Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Microbiology

Name of the Course: M.Sc. I (Sem.– I & II)

(Syllabus to be implemented from w.e.f. June 2020)

M.Sc. MICROBIOLOGY SYLLABUS (NEW CBCS PATTERN)

(w.e.f. June, 2020)

Preamble

It is imperative that younger generation, especially the students enrolled at higher education are equipped with knowledge, skills, mindsets and behaviors which may enable them to perform their duties in a manner so that they become important contributors to the development of the society. This will also help them to fully utilize their educational training for earning a decent living so that the overall standard of their families and surroundings improve leading to development of welfare human societies. In the face of the developing knowledge society, students are aware of the resources of self-development using on-line learning and this is going to be the major component of learning in the future. In the face of this need, the educational curricula, teaching learning processes, training, assessment methods, etc. all need to be improved or even re-invented. The higher educational institutions (HEI) all over the globe are in the grip of this urgent task and India needs to keep pace with all these developments.

Microbiology is the study of all forms and state of microorganisms or microbes such as bacteria, viruses, fungi, algae, cyanobacteria, protozoa and prions found in the universe. The important and diverse activities expressed by these organisms make the study of this branch very interesting, inquisitive and significant with exploration of more and more new facts, processes and functioning, etc.

The Choice Based Credit System (CBCS) curriculum for Microbiology at the post-graduate level has now been developed into a new system called Learning Outcome Curriculum Framework (LOCF) under the recommendations and guidance of University Grants Commission (UGC). The LOCF approach first envisioned the programme learning outcomes of the M.Sc. in Microbiology as well as the learning outcomes of the courses being taught under this programme, keeping in view the post-graduate attributes of the subject. For the subject Microbiology, the outcomes are defined in terms of the understanding and knowledge of the students in microbiology and the practical skills the students are required to have to be competitive microbiologists. The students are also to be trained in such a way that they develop critical thinking and problem solving as related to the microbiology. The curriculum is then developed in tune with the learning outcomes. It is envisaged that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology. Besides the contents of the curriculum, the teaching learning processes have also been designed to achieve these attributes. A variety of learning assessment tasks has been included in the curriculum. Besides assessing the knowledge/ skills acquired by the student, these tasks would also help to supplement the teaching learning process.

Introduction:

About the Programme

M.Sc. Microbiology programme offered by PAH Solapur University, Solapur is of two years duration and is divided into four semesters. The various courses of the programme are designed to include classroom teaching and lectures, laboratory work, project work, viva, seminars, assignments and field visits, etc. Three categories of courses are being offered in this programme: Core Courses (Ten mandatory courses offered by the Department), Elective Courses (student must opt for two out of four Elective Courses offered by the Department), and Open Elective (student may opt for any one Open Elective offered by either the Microbiology Department or any other Department of the Faculty of Interdisciplinary and Applied Sciences). Each Core Course is of four credits and includes classroom as well as laboratory courses. A separate research-based Core course i.e. research project that leads to a dissertation and is worth of two credits. The Elective Courses are four credits each. The student is required to complete courses of twenty five credits each semester and a total of one hundred credits to fulfill the requirements for the award of Master of Science degree in Microbiology.

The curriculum is designed to train the students in applied and advanced areas of Microbiology, keeping in mind the recent advances in the field. Particular emphasis is laid on the practical aspects of the field of Microbiology. Students will be trained to plan experiments, perform those carefully, analyze the data accurately and present the results both, qualitatively and quantitatively. To enable and develop presentation skills, the students have to deliver seminars on a wide range of topics covering different areas of Microbiology and also on the research articles from reputed peer reviewed journals. This will allow them to access a variety of reading materials with different themes and would enhance their grasping and assimilation abilities. A major component of the M.Sc. Microbiology course is a research project that the student has to undertake in the final/ 4^{th} semester. The students in groups will be allotted to a guide who will supervise and guide the students in selecting a research problem, designing experimental methodology, collecting data and analyzing and presenting the results in the form of a dissertation/research report and an oral presentation as well. This not only equips the student for a career in research/ industry, but also fosters self-confidence, think independently and self-reliance. At the end of the programme the student will be well-versed in all aspects of microbiology including medical microbiology, clinical and diagnostic microbiology, pharmaceutical and drug development and fermentation technology and molecular biology techniques as well as be familiar with the most recent advances in microbiology with gained hands-on experience in practical. The students will also be exposed to subjects like Biostatistics, Bioinformatics and Scientific Writing, etc.

