Embden Mayer Hoff pathway – Entner Doudroff pathway – glyoxlate pathway – Kreb's cycle – Electron Transport Chain and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Pasteur effect; Fermentation of carbhohydrates – homo and heterolactic fermentations.

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

Assimilation of nitrogen – dinitrogen – nitrate nitrogen – Stickland reactions - Inorganic Nitrogen - Urease - assimilation of inorganic nitrogen- ammonia – synthesis of major amino acids – polyamines; synthesis of polysaccharides – peptidoglycan – biopolymers as cell components – cell division – endospore – structure – properties – germination. Microbial development, sporulation and morphogenesis, hypahae verses yeast forms and their significance.

UNIT IV **No. of Hours: 15**

Basic aspects of bioenergetics – entropy – enthalpy – electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation. Account on photosynthetic and accessory pigments – chlorophyll – bactriochlorophyll – rhodopsin – carotenoids – phycobiliproteins. Basics concepts of acids, base, pH and buffers.

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

Enzymes as biocatalysts – Enzyme classification, specificity, active site, activity unit, isoenzymes. Enzyme kinetics: Michaelis – Menton equation for simple enzymes, determination of kinetic parameters, multistep reactions and rate limiting steps, enzyme inhibition, allosterism, kinetic analysis of allosteric enzymes, principles of allosteric regulation. Vitamins and their role as coenzymes.

Text Books

1. Caldwell, D. R. 1995. **Microbial Physiology and Metabolism**. Brown Publishers.
2. Moat, A. G and Foster, J. W. 1999. **Microbial Physiology**. Wiley.

Reference Books

1. Stainer, R. Y., Ingharam, J. L., WHeelis, M. L., Painter, P. R. 1986. **General Microbiology**. Macmillan Education Ltd.
2. Brun, Y. V. and Shimkets, L. J. 2000. **Prokaryotic Development**. ASM Press.
3. Freeman, W. H. 2001. **Stryer Biochemistry**. 5th Edition.
4. Lehniger. 2000. **Principles of Biochemistry**. Nelson and Cox (Worth) Publishers.

Web sources

1. http://www.cuchd.in/elibrary/resource_library/University%20Institutes%20of%20Sciences/Fundamentals%20of%20Biochemistry/Chap-20.pdf
2. http://www.nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-02.pdf
3. https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch12_carbohydrates/lecture_notes_ch12_carbohydrates_current.pdf
4. https://www.omicsonline.org/enzymes-biocatalyst-scholarly-open-access-journals.php

SEMESTER – I	**CORE - III**
18P1AMB03	**Total Number of Hours: 75**
Credits - 5	**5 Hours/ Week**

IMMUNOLOGY

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- Blood cell formation, Apoptosis-Structure, composition and functions of cells and organs involved in immune system. Host parasite relationship. Immune responses – Innate, Acquired, Humoral and Cell Mediated Immunity. Immunohaematology – blood groups, transfusion and Rh incompatibilities.

UNIT II – Antigens and Antibody **No. of Hours: 15**

Antigens – types and properties, Haptens, Adjuvant and Super antigens. Immunoglobulin – classes and functions – Theories of antibody production. Antibody engineering: Chimeric and Humanized monoclonal antibodies.Major Histocompatibility Complex – structure and function of Class I, Class II and Class III molecules – antigen processing and presentation, T and B cell receptors – activation of T and B lymphocytes. Complement – Classical, Alternative and lectin pathways.Biological consequences of activation.

UNIT III - Antigen – antibody reactions **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. Organ specific and systemic autoimmune diseases.

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

Tumor immunology – tumour specific antigen – immune diagnosis of tumors. Transplantation immunology – GVH reactions – Mechanism of graft rejection. Immune tolerance and immune suppression.Lymphokines and cytokines. Oncogene and induction, Cancer immunotherapy. Vaccines -

Active and passive immunization, vaccine schedule. Types of vaccine - whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine

UNIT V – Immunotechniques **No. of Hours: 15**

Vaccines – types – DNA vaccines. Monoclonal antibodies – production and its applications. Antigen and Antibody reaction – salient features.*In vitro* methods – agglutination, precipitation, Flocculation and complement fixation, immunofluorescence, RIA, ELISA, Immuno electron microscope and Flow cytometry.*In vivo* methods: Skin tests and immune complex tissue demonstrations

Text Books

1. Kindt TJ, Osborne BA and Goldsby RA (1993). **KubyImmunology.** 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 Rand 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**
18P1AMBP01	**Total Number of Hours: 45**
Credits - 3	**5 Hours/**

PRACTICAL I - GENERAL MICROBIOLOGY

Course Objectives:

- To learn the fundamental techniques in microbiology
- To gain experience with staining methods
- To be familiar with the methods of growing fungi and actinomyetes
- To understand the micrometry
- To learn the basics of preservation of microbes

Course Outcome:

CO1	The knowledge on pure culture isolation, cultivation and characterization are studied
CO2	The visualizing the morphology, size and movement of microbes are
CO3	Biochemical and control of microbial growth is determined
CO4	They could learn the preservation techniques to maintain the microbes
CO5	They could understand the micrometry

1. Laboratory Techniques for isolation and cultural characterization of Microorganisms

- Principles and methods of sterilization
- Preparation of culture media- Basal, differential, selective, enrichment, enriched, selective and transport media. and cultural characteristics of Microorganisms.
- Isolation of pure cultures using spread, pour and streak plate techniques

2. Motility and cell measurement Microscopy

- Microscopic examination of living cell Preparations (Motility Determination)
- Determination of bacterial motility - Hanging drop method and Wet mount slide method.
- Microscopic measurement of microorganisms (Micrometry)
- Determination of bacterial cell size using Micrometry.

3. Bacterial and Fungal Staining techniques

- Preparation of bacterial smears
- Simple staining
- Differential staining - Gram staining and Acid fast staining (Ziehl neelsen method)

- Negative staining
- Lacto Phenol Cotton Blue and KOH Staining for fungi
- Special staining - Spore Stain (Malachite green)and Capsule Stain

4. Cultivation of Microorganisms

- Effect of temperature, UV, pH and disinfectants
- Effect of atmospheric oxygen on growth
- Anaerobic cultivation of microorganisms
- Bacterial growth curve and determination of generation time

5. Biochemical tests for identification of bacteria

- IMViC, Triple Sugar Iron Agar, Hydrogen Sulfide, Citrate utilization, Nitrate reduction, Catalase, Coagulase, Starch hydrolysis, Urease, Oxidase, CarbohydrateSugar fermentation, API system of bacterial analysis

6. Isolation and characterization of cyanobacteria, actinomycetes and fungi.

6. Physical and Chemical Agents for the control of Microbial Growth

- *Physical Agents:* Moist Heat
- *Chemical Agents:* Antibiotic susceptibility test – Kirby-Bauer and Stokes methods & MIC

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. Dubey, R.C and D.K. Maheswari, 2005, "**Practical Microbiology**", S. Chand and Company, New Delhi.
6. Gunasekaran, P., 2005, "**Laboratory Manual in Microbiology**", New Age International (P) Ltd, New Delhi.

7. Kannan, N., 2003, "**Laboratory Manual in General Microbiology**", Fourth Edition, Palani Paramount Publications, Palani.
8. Rajan, S and R. Selvi Christy, 2015, "**Experiments in Microbiology**", Anjanaa Book House, Chennai.

PRACTICAL II – MICROBIAL PHYSIOLOGY, BIOCHEMISTRY & IMMUNOLOGY

Course Objectives:

- To understand the bacterial growth curve and environmental factors
- To enhance knowledge about biochemical test
- To familiarize with serological test
- To gain knowledge about the detection of human blood group
- To comprehend the immunological test

Course Outcome:

CO1	The student should learn the quantification of carbohydrates, protein, urea, uric acid & chloride
CO2	They could be trained the immunological diagnostic techniques
CO3	They could know the antigen preparation & separation methodologies
CO4	They could learn the growth curve determination
CO5	They comprehend the estimation of biological samples

1. Determination of growth curve.
2. Effect of environmental conditions on bacterial growth.
3. Preparation of physiological buffers.
4. Estimation of carbohydrates in a given solution by Anthrone method.
5. Estimation of sugars in biological samples.
6. Protein estimation by Lowry's and Bradford method.
7. Analysis of urine for urea, glucose, uric acid and chloride.
8. Separation and preservation of serum and plasma.
9. Identification of human ABO blood group.
10. Latex agglutination test – RA test, CRP test, ASO test.
11. WIDAL slide and tube agglutination test.
12. Flocculation test – RPR test.
13. Immunodiffusion: Radial Immunodiffusion & Ouchterlony double diffusion.

14. Immunoelectrophoresis: Counter current & Rocket immunoelectrophoresis.
15. Preparation of cellular antigen from bacteria.
16. Raising antiserum to protein (BSA) antigen (DEMO).
17. Electrophoretic separation of serum protein.

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.

ADVANCED TECHNIQUES IN MICROBIOLOGY

Course Objectives:

i) To gain the knowledge on Electrophoresis techniques
ii) To get aware on Chromatographic methods
iii) To impart the knowledge on Spectroscopy
iv) To know the analytical methods of Hybridization techniques
v) To get the knowledge on radioisotopic techniques

Course Outcome:

CO1	They could know the extraction and isolation of DNA, RNA from bacterial source
CO2	They could able to separation the macromolecules like proteins by chromatography
CO3	To analyze and quantify the components using spectroscopy
CO4	Theywill gaingained knowledge on the separation and preservation 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**

Bio molecules and electron migration. Types and uses of Electrophoresis, Buffers and supportive media. Principle procedure, detection, quantification and applications of Gel electrophoresis – Native, SDS-PAGE and DISC-PAGE, PFEG, Isoelectric focusing, 2D gel electrophoresis.

UNIT II - Chromatographic techniques **No. of Hours: 14**

Basic principles and types. Principles, procedure and applications of Paper chromatography, Thin layer chromatography (TLC), Column chromatography (CC), Gas chromatography – Mass Spectrometry spectra(GC and GCMS), MALDI, CSELDI – TOF, High performance liquid chromatography (HPLC and HPTLC). 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 – FTIR and NMR. Emission spectroscopy –Energy-dispersive X-ray spectroscopy and inductively coupled plasma Spectroscopyplasma emission spectroscopy. Scattering spectroscopy - Raman Spectroscopy. – Flow cytometry

UNIT IV - Molecular hybridization of nucleic acids **No. of Hours: 10**

Nucleotide probes and its types and labelling. Principle, procedure and application of Blotting techniques – Southern, Northern, Western and Dot blotting. DNA microarrays- steps involved in microarrays – types of DNA chips and its applications.

UNIT V – Radio isotopic techniques **No. of Hours: 12**

Radioactive labelling, principle and application of tracer techniques, Half life of isotopes, detection and measurement of radioactivity – ionization chamber, proportional chamber, GM and Scintillation counters, autoradiography and its applications. Dosimetry. Biosensors: Definition and types. Principle, preparation 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. B.B. Straughan and S. Walker (1976) **Spectroscopy**. Volume 1. Chapman & Hall, London.
4. Chapman and Hall. **Gel Electrophoresis of Proteins- A Practical Approach by Hanes**.
5. Cotterill, R. M. J. (2002). **Biophysics: An Introduction**. John Wiley & Sons, England.
6. Nölting, B. (2006). **Methods in modern biophysics**. Second Edition. Springer, Germany.

MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL

Course Objective:

i) To study the microbiological laboratory practices and biosafety methods
ii) To check the quality of food and pharmaceutical products
iii) To detect the presence of pathogen in food and water
iv) To demonstrate the quality of milk, spoilage and preservation
v) To get the knowledge on food safety procedures.

Course Outcome:

CO1	They could learn the microbiological practices and biosafety in laboratories
CO2	They could with Standards of food and pharmaceutical products
CO3	They could able to analyze the presence of pathogens in food and water
CO4	They comprehend with the determination of quality in milk
CO5	Theygaingot an knowledge on food safety procedures and organization

UNIT - I **Total No. of hours: 12**

Good laboratory practices (GLP), Good Microbiological Practices (GMP). Quality policy, quality objectives of food processing company, Standard Operating Procedures, Work instructions, Good Handling Practices (GHP) & GMP checklist.

UNIT-II **Total No. of hours: 12**

Importance and significance of microorganisms in food safety -Food and Drug Administration (FDA) and its regulation - Factors affecting the growth of micro organisms in food - intrinsic (pH, moisture, oxidation-reduction potential and nutrient content) and extrinsic (Temperature, relative humidity, gases and microbial activities).

UNIT - III **Total No. of hours: 12**

Determination of micro organisms and their products in food: sampling, sample collection, transport and storage, sample preparation for analysis. Microscopic and culture dependent methods- direct microscopic observation, culture enumeration and isolation methods.

UNIT - IV **Total No. of hours: 12**

Food spoilage: characteristic features, dynamics and significance of spoilage of different groups of foods - cereal and cereal products, vegetables and fruits, meat poultry and sea foods, milk and milk products, packed and canned foods.

UNIT- V **Total No. of hours: 12**

Rules and regulations for setting up of a processing unit. Criteria for ingredients and finished products. Aspects of microbiological safety in food preservation technologies, Establishment and implementation of HACCP, Continuous Assessment System, Total quality management and quality audits in food industries.

Text books:

1. Rajesh Bhatia (2000). **Quality Assurance in Microbiology**. CBS publishers and Distributors Pvt. Ltd., New Delhi.
2. Adams M.R and Moss M.O (2008). **Food Microbiology**, 2nd Edition, Royal Society of Chemistry.
3. Frazier W.C and Westhoff D.C (2013). **Food Microbiology**, 5th edition, Tat McGraw Education, New Delhi.

Reference books:

1. Mandal S.K (2007). **Total Quality Management - Principles and Practice**. 1st Edition. Vikas Publishing House Pvt. Ltd, Noida.
2. James M Jay, Martin J Loessner and David A Golden (2006). **Modern Food Microbiology**, 7th edition, Springer Science and Business Media, New York.
3. Richard K. Robinson (2005). **Dairy Microbiology Hand book: The Microbiology of Milk and Milk Products**, 3rd edition, John Wiley and Sons, New York.
4. Baird RM, Hodges NA and Denyer SP (2005). **Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices**, Taylor and Francis Inc.

SEMESTER – II	**CORE –IV**
18P2AMB04	**Total Number of Hours: 75**
Credits –6	**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 bacilli and Gram negative bacilli.
- To understand the fungal classification, diagnosis, cultivation and antifungal agents.
- To study the superficial, cutaneous, sub cutaneous, systemic and opportunistic mycoses.

Course Outcome:

CO1	They could be able to identify and examine the bacterial and fungal pathogens of clinical importance
CO2	Could comprehend the scientific method as it is used for classification of bacteria and fungi
CO3	Students could learn the morphology, life cycle, symptoms, diagnosis and treatment method for some important bacterial and fungal pathogens
CO4	They could be aware about the antibacterial and antifungal agents and their mode of action
CO5	They could acquire knowledge on fungi and its diseases in human

UNIT I - Introduction to Medical Bacteriology **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 bacterial pathogen **No. of Hours:15**

Brief account onMorphology, pathogenesity, symptoms and laboratory diagnosis of *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Neisseria gonorrhoeae*, *Corynebacterium diphtheriae*, *Bacillus anthracis*, *Clostridium* sp - *Clostridium perfringens* and *Clostridium tetaniMycobacterium* sp - *Mycobacterium tuberculosis* and *Mycobacterium leprae*.

UNIT III - Gram Negative bacterial pathogen and cellular parasite **No. of Hours:15**

Brief account onMorphology, pathogenesis, symptoms and laboratory diagnosis of*Neisseria gonorrhoeaeEscherichia coli*, *Klebsiella pneumoniae*, *Proteus* species, *Salmonella typhi*, *Shigella dysenteriae*, *Pseudomonas aeruginosa*, *Vibrio cholerae* and Spirochetales – *Treponema pallidum* and *Leptospira*. Obligate intra cellular parasites –*Mycoplasma pneumoniae, Chlamydia* and *Rickettsiae.*

UNIT IV - General Mycology **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 Pathogens **No. of Hours:15**

Classification of Mycoses based on infection- Brief account on pathogenesis, symptoms and laboratory diagnosis of *Tinea nigra*, 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**. 3rd edition. 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.

Web sources:

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/
6. http:// www.textbook of bacteriology.net/

SEMESTER – II	**CORE – V**
18P2AMB05	**Total Number of Hours: 75**
Credits – 5	**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: 15**

Evidences for DNA as the genetic material – Watson and Crick model – Physical and chemical properties of DNA, Types and forms of DNA – Law of DNA constancy and C value paradox –. RNA as genetic material – Structure, types and functions of RNA. Prokaryotic Genome: *E. coli* chromosome – nucleosome. Eukaryotic genome organization: Structure of chromatin, chromosome, centromere, and telomere. Genome organization in Virus and Yeast.

UNIT II - DNA replication and Repair mechanisms **No. of Hours: 15**

DNA replication – Evidence for semi-conservative replication - DNA replication mechanism, enzymology of DNA replication – bidirectional and rolling circle replication –Prokaryotic & eukaryotic DNA polymerases, Types & function - Inhibitors of DNA replication – DNA recombination – Models - Role of Rec A in homologous recombination - DNA repair mechanism – photo reactivation, excision repair, SOS repair, mismatch repair, recombination repair and glycocylase system.

UNIT III – Transcription and Translation **No. of Hours: 15**

Transcription– Structure and function of RNA polymerase. Mechanism of transcription – steps involved. Post transcriptional modifications – RNA processing: Capping, polyadenylation, splicing – Genetic code – Salient features – Wobble hypothesis. Translation – direction of protein synthesis – Ribosomes and their organization – Initiation of translation: SD sequence, initiator tRNA – Elongation of translation, translocation and termination mechanisms. Post – translational

modification. Inhibitors of transcription and translation. Gene regulation in bacteria – *lac*, *trp* and *ara* operons.

UNIT IV – Mutagenesis **No. of Hours: 15**

Mutation – Types of mutation – Mutagens - Molecular basis of mutation – Spontaneous mutations; Luria and Delbruck experiment, Newcombe experiments. Induced mutation; DNA damages – Deamination of bases, alkylation, damage due to reactive oxygen, UV induced damage. Detection and isolation of mutants, mutant selection – Beadle & Tatum experiment: detection of nutritional mutants in *Neurospora*. Carcinogenicity testing.

UNIT V – Plasmid and Gene transfer mechanisms **No. of Hours: 15**

Plasmid Biology – types and properties – compatibility, replication, control of copy number and plasmid segregation– episomes. Gene transfer in bacteria – Conjugation: Discovery, types - $F^+ \times F^-$, F', Hfr. Transformation – evidence and mechanism. Transduction – Lytic and lysogenic cycle of phage – Generalized and specialized transduction. Insertion sequences – mechanism of transposition, complex and compound transposons – T10, T5 and retroposon & 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.

Web sources:

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

SEMESTER – II	**CORE - VI**
18P2AMB06	**Total Number of Hours: 75**
Credits - 5	**5 Hours/ Week**

FOOD, INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

Course Objectives

To enable the students to

- 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 - Microbiology of food **No. of Hours: 15**

Food as a substrate for microorganisms. Intrinsic & Extrinsic factors. Important microorganisms in food (Bacteria, Mold and yeasts). Contamination of foods. General Principles of food preservation – Asepsis – removal of microorganisms – use of temperature (low & high), drying, radiation and food additives. Food Spoilage – vegetables and fruits, eggs and canned foods. Food borne diseases – Food poisoning– Bacterial, viral, Fungal and Mycotoxins.

UNIT II - Fermented food products and standards **No. of Hours: 15**

Fermented food – Bread. Oriented foods – Soy Sauce. Fermented drink – kombucha. Fermented vegetables– sauerkraut. Quality assurance - Microbiological quality standards of food. Government regulatory practices and policies. NABL, FDA, EPA, HACCP, ISI and FSSAI. Food safety, safety of dairy products, control and hazards.

UNIT III - Bioprocess technology **No. of Hours: 15**

Introduction to bioprocess - historical developments - fermentor designing, Components & types. Industrially important strains – screening, strain improvement, Inoculum development. Upstream

processing – media formulation & sterilization. Downstream processing – Recovery & purification of extracellular & intracellular products. Fermentation economics – Application of computer in fermentation technology.

Unit – IV Microbial products **No. of Hours: 15**

Microbial production technology – Antibiotics –penicillin & streptomycin, organic acids – citric acid, vitamins – B12, enzymes – amylase, alcoholic beverages - beer and wine. Single cell protein. Spirulina. Microbial transformations: steroids and alkaloids production. Vaccines – synthetic peptide vaccines & multivalent subunit vaccines. Hormones - Insulin and Somatostatin.

Unit – V Pharmaceutical Sterilization Techniques and its Standards **No. of Hours: 15**

Microbial spoilage of pharmaceutical products and their sterilization – sterile injectables – non injectables – ophthalmic preparations and implants. Quality assurance and quality management in pharmaceuticals – ISO, WHO and US certification. Sterilization control and sterility testing -heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization.

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/

SEMESTER – II	**CORE PRACTICAL –III**
18P2AMBP03	**Total Number of Hours: 45**
Credits –3	**5 Hours/ Week**

PRACTICAL - III MEDICAL BACTERIOLOGY AND MYCOLOGY

Course Objectives:

- To learn the microscopic techniques
- To gain experience with staining methods
- To be familiar with the methods of growing the bacteria
- To understand the identification methods of yeast
- To gain the basic knowledgeon cultivation of fungi

Course Outcome:

CO1	The students could understand the origin of Microbiology field, Microscopy & Staining techniques
CO2	To be aware of processing of clinical specimen
CO3	To enhance the knowledge about cultivation and identification of fungal
CO4	To comprehend the isolation and identification of yeast
CO5	The students adequate knowledge about clinical pathogens

1. Processing of clinical specimen, Isolation, Identification and Antibiogram of unknown Bacterial pathogens in specimens.

Staphylococcus spp., *Streptococcus* spp., *Bacillus* spp., *Escherichia* spp., *Klebsiella* spp., *Proteus* spp., *Salmonella* spp., *Shigella* spp., *Pseudomonas* spp.,*Vibrio* spp.,

2. Isolation and Identification of Fungal Specimens

(a) Direct Microscopy – KOH and Lacto phenol cotton blue mountpreparations

(b) Slide culture technique

3. Isolation and Identification of Yeast – Germ tube, Gram staining and Negative staining

Candida spp., *Cryptococcus* spp.