M.Sc. Microbiology Programme Details:

Programme Objectives (POs):

The prime objective of the Master's Program in Microbiology is to acquaint the students with knowledge and analytical skills in microbiological techniques in general and clinical or diagnostic skills in particular at an advanced level. The program emphasizes to understand and apply the acquired knowledge about microbial processes, interaction of microorganisms with each other, with physical and chemical environment and biological systems around. The laboratory training in addition to theory courses is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education, public administration and diagnostics, etc. Students will be able to apply their knowledge and skills in fields including medical science, clinical and diagnostic microbiology, environmental biotechnology, food, dairy and agriculture microbiology, molecular biology, r- DNA technology and bioprocess or fermentation technology. Thus at the time of completion of the M.Sc. Microbiology programme, the student will have developed extensive knowledge and skill in various areas of Microbiology. They will be trained to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy makers. By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student. The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.

Programme Specific Outcomes (PSOs):

The M. Sc. in Microbiology Programme will cater to the increasing demand of skilled young manpower. This workforce will possess an understanding of research ethics while dealing with microbiological work to contribute to the application of knowledge in the field of basics in general microbiology as well as medical microbiology, clinical and diagnostic microbiology, pharmaceutical microbiology and drug development, immunology and immunological techniques; molecular biology and bioprocess technology globally. The Microbiology and clinical laboratory hands-on training will empower them to prepare for careers in broad range fields.

The M. Sc. Microbiology students will possess:

- Ability to design and execute experiments related to Basic Microbiology, Fermentation technology, Immunology, Microbial genetics and Molecular Biology, Recombinant DNA Technology, Clinical and diagnostic microbiology.
- Knowledge about various methodological and analytic approaches in the field of medical microbiology and diagnostics, bioprocess technology, pharmaceutical microbiology and drug development and techniques in virology.
- In-depth knowledge of Microbial genetics, Molecular biology, Virology, Infectious diseases, microbial metabolism and physiology, enzymology, environmental and agricultural microbiology, food and dairy microbiology, r-DNA technology , Medical and clinical microbiology.
- Practical skills in the use of sophisticated instruments, techniques and methods involved in microbiological analytical work.
- Ability to undertake independently scientific work process including hypothesis generation, understanding of theoretical background, collection and analysis of data, statistical analysis and interpretation of results and presentation as well as publication.

- Awareness and precautions regarding health, safety and environment (HSE) issues in handling chemicals, pathogenic cultures and other biological materials as well as understanding of the environmental impacts associated with the activities in Microbiological laboratory.

Program Eligibility:
Bachelor's degree with Microbiology as principal subject or Bachelor's degree in any of the Life sciences subjects provided that the candidate had Microbiology as one of the subsidiary/optional subjects for two semesters at B.Sc. II and qualified M.Sc. entrance test conducted by PAH Solapur University (as per university notification). Students from other University with B.Sc. General Degree in life sciences (with one optional as Microbiology) and who have passed the entrance examination conducted by the University are also eligible.

Admission:
Admission to the program will be made as per the merit list and reservation rules. Merit list will be made based on average of B.Sc. aggregate and score of entrance exam (conducted by PAH Solapur University). For other university students, merit list will be based on performance of entrance examination conducted by PAHS University.

Intake capacity:
There will be 20 seats for each year.

Examination:
Twenty percent of the total marks of each course will be awarded through Internal Assessment. Final examinations for four credits courses will be of two and half hours duration while examinations for each laboratory-based course will be held over four days of eight hours each. The students will make oral presentation of their project work at the end of the semester that is assessed by external examiners during his/ her viva-voce.

Passing rule and ATKT:

Structure of M.Sc. Microbiology program

The overall structure of the M.Sc. I MICROBIOLOGY course to be implemented from the academic year 2020-21 onwards is as follows:

M.Sc. I MICROBIOLOGY CBCS w.e.f. 2020-21									
Sem. I	**Code**	**Title of the Paper**	**Semester Exam.**			**L**	**T**	**P**	**Credits**
		Hard Core	UA	CA	Total				
	HCTA 1.1	Cytology and Taxonomy of Microorganisms	80	20	100	4			4
	HCTA 1.2	Microbial Genetics	80	20	100	4			4
	HCTA 1.3	Microbial Physiology and Metabolism	80	20	100	4			4
Soft Core(Any one)									
	SCTA 1.1	Bioinstrumentation and Biotechniques	80	20	100	4			4
	SCTA 1.2	Microbial Ecology and Diversity	80	20	100	4			
		Tutorial			25		1		1
Practical									
	HCPA 1.1	Practical Course HCPA 1.1	40	10	50			2	6
	HCPA 1.2	Practical Course HCPA 1.2	40	10	50			2	
	HCPA 1.3	Practical Course HCPA 1.3	40	10	50			2	
Soft Core (Any one)									
	SCPA 1.1	Practical Course SCPA 1.1	40	10	50			2	2
	SCPA 1.2	Practical Course SCPA 1.2	40	10	50			2	
Total of First Semester			**480**	**120**	**625**				**25**
Sem. II	**Code**	**Title of the Paper**	**Semester Exam.**			**L**	**T**	**P**	**Credits**
		Hard Core	UA	CA	Total				
	HCTA 2.1	Molecular biology and Genetic Engineering	80	20	100	4			4
	HCTA 2.2	Immunology and Immuno-technology	80	20	100	4			4
Soft Core (Any one)									
	SCTA 2.1	Medical Microbiology - I (bacteriology and parasitology)	80	20	100	4			4
	SCTA 2.2	Food and dairy Microbiology	80	20	100	4			
Open	**Elective** (Anyone)								
	OETA 2.1	IPR and Scientific writing	80	20	100	4			4
	OETA 2.2	Microbial Biotechnology	80	20	100	4			
		Tutorial			25		1		1
Practical									
	HCPA 2.1	Practical Course HCPA 2.1	40	10	50			2	4
	HCPA 2.2	Practical Course HCPA 2.2	40	10	50			2	
Soft Core (Any one)									
	SCPA 2.1	Practical Course SCPA 2.1	40	10	50			2	2
	SCPA 2.2	Practical Course SCPA 2.2	40	10	50			2	
Open	**Elective (Anyone)**								
	OEPA 2.1	Practical Course OEPA 2.1	40	10	50			2	2
	OEPA 2.2	Practical Course OEPA 2.2	40	10	50			2	
Total of Second Semester			**480**	**120**	**625**				**25**

The overall structure of the M.Sc. II MICROBIOLOGY course to be implemented from 2021-22

Sem. III	Code	Title of the Paper	Semester Exam			L	T	P	Credits
		Hard Core	UA	CA	Total				
	HCTA 3.1	Bioprocess and Biochemical Engineering	80	20	100	4			4
	HCTA 3.2	Bioinformatics, Biostatistics and Pharmaceutical Microbiology	80	20	100	4			4
	HCTA 3.3	Biosafety and Lab management	80	20	100	4			4
Soft Core (Any one)									
	SCTA 3.1A	Medical Microbiology –II (Viral and fungal diseases)	80	20	100	4			4
	SCTA 3.2B	Bioenergetics and Molecular Enzymology	80	20	100	4			
		Seminar			25		1		1
Practical									
	HCPA 3.1	Practical Course HCPA 3.1	40	10	50			2	4
	HCPA 3.2 & 3.3	Practical Course HCPA 3.2 and 3.3	40	10	50			2	
Soft Core (Any one)									
	SCPA 3.1 A	Practical Course SCPA 3.1	40	10	50			2	2
	SCPA 3.2 B	Practical Course SCPA 3.2	40	10	50			2	
		In plant training/Clinical lab training	40	10	50			2	2
Total of Third Semester			**480**	**120**	**625**				**25**

Sem. IV	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
		Research Project/Dissertation	UA	CA	Total				25
		Review writing	-	20					
		Dissertation	380	120					
		Viva	80	-					
		Seminar		25					
Total of Forth Semester			**460**	**165**	**625**				**25**
Total for **I ,II, III & IV** Semesters			**1920**	**480**	**2500**				**100**

N.B.: Instead of Fourth Semester regular teaching course, it can be fully dedicated for a four months full preparation of research based Dissertation carrying 625 marks (= 25 Credits) under the allotted supervisor. The final evaluation would be UA = 460, CA = 165.

M. Sc. I MICROBIOLOGY course syllabus

Semester I

HCTA 1.1 Cytology and Taxonomy of microorganisms

No.of lectures

UNIT: I Bacterial cytology **10**

1. Surface properties of bacteria and its significance
2. Cell division, Cell cycle and differentiation in bacteria.
3. General characteristics and molecular architecture of Cyanobacteria
4. General characteristics and molecular architecture of Mycoplasmas.
5. General characteristics and molecular architecture of Rickettsias and Chlamydia.

UNIT: II Microbial cytology **10**

1. General characteristics and structure of algae, and micro algae
2. General characteristics and structure of fungi.
3. General characteristics and molecular architecture of Actinomycetes.
4. General characteristics of Lichens and Mycorrhizae.

UNIT:III Microbial Taxonomy and Bacterial nomenclature **10**

A. Outline Classification of Cyanobacteria Rickettsias, algae ,fungi, Chlamydia and Actinomycetes

B. 1. Bacterial Taxonomy**:** Nomenclature, Introduction to Bergey's manual of Determinative Bacteriology and Bergey' Manual of Systemic Bacteriology, Numerical taxonomy, chemotaxonomy, phylogenetic and serological Methods used in classification.

2. Bacterial nomenclature and classification and Principles of bacterial nomenclature.

C. Viral Taxonomy: Outline classification viruses. Cataloging the viruses through viral classification schemes by ICTV / ICNV

UNIT: IV Morphology and ultra-structure of viruses **10**

1. Brief outline of discovery of viruses.
2. Morphology and ultra-structure of viruses, viroids and prions.
3. Genetic analysis of viruses by classical genetic methods.