4. Cultivation and identification of fungal pathogens from clinical specimens

Dermatophytes, *Aspergillus* spp.

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**
18P2AMBP04	**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 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 resolution and visualization of DNA by Agarose gel Electrophoresis
2) Quantitative estimation of DNA by diphenylamine test.
3) Effect of UV radiations to study the survival pattern of *E. coli*/yeast.
4) Study the effect of chemical mutagens on bacterial cells.
5) Isolation of antibiotic resistant mutant by gradient plate technique.
6) Isolation of coli phage from sewage.
7) Demonstration of Bacterial Transformation, conjugation and transduction
8) Enumeration of microorganisms bacteria and fungi in food samples- vegetables and fruits.
9) Isolation of fungi from spoiled bread
10) Qualitative testing of milk by MBRT (Methylene Blue Reduction Test) & Resazurin test
11) Counting of bacteria in milk by breed count method
12) Wine production using grape juice and estimation of total acidity, volatile acidity and ethanol from wine

13) Sterility control by LAL test
14) ONPG test

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**
18P2AMBE03 **Total Number of Hours: 60**
Credits –4 **4 Hours/ Week**

DIAGNOSTIC MICROBIOLOGY

Course Objectives:

- To gain the knowledge on microbial 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	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: 12**

Microbiological samples: Sample collection, transport, processing and testing methods of – Blood, Urine, Stool, Sputum, Skin scrapings, Body fluids – CSF, Pleural, peritoneal & pericardial fluid, Bronchoalveolar lavage fluid, hydatid cyst fluid, Synovial fluid.

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

Microbial pathogenicity: Pathogenicity and virulence - Colonization, toxins, plasmids, enzymes, invasiveness and communicability. Quantitative measures of virulence – minimal lethal dose (MLD), LD50, ID50, TCID50. Virulence determinants – colonization, toxins, enzymes and invasiveness. Facultative / obligate intracellular pathogens.

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

Molecular microbial epidemiology: Biochemical and Immunological tools – biotyping, serotyping, phage typing, FAME, Curie Point PyMS,protein profiling, multilocus enzyme electrophoresis (MLEE); Molecular typing: RFLP (ribotyping, IS based), RAPD, 16S-23S IGS, ARDRA, rep (REP, ERIC, BOX)-PCR, PFGE, AFLP, MLST, MVLST, VNTR, SNP.

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

Clinical Bacteriology & Mycolgy: Laboratory diagnosis of pyogenic infection, Leprosy, Tuberculosis, URTI, LRTI, Enteric fever, Bacillary dysentery, Diarrhoeal diseases, Urinary tract infection and Meningitis. Candidiasis, Cryptococcosis, Histoplasmosis.Cryptococcal meningitis.

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

Clinical Parasitology & virology: Laboratory diagnosis of Malaria, Protozoal Amoebic dysentery, Kalazar, Hook worm infection, Ascariasis, Filariasis, Taeniasis, Enterobiasis, Hepatitis, Viral diarrhea and HIV/AIDS.

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 **ELECTIVE – II**
18P2AMBE04 **Total Number of Hours: 60**
Credits – 4 **4 Hours/ Week**

POULTRY MICROBIOLOGY

Course Objectives:

- To gain the knowledge on poultry and its products
- To improve knowledge about the growth of chickens
- To impart the knowledgeon entrepreneurship in poultry field
- To know the disease profile of chickens

Course Outcome:

CO1	The students could able to study about the poultry farm and its types
CO2	Could impart the knowledge on the nutraceutical value of poultry feeds
CO3	They could be aware of principles of disease prevention management
CO4	They gained the benefits of the students more conscious about viral disease
CO5	They could improve the entrepreneurship opportunities

UNIT I - House and Cage **No. of Hours: 12**

Types of poultry houses. Different types of rearing – advantages and disadvantages. Environmentally controlled housing. Brooding: Types of brooders; preparation of shed to receive chicks. Classification of poultry with respect to production characters, age and standards. Cage management – Different types; Advantages and disadvantages.

UNIT II - Nutrition Value of poultry product production **No. of Hours: 12**

Feeding management–Classification of nutrients – Factors influencing nutrient requirements – feed consumption, Nutrient requirements and feed formulations. Feeding systems – Feed restrictions – phase feeding– Additives, pre and probiotics - supplements. Nutritional and metabolic disorder – Rickets, Osteomalacia, Vitamin A deficiency, Vitamin E deficiency.

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

Formation of egg in fowl - Egg structure – Physical and chemical composition. Bio-security and principles of disease prevention management. Health care for common poultry diseases – vaccination. General principles of poultry medication. Poultry waste management, pollution, disposal of hatchery waste and environmental issues.

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

Newcastle disease –Ranikhet diseases– 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 V - Bacterial, fungal and protozoan diseasesNo. of Hours: 12

Salmonellosis – Avian coliform infection – Staphylococci – Avian tuberculosis – Infectious coryza – Avian streptococcal infection – Clostridia– Avian pasteruellosis, Psittacosis. Parasitic and Fungal diseases –Protozoan diseases – Coccidiosis. Internal parasites – *Ascardia galli*, Tape worms. External parasites - Fowl ticks, Lice, Mites. Fungal diseases. Aspergillosis and aflatoxicosis.

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.

Mapping

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

18P2AMBE04

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
First Semester
Applied Microbiology

POULTRY MICROBIOLOGY

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. Grower house
   a. rear egg type chick b. 18 weeks of age c. Egg type birds d. Male and female
2. Super intensive system has been considered as
   a. Management system b. Cage system c. Deep litter d. Open system
3. Allowing poultry to eat as much as they want is called
   a. Diet b. Feed intake c. Ad labium d. None of these
4. House orientation
   a. Location b. Site c. Direction d. Size
5. The overhang of the roof should not be ……feet
   a. 3.5 b. Above 4 c. Less than 3.5 d. None of this
6. N. Chicken originated from a certain places is called
   a. Breeds b. Variety c. Class d. Strain
7. Carbohydrates are the
   a. Trace elements b. Organic compounds c. Amino acids d. None of these
8. The optimum nutrient of poultry is called
   a. Diet b. Feed intake c. Consumption d. Feed system
9. The air cell must not exceed 1/8 inch in depth that is …….. type of egg
   a. Grade AA b. Grade A c. Grade B d. Grade C
10. Egg consists of …… major parts
    a. 4 b. 2 c. 3 d.1
11. It is the glycoprotein
    a. Avidin b. Ovomucin c. Lysozyme d. Ovamucoid
12. Power can be generated by following method
    a. Composting b. Rendering c. Anaeribic digestion d. A&B
13. The vaccine administered into the embryo is called……vaccination
    a. In ovo b. Intramuscular c. Ocular d. Nasal
14. Fowl pox produced
    a. Lesions b. Loss of feather c. Wart like lesions d. None of this

15. New castle disease is a type of
    a. Bronchitis b. Quail bronchitis c. Fungal disease d. Pneumoencephalitis
16. Highly pathogenic Newcastle disease is called
    a. Lentogenic b. Mesogenic c. Velogenic d. Phytogenic
17. Symptoms of infectious bronchitis

a. Temperature b. Weight loss c. Feed taking d. Cold

18. Mycotic pneumonia is caused by
    a. Mycoplasma b. Pox virus c. *Aspergillus* d. *Candida*
19. Incubation period of Lymphoid Leukosis
    a. 10 days b. 1 year c. 1 month d. 4 months
20. Necrotic enteritis is otherwise called as
    a. Clostridia b. EDS-76 c. Necrosis d. Trauma

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a.Give the account and types of poultry houses. (OR)
    b. Shortly describe the preparation of shed to receive the chicks.
22. a. Write about the food additives. (OR)
    b. Write the short notes on Phase feeding system.
23. a. Explain the physical composition of egg. (OR)
    b. Shortly describe the poultry biosecurity.
24. a. Give the short notes on the egg drop syndrome. (OR)
    b. Explain the gumboro disease.
25. a. Write about the infectious coryza. (OR)
    b. Shortly explain the avian pasterullosis.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Briefly explain about poultry rearing.
27. Briefly describe the classification of poultry nutrition.
28. Briefly explain about Vitamin A & E deficiency.
29. Give the essay notes on Marek's disease.
30. Briefly answered for poultry coccidiosis.

SEMESTER III

SEMESTER – III	**CORE – VII**
18P3AMB07	**Total Number of Hours: 75**
Credits –5	**5 Hours/ Week**

AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives

To enable the students to

- study 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. Role of microorganisms in composting and humus formation. Microbial degradation of cellulose. Distribution of bacteria, actinomycetes, fungi, algae, protozoa and virus in soil. Microbial interaction-mutualism, amensalism, commensalisms, protocooperation, predation, parasitism and competition. Biogeochemical Cycles- C, N, P, and S.

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

Plant microbial interaction – phyllosphere and rhizosphere. N_2 fixation and phosphate solubilisation (symbiotic and free living) - genetics of N_2 fixation. Actinorrhizae and Mycorrhizal associations.

Plant diseases – Blast of Rice, Angular Leaf Spot of Cotton (Black Arm of Cotton), Powdery Mildew of Cucurbits, Black or Stem Rust of Wheat, TMV.red rot of sugar cane, late blight of potato, bunchy top of banana and little leaf of brinjal. Biofertilizers types and methods of application –*Rhizobium*, *Azotobacter*, *Azospirilum* and Cyanobacteria. Biopesticides: bacterial, fungal and viral. Microbial nematicides and herbicides.

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

Composition of air – aerial environment **–** microbial propagules in air- Indoor and Outdoor flora of air. Seasonal and diurnal periodicities of airspora. Air sampling techniques: Settle under gravity, Centrifugal action, Filtration, Impingement and Electrostatic Precipitation.Settle plate method – Anderson sampler and impingers. Significance of air flora. Hazards of laboratory techniques. Airborne diseases and its control measures.

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

Microbiology of water - Indicator microorganisms - Detection of water borne pathogens – sewers swab method – membrane filter techniques – multiple tube fermentation test. DO, BOD and COD. Impact of eutrophication. Sewage - Physical, chemical and biological treatment process– Membrane technology - RO treatment – oxidation. Disinfestation and disposal of treated sewage: Irrigation, composting and land filling.

UNIT- V Microbial Remediation **No. of Hours: 15**

Biofilm formation and biocorrosion of water distribution system, Bioremediation and bioaugmentation of toxic and recalcitrant chemicals. Bioenergy - Biodiesel & biogas. Bioplastics, Biofilters and Bioscrubbers. Bioconcrete. Microbial enhanced oil recovery – Biosurfactants. Bioleaching of metals - Copper, Uranium and Gold. Bioaccumulation of heavy metals by microbes. Biodeterioration of paint, textile and leather.

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.