Unit: V Viral Multiplication

1. Bacteriophages: Lytic and lysogenic interactions.
2. Animal viruses: DNA and RNA viruses. Mechanism of virus adsorption and entry into the host cell, genome replication, Transcription, post transcriptional changes, translation, assembly, exit and maturation of progeny virions
3. Host cell transformation by viruses, oncogenesis by DNA and RNA viruses.

References

Cytology and Taxonomy

1. Bacterial cell structure by Rogers, ASM publications.
2. General Microbiology by stanier et al., 5th Edn.
3. Microbial Ultra structure by Fuller R.
4. Chemical Microbiology by Rose.
5. Microbial and Plant Protoplasts by Peberdy et al.
6. Biology of Mycoplasma by Smith P. I.
7. Introduction to Fungi by Alexopolus.
8. Bergy's manual of systemic bacteriology Vol. 1, 2, 3, 4 Williams, Wilkins & Baltimore, Academic Press.
9. Bergey's manual of Determinative Bacteriology Williams, Wilkins & Baltimore, Academic Press.

10. A Manual of Soil Fungi – Gilman J. C. (1967) Oxford & JBH Publications

VIROLOGY

11. Bacterial & Bacteriophage Genetics by Edward A. Birge.
12. Principles of Bacteriology, Virology & Immunity 8th edition (Vol. 4) by Topley & Wilson's.
13. General Virology – Luria.
14. Introduction to Plant Virology – Bos I. (1983) Longman, London & New York.
15. Animal Virology – Fenner, F & White, D. O. (1976) Academic Press Inc., New York.
16. Virology – Dulbecco R. and Ginsberg H. S. (1980), Harper and Ravi Publishers Inc. New York.
17. Introduction to modern virology by Dimmock. Fourth Edition. Blackwell Scientific Publication, Oxford.
18. Virology by Conrat, Kimbal and Levy, Third Edition, Englewood Cliff New Jersey Publication.
19. Principles of virology by Edward Arnold. 2000.
20. Medical virology by Morag and Tim, 10^{th} Edition. Churchil Livingstone publication, London.

HCTA 1.2 MICROBIAL GENETICS

Unit I Structure, Characteristics and forms of DNA 12

1) Evidences of DNA and RNA as genetic material:-Griffith's Experiment, identification of Transforming Principle by Avery, MacLeod and McCarty, Hershey and Chase Experiment.
2) Differences in organization of prokaryotic & Eukaryotic Genome.
3) Primary structure - Secondary structure- (Watson and Crick model), Tertiary Structure: negative and positive super helices.
4) Physical characteristics of DNA- Bouyant density, Absorption in UV, denaturation, renaturation and hybridization, Cot curve & C-Value Paradox, Denaturation / Melting of DNA, DNA breathing, DNA Bending, DNA flexibility, Linking Number of DNA, Major groove and minor groove, Cruciform DNA and hairpin DNA.
5) Forms of DNA: A, B, C and Z forms.
6) Types of DNA molecules-linear single stranded and duplex, closed circular duplex.

Unit II Replication, Modification, Mutation, Damage and repair of DNA 12

1) DNA Replication – Steps involved with enzymes in DNA replication, theta and rolling circle model.
2) DNA Modification – Post-Replicative modification and methylases.
3) Mutations at Molecular Level – Types of mutations (Base pair substitution, frame shift, missense, nonsense, silent, mutation in termination codons), Induced and spontaneous mutations (Tautomerism, mutations caused by physical and chemical agents), Genetic suppression
4) Ames and other toxicity testing, Role of mutation in evolution and antibiotic resistance
5) DNA damage and repair- types of damages
6) Repair mechanisms- Photo reactivation, dark repair, post replication recombination repair, SOS repair

Unit III Gene transfer, Transposons and Plasmids 12

1) Gene transfer – transformation, Conjugation & transduction
2) Transposons – Discovery, types of transposons- Insertion sequences and composite transposons, Transposons in Prokaryotes(Bacteria and Phages, animal viruses), transposons, Mechanism of transposition, Role of transposons in acquisition of multiple drug resistance, Detection of transposition.
3) Plasmids- Nomenclature, classification, general properties and types. Detection and purification, amplification and rearrangements, replication and transfer process, plasmids in Yeasts.
4) Genetics of fungi-alteration of generation, induction of mutation in *Neurosporacrassa* and yeast.

Unit IV Molecular aspects of gene expression and regulation, Genomics 12

1) Genetic code- Deciphering of genetic code and important properties of genetic code
2) Transcription in Prokaryotes and Eukaryotes- Structure of rRNA, tRNA and mRNA, antisense RNA and its significance, post transcriptional modifications.
3) Translation in Prokaryotes and Eukaryotes- post translational modifications.
4) Operon models - Lactose, tryptophan and arabinose.

5) Genomics: Genome analysis, complete genomics, Functional genomics, Structural genomics, Epigenomics, Metagenomics.

Unit V Phage Genetics **12**

1) T4 virulent phage- structure, life cycle, genetic map, properties of T4 DNA, Structure of T4 replisome, Silent features of T4 DNA Replication.
2) Lamda temperate phage- Structure, genetic map, lytic and lysogenic cycle, replication of lambda phages, lytic and lysogenic casacad, role of regulator proteins, lysogenic regulation, autoregulation of cI Repressor, Induction of lysogen, Immunity to superinfection
3) Filamentous bacteriophages- M13- Structure, life cycle (pattern of DNA replication), Structure and replication of phage Φx174.
4) Molecular recombination in phages

REFERENCES

1. Concepts of Genetics- Klug W. S. And Cummings M. R Prentice-Hall
2. Genetics-a Conceptual Approach Pierce B. A. Freeman
3. An Introduction to Genetic Analysis- Griffith A. F. et al Freeman
4. Principles of Genetics -Snustad D. P. And Simmons M. J. John Wiley & Sons.
5. Genetics - B.D.Singh
6. Genetics - Verma&Agrawal
7. Genetics - P.K.Gupta
8. Microbial Genetics -Maloy S., Cronan J., Freifelder D Jones and Bertlett
9. Fundamental Bacterial Genetics- Trun N and Trempy J Blackwell Publ.
10. Modern Microbial Genetics- Streips U. N. and Yasbin R E.Wiley-Liss
11. Molecular Genetics of Bacteria- Sneider L. and Champness W. ASM Publishers
12. Genetics of Bacteria- Scaife J. Academic Press
13. Genetics of Bacteria and Viruses- Birge E. A. Springer
14. Molecular Genetics of Bacteria- Dale J.W. and Park S Wiley
15. Fungal Genetics: Principles and Practice Bos C J. CRC
16. Essential Fungal Genetics-Moore D.& Frazer N. Springer
17. Fungal Genetics- Fincham Springer

HCTA 1.3 Microbial Physiology and Metabolism

Unit- I **10L**

Transport in Bacteria

1. Transport mechanism of nutrients across the cell membrane- Simple diffusion, facilitated diffusion, group translocation and Active transport and Passive transport.
2. Permeation – different permeation systems in ***E.coli,*** amino acid permeases transport of inorganic ions physiological consequences and significance of permease mechanism.

Unit-II

Electron transport chain and TCA Cycle **10L**

1. ETC: Concept, components involved in electron transport and oxidative phosphorylation, theories of ATP formation.
2. Bacterial Electron Transport Chain- photosynthetic and non-photosynthetic, aerobic and anaerobic bacterial ETC.
3. Mitochondrial ETC: structure of mitochondria, mitochondrial ETC, shuttle system across membrane, Atkinson`s energy change.
4. TCA (Citric acid) cycle: steps involved, amphibolic nature, anapleurotic reaction.

Unit-III **10L**

Biosynthesis

a) Purines and pyrimidines synthesis by de novo
b) Saturated fatty acids.
c) Amino acid synthesis pathways

Unit-IV **10L**

Oxidation of hydrocarbons and Drug metabolism:

a) Aliphatic hydrocarbons- Alkanes and alkenes – alpha, beta, and omega oxidation.
b) Aromatic hydrocarbons – beta keto adipate pathway, valerate pathway, gentisate pathway.
c) Drug metabolism and detoxification.

Unit-V **10L**

Osmosis, Oxygen toxicity and Microbial hormones

1. Osmosis – Definition, microbial response to osmotic stress, avoidance of osmotic stress, responses of microbial plasma membrane to osmotic stress. Reverse osmosis.
2. Oxygen toxicity – catalase, peroxidase, super oxide dismutase, mechanism of O_2 toxicity
3. Microbial hormones and their significance.

References: Microbial Physiology and Metabolism

1. Bacterial Physiology and Metabolism by R. J. Sokath.

2. Metabolism by Doelle, Academic Press, London.

3. Biochemistry of Microbial growth – by Mandelstam.

4. Methods in Microbiology Vol. 3 A, Norris & Ribbons (eds) Academic Press.

5. Microbial Physiology – Dawes I. W., and Sutherland J. W, (1976) Halsted press

6. Metabolic Pathways 3rd edition – Greenberg D. M, (1976) Springer Verlag, New York.

7. Microbial Physiology - Albert G. Moat, John W. Foster John John Wiley & Sons.

SCTA 1.1 Bioinstrumentation and Biotechniques

50 L

UNIT I: **10 L**

Electrochemistry: pH and Buffers Potentiometric and Conductometric titration. Principal and application of light, phase contrast, Fluorescence, Scanning and Transmission electron microscopy

UNIT II: **Principle Methodology and applications:** **10 L**

Gel filtration, ion exchange and affinity chromatography, thin layer and gas chromatography, High performance liquid chromatography
Centrifugation: Basic principal and application, differential – density gradient and ultra-centrifugation.