Mapping

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

18P3AMB07

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
Third Semester
Applied Microbiology

AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. Which of these has the smallest size of particles?
a) Sandb) Siltc) Clayd) Gravel
2. Water logging can be expected in soil which is rich in
a) sandb) clayc) siltd) humus
3. What is loss of topsoil from wind and water?
a) Eutrophication b) Soil erosion c) Desertification d) Urbanization
4. In process of photosynthesis energy from sunlight is trapped by
a) Roots b) Stomata c) Chlorophyll d) Mesophyll
5. The use of living microorganism to degrade environmental pollutants is called
a) Microremediation b) Nanoremediation c) Bioremediation d) All of these
6. The association which involves the exchange of nutrients between two species is referred as ----------
a) Mutualism b) Syntrophism c) Commensalism d) Antagonism
7. Which of the following organisms are known to grow on the surfaces of freshly exposed rocks?
a) Green algae b) Diatoms c) Cyanobacteria d) Yeast
8. Microorganisms secrete an enzyme which helps in digestion of cellulose known as
a) Cellulose b) Catalase c) Sucrose d) Pepsin
9. Cellulose is highly insoluble in water and is not digested in digestive tract of
a) Human b) birds c) Protozoa d) Insects
10. An association between two individuals or populations where both are benefitted and where neither can survive without the other is ----------
a) Competitionb) Commensalismc) Mutualismd) Protocoperation
11. *Pencillium* does not swallow the growth of bacterium Staphylococcus which relationship is called
a) Commensalismb) Predationc) Amensalismd) Mutualism
12. The process of extracting metals from ore bearing rocks is called
a) Bioextraction b) Microbial extraction c) Biofiltration d) Bioleaching
13. Mycorrhizae is associated with the following
a) Formation of root nodules b) Hyphae penetrating the soil
c) Found mostly in lower plants d) Soil erosion
14. The xanthophyte walls are typically of ------
a) Chitin b) Cellulose c) Cellulose and pectin d) Starch
15. In Chalmydomonas the most common method of sexual reproduction is

a) Isogamy b) Heterogamy c) Oogamy d) Spore formation

16. Organic farming is the technique of raising crops through uses of?
a) Manures b) Biofertilizers c) Resistant varieties d) All of these

17. *Azolla* is used as biofertilizer as it has
a) *Rhizobium* b) *Cyanobacteria* c) *Mycorrhiza* d) large quantity of humus

18. Which of the following compounds are required for growth of saprophytic bacteria and fungi?
a) Organic compounds b) Nitrates c) Phosphates d) Mercury

19. Which of the following bacterium is called as the superbug that could clean up oil spills?
a) *Bacillus subtilis* b) *Pseudomonas putida*
c) *Pseudomonas denitrificans* d) *Bacillus denitrificans*

20. Which of the following microbe is widely used in the removal of industrial wastes
a) *Trichoderma* sp b) *Aspergillus niger* c) *Pseudomonas putida* d) All of these

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Explain the Role of microorganisms in composting and humus formation **(OR)**
b) Write short note on mutualism and amensalism.

22. a)Write about the plant disease – red rot of sugar cane **(OR)**
b) Explain about the microbial herbicides.

23. a) Write a short note on indoor and outdoor flora of air **(OR)**
b) Briefly explain the significance of air flora.

24. a) Write a short note on membrane filter technique **(OR)**
b) Explain in detail about BOD and COD.

25. a) Write a short note on microbial fuel cells **(OR)**
b) Explain in detailed about super bug.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Write a detailed account on different Microbial interactions.
27. Write an essay about Mycorrhizal association.
28. Explain in detail about air sampling techniques.
29. Write an essay on sewage and effluent treatment.
30. Explain in detailed about bioleaching of metals.

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 by helminthes.

Course Outcome:

CO1	The students could understand the basic concepts in medical virology
CO2	Could gain the knowledge on arthropod and rodent borne viral infections
CO3	Could get information on viral diseases, preparation and their schedule of vaccine
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 Introduction to Medical Virology **No. of Hours: 15**

Introduction and Historical perspective of medical virology - General Properties of viruses and virus multiplication. Baltimore classification viruses. Collection, transport and processing of clinical samples for the viral infection diagnosis by serological and molecular techniques. – Methods of cultivation of viruses detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Antiviral agents, Vaccines – immunization schedule and Interferons.

UNIT - II Arthropod and rodent borne diseases **No. of Hours: 15**

Poxviridae:*Othropoxviruses – Variola, Vaccinia* and *Cowpox virus*. ***Herpesviridae***: *Human herpes viruses - type 1 to 8*. ***Adenoviridae:*** *Human adeno viruses.****Papillomaviridae***: - *Human papilloma viruses*. ***Picornaviridae:****Enterovirus - Polio virus, Coxsackie A viruses (CA)* and *Coxsackie B viruses*. ***Rhabdoviridae***: *– Lyssavirus - Rabies virus*. ***Hepatitis viruses:*** A, B, C, D and E. ***Orthomyxoviridae***: *Influenza A – Spanish flu, Asian flu, Hong Kong flu* and recent epidemic.

Picorna viruses, Rabies, Orthomyxo and Paramyxo viruses. Recent Epidemics - Ebola - Nipah, Dengue, H1N1 Influenza, Chikungunya, Zika and Marburg virus.

UNIT - III Viral Diseases and Vaccines **No. of Hours: 15**

Paramyxoviridae: *Morbillivirus – Measles*; *Orthorubulavirus – Mumps* and *Henipavirus - Nipahvirus*. ***Matonaviridae:*** *Rubivirus - Rubella virus* - German measles. ***Togoviridae****: Alphavirus – Chickungunya virus, O' nyong nyong virus*and *Ross river virus*. ***Flaviviridae****: flavivirus – Yellow fever, KFD virus, Dengue* and*Zika virus*. ***Filoviridae:****Ebola* and *Marburg virus*. ***Coronoviridae****: Betacoronavirus – SARS-CoV, MERS-CoV* and *SARS-CoV-2*. ***Retirovidae:*** *Lentivirus - Human Immunodeficiency virus*.

Pox, Adeno, Herpes, Varicella Zoster, CMV, Epstein – Barr Viruses, Hepatitis viruses, HIV Viruses, Oncogenic viruses **–** Viral vaccines - Preparation and their immunization schedule.

UNIT - IV Introduction to Medical Parasitology **No. of Hours: 15**

Introduction to medical parasitology: Host - parasite Classification and interactions, classification of medically important parasites. **Intestinal protozoans**: *Entamoeba*spp*histolytica*, *Giardia lamblia*, *Cryptosporidium parvum* and *Balantidium*sps*coli*. **Blood and tissue protozoa:***Trypanosoma sps brucei and cruzi; Leishmania*sps*donovani*, *tropica*and*braziliensis; Plasmodium*sps*falciparum*, *ovale*, *malariae*and*vivax; Trichomonas*sps*vaginalis*; Toxplasma spsgondii.

UNIT - V Helminthic infections **No. of Hours: 15**

Intestinal helminths:*Ascaris lumbricoides* (roundworm), *Taeniasolium and saginata* (Tapeworm), *Enterobius vermicularis* (Pinworm), *Trichiuris trichiuria* (whipworm), *Ancylostoma duodenale*, and *Necator americanicus* (hookworms).**Liver flukes:**Platyhelminthes *Fasciola hepatica*and*Faciolopsis buski*. **Lung fluke**: *Paragonimus westermani*. **Blood fluke:***Schistosoma haematobium*and *japonicum*. *Nemathelminthes***Microfilaria:***Wuchereriabancrofti*. Laboratory techniques in Parasitology. Concentration methods - Examination of faeces for ova and cysts. Blood smear examination for parasites. Cultivation of protozoans Parasites.

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'sText 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.

Mapping

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

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
Third Semester
Applied Microbiology

MEDICAL VIROLOGY AND PARASITOLOGY

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. Viruses range in size from ----------
a.1-100 nm b. 25-300 nm c. 10-100 µm d.400-1000 nm
2. Which of the following virus contains heamagglutin spikes?
a. Entero virus b. Influenza virus c. VZV d. None of the above
3. Which of the following virus is arthropod born virus?
a. HIV b. HSV c. Dengue d. Hepatitis
4. Virus growth in cell culture identified by ----------
a. CPE b. Light microscope c. ELISA d. Granules
5. How soon do symptoms typically appear after a person is infected with the rabies virus?
a. 48 hours b. 1 week c. 1 month d. 1 year
6. The influenza virus is mainly controlled in special "risk" sectors by:
a. Hygiene b. Vaccination c. Antiviral drugs d. Humanised monoclonal antibodies
7. Which of the following is a morphological characteristic of the paramyxoviruses?
a. Fragile viruses often visualised with RNA spewing from the inside b. Elongate viruses
c. Icosa hedral viruses with envelope d. Very large viruses
8. Lassa and Ebola are emergent viruses in W. Africa. What is their origin?
a. Humans b. Primates c. Fruit bats d. Pigs
9. What is a reactivation of chickenpox in adults?
a. Measles b. Shingles c. Warts d. Impetigo
10. The adenovirus virion has which unique structural feature?
a. Icosahedron b. Icosa hedron with slender fibres
c. 'Complex' structure not yet fully explored d. Flexuous lipid containing structure
11. The following diseases are associated with Epstein-Barr virus infection, except -------
a. Infectious mononucleosis b. *Epidermodysplasia verruciformis*
c. Nasopharyngeal carcinoma d. Oral hairy leukoplakia
12. Which is the best choice today for her immunoprophylaxis of hepatitis A?
a. A dose of hepatitis A vaccine
b. A dose of IM immunoglobulin and a dose of hepatitis A vaccine
c. A dose of IM immunoglobulin
d. First dose of hepatitis A vaccine today and a booster dose the day before she leaves
13. African sleeping sickness is caused by which of the following protozoa?
a. *Entamoeba histolytica* b. *Trypanosoma gambiense*
c. *Leishmania donovani* d. *Plasmodium vivax*

14. In malaria, the form of plasmodia that is transmitted from mosquito to human is the --------
a. Sporozoite b. Gametocyte c. Merozoite d. Hypnozoite
15. Which of the following agent is used to prevent Malaria
a. Mebendazole b. Chloroquine c. Inactivated vaccine d. Zinc table
16. A patient experiences persistent diarrhea, abdominal pain and weight loss. Which of the following is a likely diagnosis?
a. visceral leishmaniasis b. amebic encephalitis c. Chagas' disease d. None of these
17. Host of *Taenia solium*
a. Pigs b. Humans c. Both d. None
18. How does a Scistosome normally enter in to the body?
a. Through the skin b. Through drinking water c. Through the urethra d. Through the nose
19. The common name for *Ascaris lumbricoides* is ----------
a. Roundworm b. Hookworm c. Whipworm d. Threadworm
20. Difference in appearance from Necatoris that mouth has 4 teeth on front and smaller pair of teeth in back of buccal cavity --------
a. *Ancylostoma duodenale* vs Necatora mericanus b.teeth of *Ancylostoma duodenale*
c. *Necatora mericanus* adult d. dog hookworm infestation of human

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a. Give brief introduction on vaccines and its types (OR)
b. Explain interferon and its function in viral infection.
22. a. Write pathogenesis of Dengue Virus (OR)
b. Explain clinical manifestation of Chikungunya virus
23. a. Give introduction to Adeno virus and clinical features. (OR)
b. Give account on immunization schedule.
24. a. General characteristics of Parasites (OR)
b. Describe the clinical manifestation of *Plasmodium* species
25. a. Explain flotation technique (OR)

b. Explain sedimentation technique

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Explain in details on antiviral agents.
27. Give detailed account on polio virus infection.
28. Give introduction to viral vaccines, types and preparation.
29. Explain infection caused by *Giardia intestinalis.*
30. Explain pathogenesis and clinical features of *Wuchereria bancrofti.*

SEMESTER – III **CORE - IX**
18P3AMB09 **Total Number of Hours: 75**
Credits - 5 **5 Hours/ Week**

GENETIC ENGINEERING – CONCEPTS AND APPLICATIONS

Course Objectives

To enable the students to

i) acquire knowledge on DNA modifying enzymes
ii) understand the molecular biology of vectors
iii) be familiar with the cloning techniques
iv) understand the concept of transgenic technology
v) learn the applications of genetic engineering

Course Outcome:

CO1	The students familiar with molecular techniques
CO2	To be aware of Enzymology of Genetic Engineering
CO3	To improve the knowledge aboutCloning strategies
CO4	To get knowledge about advanced molecular techniques
CO5	To achieve knowledge about gene biotechnology

UNIT – I Concepts on Gene biotechnology **No. of Hours: 15**

History and Scope. 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*, T4 DNA polymerase) and reverse transcriptase.