UNIT III: **10 L**

Principle of biophysical method for analyzing biopolymer structure:

X ray diffraction Fluorescence, UV ORD/CD Visible IR, NMR and ESR spectroscopy, Atomic absorption and plasma emission spectroscopy, MS and MALDI –TOF

Unit IV: **10 L**

Electrophoresis, Principle and application of Native, SDS Agarose and 2D gel Electrophoresis.
Blotting techniques – Southern blotting, Northern blotting, Western blotting.

UNIT V: **10 L**

Microscopy:- Optical corrections, Properties and types of objectives. Oculars, Illumination. Types of light microscopes: Bright field, dark field, fluorescence and phase contrast Micrometry.

Electron microscopy: Basic components of electron microscopes. Thermionic and field emission electron guns. Types of electron microscopes: TEM, SEM, STEM, ESEM and HVEM

References:

1. Shrama BK, Instrumental method of chemical analysis
2. DA Skoog. Instrumental methods of analysis
3. Plummer, An introduction to practical Biochemistry
4. Chatwal and Anand, Instrumentation Boyer, Modern experimental Biology
5. Biochemistry by Lubert Stryer
6. Plummer, An introduction to practical Biochemistry
7. Boyer, Modren experimental Biology
8. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker. Cambridge University Press India Pvt. Ltd.
9. Biochemistry and Molecular Biology, Keith Wilson, John Walker. Cambridge University Press India Pvt. Ltd.
10. Principles of Physical Biochemistry – Van Holde, et al., Prentice Hall.
11. Crystallography made crystal clear – G. Rhodes, Academic Press.
12. Introduction to Protein Structure – Branden and Tooze, Garland Publishing Co
13. Principles of Protein X-Ray Crystallography - Jan Drenth Third Edition.

SCTA 1.2 Microbial Ecology and Diversity

No. of lectures.

Unit-I **10**

Microbial Ecology

Basic ecological principles, Ecosystems, habitats, ecological niches, gen burst of population and population explosion, community, energy transfer and ecosystem management, microbe-microbe, microbe-plant and microbe-animal interactions. Endolithic microorganisms of Antarctica. Concept of autotrophy – an example of extreme synthesis

Unit-II **10**

Microbial Diversity:

1) Microbial World: General characteristics and outline classification of Bacteria, Yeasts, Molds, Viruses, Protozoa, Lichens, Mycorrhiza Viroids and Prions and their role in the biosphere 2) Differentiation: In Bacillus, Azotobacter, Candida, Mycoplasma and Aureobasidium spp.

Unit-III **10**

Anoxygenic and Oxygenic photosynthesis:

1)Anoxygenic photosynthetic microbes-General characteristic of purple and green sulphur bacteria 2)Oxygenic photosynthetic microbes- General characteristics of Cyanobacteria and Prochlorales

3)Methanogenic Archeobacteria—General characteristics

Unit-IV **10**

Bioluminescence nitrogen fixation Microbial fossils and uncultured organisms:

1. Bioluminescent and nitrogen fixing bacteria- A high energy spending bacteria
2. Magnetotactic bacteria
3. Microorganisms in prospecting of oils

4)Microbial fossils

5) Identification of uncultured organisms

Unit-V **10**

Extremophiles:

1) Acidophilic, alkalophilic, psychrophilic, thermophilic, barophilic, osmophilic and halophilic microorganisms

2) Microbes in toxic environments like acid mine drainage, coal desulphurisation ,wastes containing cyanides, xenobiotics, pesticides and chemicals, heavy metals, hydrocarbons and radio isotopic materials

3) Biodeterioration-concept, biodeterioration of wood, stonework, pharmaceutical products, rubber, plastic, paints, lubricants, cosmetics, & control of biodefenoration

References:

1. Extremophiles-(2000) By B.N.Johari Springer Verlag,New ork.
2. Microbial diversity (1999) by D.Colwd Academic Press
3. Bergy's Manual of Systematic Bacteriology (1984).Vols.I and III .Williams and Wilkins, Baltimore Academic press
4. Microbial life in extreme environments (1978) by D.s.Kushner Academic press
5.Microbial ecology (1979) by J.M.Lynch and N.J.Poole .Blackwell Scientic
6. Brock biology of microorganisms (2000).9th eds.by M.T. Madigan,J.M.Martinko and Jack parker.
7. Biochemistry, Bioengineering and biotechnology Hand book (1991).by B. Atkinson

Semester I Practical course

HCPA 1.1 PRACTICAL COURSE HCPA 1.1

1) Demonstration of: Bacterial and yeast DNA
2) Preparation of yeast protoplasts.
3) Isolation and purification of lysozyme from egg white and preparation of bacterial protoplasts
4) Study of magnetic and electric field on behavior of microorganisms
5) Isolation and identification of reserved food material from *Bacillus megaterium* . Isolation and morphological studies of –
Algae – *Spirulina, Scenedesmus* spp.

Fungi- *Aspergillus, Penicillium, Rhizopus, Fusarium, Trichoderma and saccharomyces.*
Protozoa – *Euglena, Paramoecium and Plasmodium*.
Mycorrhiza – VAM fungi – demonstration. v.) Lichen- demonstration.
6) Induction of ascospore in yeasts of *Saccharomyces cerevesiae*.

7) Isolation, titration and high titer stock preparation of E.coli phages from sewage.
8) Phage typing of E.coli and Salmonella strains.
9) Infectivity Assays (Plaque and end-point)
10) Study of Egg inoculation techniques.
11) Cultivation of animal viruses in embrocated eggs

HCPA 1.2 PRACTICAL COURSE HCPA 1.2

1. Isolation of DNA from bacteria and yeasts.
2. Isolation and estimation of RNA from Bacteria and yeasts.
3. Quantization of DNA by spectrophotometer.
4. Size fractionation of total DNA using electrophoresis.
5. Isolation and Estimation of total Protein from Baker's Yeast (Translation).
6. Fluctuation test.
7. Isolation of RNA from yeasts.
8. Isolation of bacterial and yeast plasmids (amplification, curing and purification).
9. Study of transformation, transfection, conjugation, transduction, protoplast fusion in bacteria
10. Isolation of thiamine requiring mutants of *E.coli* using replica plate technique
11. Testing of chemicals for mutagenicity by Ames, lambda-muta test and Induct-test
12. Study of UV absorption spectra of Macromolecules (Protein, Nucleic Acid and Bacterial Pigments

HCPA 1.3 PRACTICAL COURSE HCPA 1.3

1. Study of galaxies transport in yeasts
2. Determination of specific growth rate and generation time of E. coli
3. Determination of protein content of bacteria
4. Determination of carbohydrate content of bacteria
5. Determination of nucleic acid (DNA, RNA) content of bacteria
6. Determination of phenol coefficient of test disinfectant
7. Effect of hypotonic and hypertonic solutions on cells

SCPA 1.1 PRACTICAL COURSE SCPA 1.1

1. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using paper Chromatographic techniques
2. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using thin layer Chromatographic techniques.
3. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using column Chromatographic techniques
4. Electrophoretic separation of proteins and nucleic acids by agarose gel electrophoresis
5. Electrophoretic separation of proteins and nucleic acids by polyacrylamide gel electrophoresis
6. Electrophoresis of polysaccharide and glycoprotein, lipoproteins etc.
7. Studies on the principles of light spectroscopy – Beer and Lambert`s laws, extinction coefficient and molar extinction coefficient.
8. UV – visible spectrophotometry & atomic absorption spectroscopy.
9. Immunochemical techniques: Immuno diffusion, immune electrophoresis, radioimmunoassay, enzyme linked immunosorbent assay , immune blotting, immunohistochemistry

SCPA 1.2 PRACTICAL COURSE SCPA 1.2

1. Different cultivation techniques for Actinomycetes
2. Isolation of Methane bacteria from Biogas slurry
3. Studies on Magnetotactic Bacteria
4. Isolation of Cyanobacteria from water sample
5. Enrichment and Isolation of anoxygenic phototrophic bacteria
6. Study of Bioluminescent bacteria.
7. Isolation microorganisms producing plant growth promoting substances Indol Acetic Acid & Gibberellins.
8. Isolation of of bacteria and other microorganisms producing catalase, peroxidases, dismutase.,
9. Isolation of bacteria producing alkaline lipase and proteases.
10. Isolation of chemolithotrophic bacteria like Nitrosomons and Nitrobacter spp.

M. Sc. I MICROBIOLOGY course syllabus
SEMESTER: II
HCTA 2.1: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I **10**

Recombinant DNA and other DNA based techniques and their applications:

1) Blotting techniques(Southern, Northern, Western and Eastern blotting)
2) PCR (Reverse transcriptase PCR, Real time PCR)
3) DNA sequencing, Micro satellite repeats
4) DNA finger printing
5) Gene therapy, PCR-ELISA, Fluorescence in situ hybridization (FISH)
6) Microarray, RFLP, RAPD
7) Human genome project

UNIT II **10**

Cancer markers, Cell cycle, apoptosis and treatment:

1) Cell homeostatsis and cell cycle, Regulation of cell cycle, Cell apoptosis, Tumor benign and malignant, Oncogenes and protooncogenes
2) Etiology of cancer and chemical carcinogens, Anticancer drugs and approaches
3) Genetic Tests for Hereditary Cancer Syndromes
4) Identification of Genetic Changes in Cancer
5) Identification of actionable cancer gene mutations and treatment by Genomic profiling.