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

Types and properties of vector. Plasmid vector: pBR^{322}, 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**

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 Transgenics and its applications **No. of Hours: 15**

Transgenic and gene knockout technologies: targeted gene replacement, gene augmentation and gene silencing. DNA sequencing: enzymatic, chemical and pyro sequencing. Mutagenesis: site directed, cassette and random mutagenesis.PCR - Types and applications. RAPD, RFLP and AFLP.

Regulation in gene biotechnology - Development of transgenic plant for disease resistant, herbicide tolerance, nutritional quality (Gold Rice). Transgenic animal for Disease resistant

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

Medicine (production of Hormone: insulin, somatostatin and somatotropin interferon and recombinant vaccines). Ethics and fate of genetically modified organisms (GMOs).Environment-(Biosensor: Structure and function. Biochips). Genetically Modified Organism: *Pseudomonas putida* (super bug).Biosafety, IPR, IPP – Biohazard, Environmental Hazard, Genetically Modified Organisms (Plant & Animals)

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. and Park, S.F., "**Molecular Genetics of Bacteria**", Fourth Edition, John Wiley & Sons Ltd., Chichester, 2004.
4. 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.
5. Dubey, R.C., "**A Text Book of Biotechnology**", S. Chand and Company, New Delhi, 2000.
6. Freifelder, D, "**Molecular Biology**", Narosa Publishing House, New Delhi, 1991.
7. Glick, B.R. and *Pasternak, J.J.,* "**Molecular Biotechnology**", A.S.M. Press, London, 2001.
8. Karp, G., "**Cell and Molecular Biology: Concepts and Experiments**", Sixth Edition, John Wiley & Sons Inc., New York, 2010.
9. Primrose, S.B. and Twyman, R.M., "**Principles of Gene Manipulation and Genomics**", Seventh Edition, Blackwell Science Publishing, Oxford, 2006.

Mapping

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

18P3AMB09

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS

-------- / ------- 2018.
First Semester
Applied Microbiology

GENETIC ENGINEERING – CONCEPTS AND APPLICATIONS

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. **Which of the following enzyme is used to synthesize DNA using an mRNA template**
a) Taq polymerase b) Alkaline phosphatase c) Reverse trascriptase d) Nuclease
2. Which of the following enzyme is used to cut the DNA molecule
a) Restriction endonuclease b) DNA ligase c) Ribonuclease H d) S1 Nuclease
3. Which of the following enzyme is used to join the DNA molecule
a) DNA ligase b) Exonuclease c) Endonuclease d) Phosphatase
4. Which of the folloeing enzymes commonly used in rDNA technology
a) Type I b) Type II c) Type III d) Type IV
5. Which is an example of a simplest vector (in terms of size)?
a) 2 micron circle b) Bacteriophage c) Plasmid d) YAC
6. Bolivar and Rodriguez constructed which vector?
a) Yip7 b) R6-5 c) pUC8 d) Pbr322
7. Which antibiotic resistance is present in pBR322?
a) Ampicillin b) Kanamycin c) Lactase d) Gentamycin
8. What is the copy number of the pUC8 plasmid vector?
a) 5-10 b) 50-100 c) 100-200 d) 500-700
9. In which stage of genetic engineering a probe is used?
a) Cleaving DNA b) Recombining DNA c) Cloning d) Screening
10. Vector and insert are mixed, ligated and packaged and introduced into the host by
a) transformation b) transduction c) infection d) transformation and infection
11.The first genomic libraries were cloned in ----------
a) Plasmid b) Bacteria c) Human d) Plants
12. A genomic library is a collection of ----------
a) Genes b) Proteins c) Vectors d) Recombinants
13. Chain-termination is a type of ----------
a) Sequencing b) Vector generation c) Antibiotic production d) Gene manipulation
14. What is the main enzyme component of Sanger sequencing?
a) Helicase b) Polymerase c) Nuclease d) Gyrase
15. If two successive PCR are carried out, it is called as ----------
a) Touch-down PCR b) Hot-start PCR c) Combined PCR d) Nested PCR
16. Polymerase used for PCR is extracted from ------

a) *Escherichia coli* b) *Homo sapiens* c) *Thermus aquaticus* d) *Saccharomyces cerevisiae*

17. Which of the following is the genetically engineered insulin?

a) Humulin b) Rumulin c) H-insulin d) R-insulin

18. The subunit vaccine for hepatitis B is created against ----

a) Surface protein b) Core protein c) Genome d) Whole virus

19. Which of the following bacterium is called superbug that clean up the spil?

a) *Bacillus subtilis* b) *Pseudomonas putida* c) *Pseudomonas denitrificans* d) *Bacillus amyloliqufaciens*

20. The human growth hormone for the first time wasgenetically isolated by?

a) Benting and best b) Ross c) Pasteur d) Goeddel

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Describe about the DNA ligase (or)
    b) Discuss about the DNA polymerase enzyme.
22. a) Write short notes on pBR322(or)
    b) Explain about the cosmid vectors.
23. a) Write short notes on cDNA library (or)
    b) Explain about the cloning stratergies.
24. a) Discuss about the RAPD (or)
    b) Give short notes on Pyrosequencing.
25. a) Write short notes on biochips (or)
    b) Discuss about the insulin production.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Briefly explain about the restriction enzymes.
27. Explain about the bacteriophage vectors
28. Discuss the Construction of genomic library.
29. Give a brief account on PCR & its types
30. Explain briefly about the applications of genetic engineering.

PRACTICAL - V AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

Course Objectives:

To enable the students to

- study the soil microbial distribution, interaction and their possible utility
- learn the mass production of Azolla and Mycorhizae
- be familiar with nitrogen fixing bacteria
- be aware of waste quality analysis
- acquire knowledge on isolation of microbes from soil samples

Course Outcome:

CO1	The students understanding the isolation of microbes from rhizosphere soil
CO2	To be aware of environmental microbiology
CO3	To enhance the knowledge about agricultural microbiology
CO4	To get knowledge on water quality analysis
CO5	To achieve knowledge aboutagricultural and environmental microbiology

1. . Isolation of bacteria, fungi and *Actinobacteria* from rhizosphere soil

2. Isolation of *Rhizobium* sp from root nodule

3. Isolation and culturing of *Azotobacter* sp

4. Isolation and culturing of *Azospirillum* sp

5. Isolation of Cyanobacteria from paddy field

6. Isolation of phosphate solubilizing bacteria from soil

7. AM Staining

8. *Azolla* sp cultivation (Demonstration)

Mass production of Azolla, mycorhizae

9. Isolation of cellulose degrading bacteria from compost

10. Water Quality Analysis: BOD, COD

11. Water analysis by MPN technique

12. Water analysis by Membrane filter technique

13. Microbial assessment of air quality using air sampler

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. Dubay, 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

Mapping

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

SEMESTER – III **CORE PRACTICAL - VI**
18P3AMBP06 **Total Number of Hours: 45**
Credits - 3 **5 Hours/ Week**

PRACTICAL - VI MEDICAL VIROLOGY, PARASITOLOGY AND GENETIC ENGINEERING

Course Objectives:

- To gain knowledge about medical microbiology
- To be aware of the cultivation of viruses
- To gain knowledge about the serological test
- To identificationofidentify theparasites
- To gain knowledge about isolation of plasmid DNA from bacteria

Course Outcome:

CO1	The students understanding the medical microbiology especially for virology
CO2	To be aware of genetic engineering techniques
CO3	To gain knowledge about cultivation of virus
CO4	The student gain more knowledge about parasites
CO5	To be aware of serological test

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:

- Sedimentation & Flotation techniques
- Saline, KOH and Iodine wet mount

4. Isolation of genomic DNA from bacterial cells and quantification by UV spectrophotometer

5. Isolation of plasmid DNA from bacterial cells and separation by agarose gel electrophoresis.

6. Melting point determination of bacterial DNA.

7. Single and Double Restriction enzyme digestion of plasmid DNA.

8. Determination of Molecular weight of proteins by SDS PAGE.

9. Bacterial transformation and blue white selection assay.

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.
3. Chaitanya KV (2013). **Cell and Molecular Biology: A Lab Manual.** Prentice Hall India Learning Pvt Ltd.
4. Vennison SJ (2010). **Laboratory Manual for Genetic Engineering**. 1st Edition, Prentice Hall India Learning Pvt Ltd.
5. Palanivelu P (2009). **Analytical Biochemistry and Separation Techniques.** 4th Edition. Twenty First Century Publications.

Mapping

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

SEMESTER – III **ELECTIVE-III**
18P3AMBE05 **Total Number of Hours: 60**
Credits - 4 **4 Hours/ Week**

GENOMICS AND PROTEOMICS

Course Objectives

To enable the students to

i) be familiar with the concepts of genomics
ii) learn the techniques of genome sequencing
iii) acquire knowledge on proteomic methods
iv) understand the principle of mass spectrometry
v) be familiar with the applications of genomics and proteomics

Course Outcome:

CO1	The students could know the basic concepts of genomics and proteomics
CO2	To gain the knowledge about molecular identification techniques
CO3	To obtain knowledge on proteomics techniques
CO4	To understand the working principle of mass spectrometry
CO5	To be proverbial with genomics and proteomics and its application

UNIT – I Genomics **No. of Hours: 12**

Basic concepts and scope of genomics. Structural features: Prokaryotic genome (*E.coli*) - eukaryotic genome (Yeast, *Drosophila,Arabidopsis thaliana* and human genome). Genome projects: *E.coli*, *A.thaliana* and *Homo sapiens*. Genome mapping: Physical mapping and cytological mapping. Genome, Genomics and Omics. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, *Homo sapiens*, etc.

UNIT – II Genome sequencing **No. of Hours: 12**

Hierarchical sequencing and whole genome shotgun sequencing. Genome annotation. Expressional analysis: Parallel analysis of gene expression- cDNA microarray, Long oligonucleotide microarray, Short oligonucleotide microarray and SAGE.

UNIT – III Proteomics **No. of Hours: 12**

Basic conceptsIntroductionand scope of proteomics. Types of proteomics. Techniques involved proteomics study-Protein separation: Single dimensional and two dimensional gel electrophoresis - Detection of protein spots in gel: Organic dye staining, silver staining and fluorescent staining and image analysis. Protein arrays: Definition, applications, diagnostics and expression profiling.

UNIT – IV Proteomic tools **No. of Hours: 12**

Gel spot visualization and picking. Tryptic digestion of protein and peptide fingerprinting. Mass spectrometry: Ion source (MALDI) - analyzer (ToF) and detector. Genetic mapping- DNA markers - RFLPs, SSLPs and SNPs

UNIT – V Application of genomics and Proteomics **No. of Hours: 12**

Embryogenomics - Cancer genomics –Pharmacogenomics - Metabolomics. Personalised medicine. Computational approaches to Phenomics. Phylogenomics.Applicationsof proteome analysis: Protein-

protein interaction (Two hybrid interaction screening) - Protein engineering - Protein chips and functional proteomics.

Reference Books

1. Brown, T.A., "**Gene cloning and DNA analysis: An Introduction**" Sixth Edition, Wiley-Blackwell Publishing Ltd., London, 2010.
2. Gibson, G. and Muse, S.V., "**A primer of Genome Science**", Second Edition, Sinauer Associates Inc., Massachusetts, 2004.
3. Hoffman, E.D. and Stroobant, V., "**Mass Spectrometry-Principles and applications**", Third Edition, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, 2007.
4. Liebler, D.C. and Yates, J.R., "**Introduction to Proteomics-Tools for the New Biology**", Humana Press, Totowa, 2002.
5. Mishra, N.C., "**Introduction to Proteomics: Principles and Applications**", First Edition, John Wiley & Sons, Inc. New Jersey, 2011.
6. Primrose, S.B. and Twyman, R.M., "**Principle of Gene Manipulation and Genomics**", Seventh Edition, Black Well Publishing Company, Oxford. 2012.
7. Rehm, H., "**Protein Biochemistry and Proteomics**", First Edition, Elsevier Academic Press., Burlington, 2006.
8. Starkey, M. and Elaswarapu, R., "**Genomics: Essential Methods**" John Wiley & Sons, Ltd. West Sussex. 2011.
9. Veenstra, T.D. and Yates, J.R., "**Proteomics for biological Discovery**", First Edition, A John Wiley & Sons, Inc. New Jersey, 2006.
10. Westermeier, R. and Naven, T., "**Proteomics in Practice: A laboratory Manual of Proteome Analysis**". Wiley-VCH, Darmstadt, 2002.

Mapping

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

18P3AMBE05

(For the candidates admitted from 2018 - 19 onwards)

M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
Third Semester
Applied Microbiology

GENOMICS AND PROTEOMICS

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. The effects of protein on an entire organism is described in ----------
a) Phenotypic function b) Cellular function c) Molecular function d) Structural genomics
2. Sequencing of genomic DNA is included in --------
a) Phenotypic function b) Cellular function c) Molecular function d) Structural genomics
3. Genes of same species, similarly related to each other are -------
a) Ortholog b) Synteny c) Paralog d) Microarray
4. The precise biochemical activity of a protein is described in
a) Phenotypic function b) Cellular function c) Molecular function d) Structural genomics
5. International Human Genome project was initiated by
a) National Institute of Health (NIH) b) Celera genomics
c) US Department of Energy (DoE) d) NOH and US DoE
6. Genomics introduced
a) Thomas Roder b) craig venter c) Thomas cech d) None of these
7. One of the following is not a gene expression database?
a) fly view b) GenBank c) Body map d) None of these
8. Which DNA is restricted to making a genomic library?
a) Genomic b) Plasmid c) Phage d) Plant
9. Gene mapping provides useful information about chance of ----------
a) inheritance of disorders b) inheritance of genes
c) inheritance of recessive gene d) inheritance of dominant gene
10. Methods used to identify locus of gene and distances between genes are called as -------
a) gene localization b) gene linkage c) gene pooled d) gene mapping
11. How many potential open reading frames are present in a DNA sequence?
a) One b) Three c) Six d) More than Six
12. Secondary structure of RNA molecules -----
a) depends on complementary base pairing
b) is generated by covalent bonding between sections of the RNA molecule
c) can be described as interactions between portions of the backbone of the molecule
d) does not have an impact on function of the molecule

13. Structure of 'mitochondrial' DNA, considered as ---------
a) Linear b) Double helix c) Ladder like d) Circular
14. Study of functions and structure of genome is called:
a) Genetics b) Genomics c) Hereditary d) Inheritance

15. Which of the following are known as helix breakers?
a) Proline and glycine b) Isoleucine and leucine c) Valine d) Threonine
16. Unfolding of a protein can be termed as ----------
a) Renaturation b) Denaturation c) Oxidation d) Reduction
17. What are the following is not a factor responsible for denaturation of proteins?
a) pH change b) Organic solvents c) Heat d) Charge
18. The first protein sequenced by Fredderick Sanger ----------
a) Haemoglobin b) myoglobin c) insulin d) mysoin
19. Which of these amino acids are not optically active?
a) Cysteine b) Lysine c) Arginine d) Glycine
20. How is the secondary structure of a protein stabilized?
a) Van der wall forces b) Hydrogen bonding c) Covalent bond d) Hydrophobic bond

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Explain the prokaryotic genome **(OR)**
    b) Write short note on genomic mapping.
22. a)Write about the genome annotation **(OR)**
    b) Explain about the cDNA microarray.
23. a) Write a short note on application of protein arrays **(OR)**
    b) Briefly explain the organic dye staining.
24. a) Write a short note on mass spectrometry **(OR)**
    b) Explain in detail about ToF.
25. a) Write a short note on application of genomics and proteomics **(OR)**

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Write a detailed account on genome project.
27. Write an essay about parallel analysis of gene expression.
28. Explain in detail about protein separation methods.
29. Write an essay on proteomic tools.
30. Explain in detailed about embryogenomics.

SEMESTER – III	**ELECTIVE -III**
18P3AMBE06	**Total Number of Hours: 60**
Credits - 4	**4 Hours/ Week**

MICROBIAL FUEL CELL TECHNOLOGY AND NANOTECHNOLOGY

Course Objectives

To enable the students to

i. acquire the knowledge on nanotechnology
ii. learn the methods of nanoparticle synthesis
iii. study the applications of nanotechnology
iv. know the microbial fuel cell technology and its types
v. 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	Tounderstandunderstating the mechanism of microbial fuel cell technology

UNIT – I

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

Flow control in microbial fuel cell technology. Biochemical and electrochemical perspectives of the anode of a microbial fuel cell- Catabolic pathways involved in energy production from microbes and electron transfer mechanisms. Factors that affect performance of microbial fuel cells and potential remedies. Applications- power generation, biosensor and water treatment.

UNIT – II

Flow control in microbial fuel cell technology. Biochemical and electrochemical perspectives of the anode of a microbial fuel cell- Catabolic pathways involved in energy production from microbes and electron transfer mechanisms. Factors that affect performance of microbial fuel cells and potential remedies. Applications- power generation, biosensor and water treatment.

UNIT – III

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

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

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

References:

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.

Mapping

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

18P3AMBE06

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
Third Semester
Applied Microbiology

MICROBIAL FUEL CELL AND NANOTECHNOLOGY

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. A fuel cell is used to convert chemical energy into ---------
a) Mechanical energy b) Solar energy c) Electrical energy d) Potential energy
2. Select the incorrect statement from the following option.
a) Fuel cells have high efficiency
b) The noise levels of fuel cells are high
c) The emission levels of fuel cells are far below the permissible limits
d) Fuel cells are modular
3. _____ and suitable catalyst are required to promote high rate of electrode processes.
a) Lower temperature b) Higher temperature c) Moderate temperature d) Very low temperature
4. Fuel cells are free from vibrations, heat transfer and thermal pollution.
a) True b) False
5. A stable interface between solid _____ liquid _____ and gaseous _____ promotes high rate of electrode processes.
a) Fuel, electrolyte, electrode b) Electrode, fuel, electrolyte
c) Electrode, electrolyte, fuel d) Fuel, electrode, electrolyte
6. Which of the following is not an example of a fuel cell?
a) Hydrogen-oxygen cell b) Methyl-oxygen-alcohol cell
c) Propane-oxygen cell d) Hexanone-oxygen cell
7. The electrolytic solution used in a hydrogen-oxygen fuel cell is
a) 75% KOH solution b) 25% KOH solution c) 75% NaOH solution d) 25% NaOH solution
8. The standard emf of the hydrogen-oxygen fuel cell is
a) 1.23 V b) 2.54 V c) 3.96 V d) 0.58 V
9. The residual product discharged by the hydrogen-oxygen cell is
a) Hydrogen peroxide b) Alcohol c) Water d) Potassium permanganate
10. Hydrogen-oxygen fuel cell can produce drinking water of potable quality.
a) True b) False
11. In standard hydrogen electrode, concentration of hydrogen is_____
a) 0M b) 0.5M c) 1M d) 1.5M

12. The temperature maintained in the standard hydrogen electrode is _____
a) 22°C b) 23°C c) 24°C d) 25°C
13. The emf of the standard hydrogen electrode is _____
a) 0V b) 1V c) 2V d) 3V
14. Which of the following is the correct equation?
a) $E = E^o [(2.303RT)/nF] \log_{10} [H^+]$ b) $E = E^o + [(2.303RT)/nF] \log_{10} [H^+]$
c) $E = E^o - [(2.303RT)/nF] \log_{10} [H^+]$ d) $E = E^o / [(2.303RT)/nF] \log_{10} [H^+]$
15. If the standard hydrogen electrode is used as the reduction electrode, then the emf is given by_____
a) $E_{red} = -E^o + (5/n) \log_{10} [H^+]$ b) $E_{red} = -E^o - (0.0591/n) \log_{10} [H^+]$
c) $E_{red} = E^o + (0.0591/n) \log_{10} [H^+]$ d) $E_{red} = -E^o + (0.0591/n) \log_{10} [H^+]$
16. In standard calomel electrode, for saturated KCL solution, electrode potential is_____
a) 0.897V b) 0.456V c) 0.3512V d) 0.2415V
17. For 1N KCL standard reduction potential in the calomel electrode is_____
a) 0.28V b) 0.25V c) 0.5V d) 1V
18. The calomel electrode is only used as_____
a) Oxidising electrode b) Reducing electrode c) Depends on the half cell d) Cannot be said
19. _____is the device used to measure the emf of the cell.
a) Voltmeter b) Potentiometer c) Ammeter d) Multimeter
20. The emf of the Weston standard cell is _____ at 20°C.
a) 16.7989V b) 5.2572V c) 1.0183V d) 0V

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Write a short note on Microbial fuel cell (Or)
    b) Write the type Microbial fuel cell.
22. a) Application power generation and biosensor (Or)
    b) Briefly narrate the history of Nanotechnology.
23. a) Write a short note on energy production microbes (Or)
    b) Discuss about scope of Nanotechnology.
24. a) Explain TEM sample preparation methods (Or)
    b) Factor affecting microbial fuel cell performance.
25. a) Explain application microbial fuel technology in power generation (Or)
    b) Nanotechnology in Agriculture.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Explain in detail the types of Microbial Fuel Cell.
27. Explain the catabolic pathway involved in energy production from microbes.
28. What is difference between TEM and SEM? How can one make the sample SEM for solid and liquid sample?
29. Discuss and detail Nano drug delivery.
30. Write different method of nano particle synthesis. Give a suitable example.

SEMESTER IV

SEMESTER – IV	**CORE - X**
18P3AMB010	**Total Number of Hours: 75**
Credits - 5	**5 Hours/ Week**

RESEARCH METHODOLOGY AND BIOSTATISTICS

Course Objectives

To enable the students to

i) understand the about basics in research

ii) understand the mechanism Advanced techniques in microbiology

iii) acquire the knowledge about separation techniques

iv) learn the methods of basic statistics

v) provide them knowledge in big data analysis

Course Outcome:

CO1	The students gain knowledge on research methodology
CO2	To be aware of advanced techniques in microbiology
CO3	The studentsToobtain the knowledge on separation techniques
CO4	To enhance knowledge about biostatistics
CO5	To provide them knowledge on data analysis

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

Introduction – importance - identification of research areas. Review of Literature- Research design and experimentation-Preparation of research report - Hypothecation of research. Guidelines for preparing an article -ISSN, ISBN impact factor, citation index, h-index, I-index, Google scholar, Scopus.

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

Microscopy – TEM, SEM, AFM, Electrophoresis, PCR, RAPD, RFLP and AFLP. Immuno-assays: SRID, ELISA, RIA, Western Blotting, Immunofluroscens and their application. Histochemical studies.Thesis writing

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

Analytical Techniques-Centrifugation. Chromatography techniques - Column, Gas and High Pressure Liquid Chromatograpy, Spectrophotometer techniques - NMR, Atomic Adsorption and Mass Spectroscopy. GM counter and Scintillation Counter and X-ray diffraction. Fluorimetry. Radio isotope techniques.

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

Basic definitions and applications. Measures of central tendency: Mean, Median, Mode. Representative sample, sample size, sampling bias and sampling techniques. Data collection and presentation: Types of data, methods of collection of primary and secondary data, methods of data presentation.

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

Tests of significance: Small sample test (Chi-square t test, F test), large sample test (Z test) and standard error. Frequency distributions, Probability curve, Measures of central tendency, Variability, z-scores, Correlation-regression, Student's t-test, Chi square test, F-test, ANOVA, one and two way classification. Statistical tools –SPSS, CCD with RSM. Computers in biological research-methods of data presentation, graphical representation by histogram, polygon, ogive curves and pie diagram.

Reference Books

1. Gurumnani, N., (2006). **Research methodology for biological sciences** (1st Edition). MJP Pubsihers. A unit of Tamilnadu Book House, Chennai.
2. Bajpai, S. (Ed.), (2006). **Biological instrumentation and methodology**. Chand & Company Ltd., New Delhi,
3. Jeffrey A. W. and L. S.Myra, (2002). **Statistics for the Life Sciences** (3rd Edition). Prentice Hall.
4. **Essentials of Immunology by Riott** I .M. 1998. ELBS, Blackwell Scientific Publishers, London.
5. Glick, B.R. and J.J.Pasternack, (1998). **Molecular Biotechnology** (2nd Edition). ASM Press, Washington, DC.
6. Webster, J.G., (2004). **Bioinstrumentation**. Student Edition. John Wiley and Sons, Ltd.
7. Glantz, S.A., (2001). **Primer of Biostatistics**. McGraw-Hill.
8. Rosner, B., (1999). **Fundamentals of Biostatistics**. Duxbury Press.
9. Motulsky, H., (1995) **Intuitive Biostatistics**. Oxford University Press.

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http://www.math.yorku.ca/scs/statResource.html# General
http://www.jegsworks.com/Lessons/index.html
http://www.bettycjung.net/statsites.html
http://www.biostat.harvard.edu/links/
http://www.ped.mod.utah.edu/genpedscrr/Epibio.html.

Mapping

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

18P3AMB010

(For the candidates admitted from 2018 - 19 onwards)

M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
First Semester
Applied Microbiology

RESEARCH METHODOLOGY AND BIOSTATICS

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. The main concept behind doing research is to
a. study and explore knowledge b. start with a predefined and clear-cut objectives
c. get new ideas d. define clear objectives.
2. For any study should question the validity and reliability of
a. the sample procedure b. the questionnaire c. the interviewing process d. all the above
3. Which of the following is used in electron microscope?
a. electron beams b. magnetic fields c. light waves d. electron beams and magnetic fields
4. Which of the following is a mismatch?
a. Polymerase – Taq polymerase b. Template – double stranded DNA
c. Primer – oligonucleotide d. Synthesis – 5' to 3' direction
5. Polymerase used for PCR is extracted from _____
a. *Escherichia coli* *b. Homo sapiens* *c. Thermus aquaticus* *d. Saccharomyces cerevisiae*
6. Polymorphism in RAPD is observed because _____
a. DNA used is from different chromosomes of same species
b. DNA used is from same chromosomes of same species
c. DNA used is from different chromosomes of different species
d. DNA used is from complementary chromosomes of same species
7. The inheritance pattern of RAPD is _____
A) Dominant B) Recessive C) Codominant D) Random
8. The direct ELISA test requires
A) known antigen B)complement C) patient antibody D)known antibody
9. At what speed do you centrifuge blood?
A) 2200-2500 RPM B) 3000-3200 RPM C) 1000-1500 RPM D) 4000 RPM
10.Which of the following is not a type of centrifugation?
A) Hydro cyclone B) Tubular centrifuge C) Microfiltration D) Disk stack
11. Which of the following is used in uranium enrichment?
A) Tubular centrifuge B) Disk-stack centrifuge C) Gas centrifuge D) Zippe-type centrifuge
12. Chromatography is used to separate
A) Solution B) mixtures C) molecules D) atoms
13. Mean, Median and Mode are ------
A) Measures of deviation B) Ways of sampling

C) Measures of control tendency D) None of the above
14. A common test in research demands much priority on
A) Reliability B) Useability C) Objectivity D) All of the above
15.In the process of conducting research 'Formulation of Hypothesis" is followed by
A) Statement of Objectives B) Analysis of Data
C) Selection of Research Tools D) Collection of Data
16. How is stochastic equation of information solved?
A) By statistical rules B) By dynamic rules
C) By statistical and dynamic rules D) None of these
17."Controlled Group" is a term used in..... .
A) Survey research B) Historical research C) Experimental research D) Descriptive research
18. Which of the following is not a "Graphic representation"?
A) Pie Chart B) Bar Chart C) Table D) Histogram
19. A set of rules that govern overall data communications system is popularly known as.....
A) Protocol B) Agreement C) Pact D) Memorandum
20. Questionnaire is a -------
A) Research method B) Measurement technique
C) Tool for data collection D) Data analysis technique

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Write a short note on identification of research areas? OR
    b) Write a short note on histogram and pie diagram?
22. a) Write a short note on electrophoresis? OR
    b) Write a short note on RAPD?
23. a) Write a short note on flurimetriy? OR
    b) Write a short note on NMR?
24. a) Write a short note on Types of data? OR
    b) Write a short note on methods of data presentation?
25. a) Write a short note on Chi square T test and F test? OR
    b) Write a short note on Anova?

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Explain about the guidelines for preparing articles?
27. Detailed account on SEM, TEM and AFM?
28. Explain in detail about HPLC?
29. Detailed account on Mean, Median and Mode?
30. Detailed account on SPSS and RSM?

SEMESTER – IV **ELECTIVE - IV**
18P4AMBE07 **Total Number of Hours: 60**
Credits - 4 **4 Hours/ Week**

BIOETHICS, BIOSAFETY AND IPR

Course Objectives:

The students will able to

i) gain awareness about Intellectual Property Rights (IPRs) to protect their ideas

ii) devise business strategies by taking account of IPRs

iii) to assists in technology upgradation and enhancing competitiveness.

iv) acquire adequate knowledge in the use of genetically modified organisms and its effect on human health

v) gain more insights into the regulatory affairs.

Course Outcome:

CO1	The students gain knowledge on Intellectual Property Rights
CO2	To gain awareness about biosafety
CO3	To be aware of Regulation of national and international guidelines of Biosafety
CO4	To gain knowledge on bioethics
CO5	To students gain knowledge about bioethics and biosafety

Unit – I: Biosafety

Biosafety – Introduction. Different levels of biosafety. Guidelines for Recombinant DNA Research Activities in Microorganisms. Good Laboratory Practices (GLP). Containments – Types. Basic Laboratory and Maximum Containment microbiology Laboratory research.

Unit – II: Bioethics

Bioethics - Definition – Principles of Bio ethics – General Issues Related to Environmental release of Genetically Modified Microorganisms. Ethical Issues Related to the use of Animal as Models for Microbial Diseases - Animal ethics Norms in India - Licensing of Animal House - 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

Introduction to Intellectual Property - IPR - Definition - Types of IPR: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical

Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

Unit – IV: Agreements and treaties

Agreements and Treaties - History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & Recent Amendments.

Unit – V: Types and Applications of Patents

Basics of Patents and Concept of Prior Art IPR & edits. Introduction to Patents; Types of Patent Applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and Complete; Process of Patenting, Indian and International Agencies Involved in IPR & Patenting, Global Scenario of Patents and India's Position, Patenting of biological material, GLP, GMP.

Text books

1. Mike Martin and Roland Schinzinger, "**Ethics in Engineering**", McGraw-Hill, New York 1996.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, " **Engineering Ethics**", Prentice Hall of India, New Delhi, 2004.

Reference books

1. Sasson A, **Biotechnologies and Development**, UNESCO Publications, 1988.

2. Sasson A. **Biotechnologies in developing countries present and future**, UNESCO publishers, 1993. 7. John R Boatright, "**Ethics and the Conduct of Business**", Pearson Education, New

3. Edmund G Seebauer and Robert L Barry, "**Fundamentals of Ethics for Scientists and Engineers**", Oxford University Press, Oxford, 2001.

4. Singh K. "**Intellectual Property Rights on Biotechnology**", BCIL, New Delhi.

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. Narayan, P., Patent Law, Eastern Law House (1975).

2. Jonathan, Y.R., Anthology of Biosafety (Vols. 1-4), American Biological Safety Association (2005).
3. Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons Inc. (2005).

Books Recommended:

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.ISBN-1555811804,9781555811808.

2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219 3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.

4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,

5. Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997) ISBN:0195905024.

6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed) ISBN-10 3527304320.

7. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.

8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.

9. B.D. Singh. Biotechnology expanding horizons.

10. H.K.Das. Text book of biotechnology 3rd edition.

Mapping

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

18P4AMBE07

(For the candidates admitted from 2018 - 19 onwards)

M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
Fourth Semester
Applied Microbiology

BIOETHICS, BIOSAFETY AND IPR

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. What agency provides guidance on laboratory design for increasing Biosafety levels?
a. IATA – Dangerous Goods Regulations b. DOT – 49CFR
c. CDC/NIH – BMBL d. WHO
2. What agency regulates the transport of all hazardous materials within the United States?
a. IATA b. DOT c. CDC d. NIH
3. The JSC Biosafety Review Board (BRB) reviews ground-based research, payloads, and flight operations for Biosafety concerns.
a. True b. False
4. How often does the JSC biosafety inspection of laboratories occur?
a. 3 months b. 6 months c. Once a year d. Every 2 years
5. Genetically modified materials – recombinant DNA must be approved for use by the BRB using which form?
a. JSC 713 b. JSC 1161 c. JSC 644 b. Approval is not required
6. Risk of exposure can vary with the amount of infectious material used, therefore, CDC/NIH BMBL
a. Recommends different procedures be used based on amounts/manipulation being performed
b. Recommends that you always use the highest Biosafety level
c. Recommends you contact the WHO for further information
d. None of the above
7. It is recommended by the CDC/NIH that Biosafety Level 2 laboratories have -
a. Physical Containment equipment (Biosafety Cabinet)
b. Limited access, unidirectional airflow, and physical containment equipment (Biosafety cabinet)
c. A and B, plus respiratory protection
d. None of these are recommended for BSL-2
8. When should you wash your hands?
a. After removing gloves b. After a spill c. Before leaving the laboratory d. All of the above
9. To aid in Biosecurity, an inventory of all microorganisms in-use at JSC is maintained by the BRB.
a. True b. False
10. Eye protection should always be worn when there is a chance for aerosol production?

a. True b. False

11. Biosafety cabinets are among the most effective and most commonly used _____ containment devices when working with infectious agents

a. Primary b. Secondary c. Tertiary d. Quaternary

12. The HEPA filters in a BSC filter particulates to size_____and are_____efficient.

a. 0.01µm, 85% b. 0.3µm, 99.97% c. 0.1µm, 95.9% d. 3.0µm, 90%

13. What % of air is re-circulated in a Class II B1 Biosafety Cabinet?

a. 70 b. 30 c. 100 d. 50

14. When working in a Biosafety cabinet, what area of the cabinet should samples be placed in for the best protection?

a. Back b. Middle c. Front d. Sides

15. A clean bench protects the samples only, not the laboratory worker.

a. True b. False

16. If it is not moved or repaired, how often are BSC re-certified in JSC labs?

a. 3 months b. 6 months c. Every year d. Every 2 years

17. Gloves, broken glass and absorbent materials from a spill should be placed in the appropriate biomedical waste container.

a. True b. False

18. Biohazard waste containers should be open_____.

a. At all times b. Only when actively adding waste to them

c. When they are placed outside for storage d. None of these

19. Close-calls, mishaps and illnesses with fever should all be reported to your supervisor when working with Blood borne pathogens and infectious agents.

a. True b. False

20. Biosafety training at JSC is required every two years.

a. True b. False

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a. Write short notes on safety, responsibility and rights (OR)
    b. Social and ethical issue in Biotechnology.
22. a. Write short notes on WTO (or)
    b. Write to safety procedure in laboratory.
23. a. Explain the farmer rights (or)
    b. Write short notes on Intellectual property rights
24. a. Write detailed note on Copyrights and its scope (OR)
    b. Write a short note on Geographical indications and their objectives
25. a. Write a short note on Non -patentable inventions in India (OR)
    b. Scope for protection of new plant varieties in India.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Why biosafety is an important issue in transgenic research? Explain various biosafety guidelines at national level for research involving DNA molecules.
27. Write detailed note on following: a. Ethical issues in biotechnology research.
b. Socioeconomic impact of biotechnology products.
28. What do you mean by IPRs? Describe different types of IPRs available under various legislations in India for protection of intellectual property.
29. Define term 'patent'. Describe the criteria for grant of patents related to biotechnology inventions in India.
30. Write a detailed note on minimum standards laid down under TRIPs agreement for different types of IP Protection.

SEMESTER –IV **ELECTIVE - IV**
18P4AMBE08 **Total Number of Hours: 60**
Credits - 4 **4 Hours/ Week**

ENTREPRENEURSHIP IN MICROBIOLOGY

Course Objectives

To enable the students to

i) understand the fundamental concepts of entrepreneurship

ii) comprehend the procedure in starting an entrepreneurial career

iii) keep abreast of the institutional support in the field of entrepreneurship

iv) know the role of microbes in environmental management

v) 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 ProjectGeneration 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 Entrepreneural 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. Study material prepared by the Department of Microbiology.

Reference Books

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. Gordon, E. and K. Natarajan, 2009, "**Enterpreneur Development**", Third Edition, Himalaya Publishing House, Mumbai.
4. Gupta, C.B. and N.P. Srinivasan, 2003, "**Entrepreneurial Development**", Reprint, Sultan Chand and Sons, New Delhi.
5. Hisrich, D.R., 2008, "**Entrepreneurship**", Sixth Edition, Tata McGraw Hill Private Limited, New Delhi.
6. Mohanty, S.K., 2005, "**Fundamentals of Entrepreneurship**", Sixth Edition, Prentice Hall India Private Limited, New Delhi.
7. Nagendra, S., 2008, "**Entrepreneurship and Management**", Sanguine technical Publishers, New Delhi.
8. Naidu, V.V.R., 2008, "**Management and Entrepreneurship**", I.K. International Pvt. Ltd,New Delhi.
9. Saxena, S., 2015, "**Applied Microbiology**", Springer, New York.

Web Sources

1. www.ucc.ie/en/ProspectiveStudents/Admissions/programmes/DocumentFile, 41238, en.pdf
2. www.orgs.tigweb.org/33065
3. www.womensjoblist.com/resumes/18143-Microbiologist.html
4. www.entretechforum.org/mm_May19_2009.htm
5. www.linkedin.com/pub/dir/george/hlass.

Mapping

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

18P4AMBE08

(For the candidates admitted from 2018 - 19 onwards)
M.Sc., DEGREE EXAMINATIONS
-------- / ------- 2018.
First Semester
Applied Microbiology

ENTREPRENEURSHIP IN MICROBIOLOGY

Time: Three hours **Maximum Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **ALL** the Questions

All questions carry equal marks

1. Why should an entrepreneur do a feasibility study for starting a new venture?
a) To identify possible sources of funds b) To see if there are possible barriers to success
c) To estimate the expected sales d) To explore potential customers
2. A women entrepreneur is supposed to have a minimum financial interest in share capital of entrepreneur's enterprise
a) 35 per cent b) 51 per cent c) 25 per cent d) None of the above
3. The ways entrepreneurial makes decision
a) Entrepreneurial domain b) Reverse brain storming
c) Heuristics d) None of the two mentioned
4. International entrepreneurship is
a) Licensing b) Exporting c) Both A and B d) None of the two mentioned
5. Members of distribution channels are excellent sources for new ideas because
a) They are familiar with the needs of the market b) They earn a handsome profit from new business
c) They do not bother if entrepreneur bears a loss d) They have well-developed sales force
6. Sales promotions are thought to make consumer purchase decisions
a) More satisfying b) Simpler c) Less satisfying d) More complex
7. The main reason why organizations use exhibitions is to
a) Create publicity opportunities b) Have a competitive presence
c) Make sales d) Develop relationships
8. How many feasibility studies are conducted in requirement analysis?
a) Two b) Three c) Four d) None of the mentioned
9.Small Industry Development Organization (SIDO) was established in the year of
a) 1954 b) 1967 c) 1964 d) 1974
10. Which one of the following Central Government Policy is to provide handholding support and assistance to the potential first generation entrepreneurs?
a) Rajiv Gandhi Udyami Mitra Yojana (RGUMY)
b) Micro and Small Enterprises- Cluster Development Programme (MSE-CDP)
c) Assistance to States for Developing Export Infrastructure and Other Allied Activities (ASIDE)
d) Scheme for Technology Upgradation Fund
11. Which one of the following is signed MOU with the Ministry of Micro, Small and Medium Enterprises (MSME) in India for operating a programme to encourage and assist women entrepreneurs
a) The Oriental Bank of Commerce b) Dena Bank

c) Punjab and Sind Bank of India d) Saraswat Cooperative Bank

12. Which one of the following scheme is provided by AXIS bank
a)Priyadarshini Yojana b) Mahila Vikas Nidhi Scheme c) Smart Privilege d)Udyagini Scheme
13.Which of the following SWOT elements are internal factors for a business?
a) Strengths and Weaknesses b) Opportunities and Threats
c) Strengths and Opportunities d) Weaknesses and Threats
14. Mesophiles are group of bacteria that grow within the temperature range of
a) 0-20 degree Celsius b) 25-40 degree Celsius
c) 45-60 degree Celsius d) more than 60 degree Celsius
15. What is the optimum pH for the growth of most of the microbes in composting pile
a) 5-9 b) 6.5-7.5 c) 2-3.5 d) 9-9.5
16. Vermicompost is biofertilizer which is rich in
(a) Phosphorus (b) Calcium (c) Nitrogen (d) All of the above
17. The colour of the body in earthworm is brown due to the presence of
a) blood b) haemoglobin c) haemocyanine d) prophyrin
18. Which one of the following C:N ratio is leads to under utilization of N and the excess may be released into atmosphere as ammonia
a) Greater than 40:1 b) Less than 20:1 c) 20:20 d) None of the above
19. Isolation of genomic DNA follows the same principles as that of obtaining plasmid from E. coli. Which of the following is not included in it?
a) Cell lysis b) Removal of proteins
c) Removal of chromosomal DNA d) Dissolving plasmid in water
20. Cell lysis is carried out by which substance?
a) Lysozyme and detergents b) Water c) Sugar solution d) Suphuric Acid

PART - B (5 × 5 = 25 Marks)

Answer **ALL** the Questions

All questions carry equal marks

21. a) Write about type of entrepreneur (OR)
b) Write short notes on characteristics of entrepreneurship.
22. a) Elaborate on methods of project identification and selection (OR)
b) Give a brief account on project formulation.
23. a) Explain the Government initiatives (OR)
b) Detail about the nationalized banks
24. a) Write about Skills of entrepreneur (OR)
b) Explain about marketing methods
25. a) How can you assess the quality of clinical laboratory? (OR)
b) Write a short note on Spirulina cultivation.

PART - C (3 × 10 = 30 Marks)

Answer **ANY THREE** the Questions

All questions carry equal marks

26. Explain the role of entrepreneurship in economic development
27. Give a detailed note on feasibility analysis.

28. Write in detail the government initiatives to support bioentrepreneurs.
29. Write in detail the negotiation skills and SWOT analysis.

30. Give a detailed account on Plasmid DNA isolation and Widal test kit production.

SEMESTER – IV	**Extra Disciplinary Course – I**
18P4AMBED01	**Total Number of Hours: 30**
Credits - 2	**2 Hours/ Week**

MEDICAL LABORATORY TECHNIQUES

OBJECTIVES

To enable the students to

i. understand the fundamental concepts of laboratory
ii. comprehend the procedure inoculation and preservation methods
iii. To study the blood composition and grouping
iv. To gain knowledge on clinical specimens
v. learn the antibody - antigen reactions

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

Basic lab principles and procedures in lab accidents - 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 - lab methods of diagnosing fungal infections - microscopy- KOH and LCB mount.

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

Introduction - Blood composition and component preparation - Anticoagulant - complete blood count - ABO & Rh blood group system - Blood grouping - Rh type compatability - Transfusion reaction.

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

Clinical specimens - Urine, Blood, feaces, CSF - Concentration techniques in stool - examination of blood and malaria - identification of bacteria by biochemical test.

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

Antigen-Antibody reactions - diagnosis of infectious diseases- precipitation, agglutination, immunofluroscence - Immunoelectrophoresis - RIA, ELISA, HAT - 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. Sood R (2006). **Textbook of Medical Laboratory Technology**, Jaypee Brothers Publishers, New Delhi.

4. 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.
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