UNIT III **10**

Protein engineering and Metabolic engineering:

1) Proteins- cellular storage and secretions, Protein sequencing and Engineering-Methodology and Applications
2) Protein arrays & their applications.
3) Metabolic engineering- Essence of metabolic engineering, examples of pathway manipulations, metabolic engineering in practice
4) Metabolic flux analysis and its applications, synthesis low molecular weight compounds

UNIT IV **10**

Tools required Vectors and Constructions of rDNA:

1) Tools required for genetic engineering: Restriction endonucleases (types, nomenclature, recognition sequences, and cleavage patterns with examples), *E. coli* DNA ligase, T4 DNA ligase, alkaline phosphtase, Polynucleotide kinase, Terminal deoxynucleotidyl transferase, Reverse transcriptase and DNA Methylases
2) Vectors in Genetic engineering: Plasmid vectors pBR322, pUC18, Ti plasmid vectors. Bacteriophage vectors-Insertion vectors, replacement vectors, λ- bacteriophage, Cosmid vectors, phagemid vectors, M13 phages, shuttle vectors, YAC, BAC, HAC.
3) Construction and applications of Genomic libraries and cDNA libraries.
4) Constructions of recombinant DNA- selection of DNA fragment for cloning, cDNA synthesis, chemical synthesis, gene synthesizers, ligation with REs, homopolymer tailing, blunt end ligation, linkers and adaptors.

UNIT V **10**

Insertion & Screening of rDNA, Applications & Legal aspects of Genetic engineering:

1) Insertion of recombinant DNA-Host selection, Transformation, Transfection Electroporation, Lipofection, Microinjection, Protoplast fusion, Biolistic transformation, Calcium phosphate method, Polyethene glycol and Gene gun.
2) Screening of recombinants by Colony hybridization, Phage plaque assay, Blue- white screening, Direct Screening, Indirect Screening, Immuno-Screening.
3) Applications of Genetic engineering in Agriculture, Industries, Human health and Environmental pollution control.
4) Ethical and legal aspects of Genetic engineering.

HCTA 2.2 Immunology and Immuno-technology

UNIT I Components of Immunity 15L

1. Innate immunity: Anatomical, physiological and biological barriers
2. Adaptive immunity:
   A] Characteristics of adaptive immune
   B] Cells of immune system: structure and role, cell receptor & B cell receptor
   C] Organs of immune system: structure and role
   D] Mechanism of humoral & cell mediated immune response, Cytokines & their role
3. Complement system: components, alternate & classical pathway, complement deficiency disorders

UNIT II Major Histocompatibility Complex and transplantation immunology [10]

1. MHC- organization: human & mouse
2. MHC Molecules: Structure and function of MHC Class I & Class II inheritance, self MHC restriction, polymorphism of MHC Class I & Class II
3. Antigen presentation & processing: endogenous and exogenous pathway for antigen processing.
4. MHC & disease susceptibility
5. Regulation of MHC expression
6. Transplantation immunology

UNIT III: Immunology in Health and Diseases: 10L

1. Autoimmunity: mechanism & types of autoimmunity, central & peripheral Tolerance
2. Allergy and Hypersensitivity Reactions, Types of Hypersensitivity reactions,
3. Immunodeficiency Disorders, Diseases of the Immune system
4. Tumor immunology: origin & terminology, Tumor antigens, immune response to tumors, immunotherapy

UNIT IV:Vaccinology 4L

1. Basic concept, Active and passive immunization
2. Classification of common vaccines: whole organism & purified macromolecules, toxoid vaccines, recombinant vaccines, DNA vaccines, synthetic peptide vaccines

UNIT V: Immunological Techniques 6L

1. Immunological Techniques: principle method, Principle & applications of Agglutination, precipitation, immune-fluorescence, immunoelectrophoresis, immunoblotting, ELISA, RIA, Flow cytometry, immunohistochemistry
2. Production and purification and application of monoclonal antibodies

References

1. Kuby Immunology by J.A. Owen, J. Punt , S.A. Stranford. 7th edition. WH Freeman. 2013.
2. Cellular and Molecular Immunology by A.K. Abbas, A.H. Lichtman, S. Pillai. 9th edition. Saunders Elsevier. 2018.
3. Janeway's Immunobiology by K. Murphy and W. Casey. 9th edition. Garland Science Publishing. 2017.

4. Review of Medical Microbiology and Immunology by W.Levinson. 15thedition.Lange Publication. 2018.
5. Fundamental Immunology by W.E. Paul. 7th edition. Lippincott Williams and Wilkins. 2013.
6. Roitt's Essential Immunology by P.J. Delves, S.J. Martin, D.R. Burton, I.M. Roitt. 13th edition. Blackwell Publishing. 2017.
7.Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007). Panima Publishing Corporation , New Delhi.
8. Immunology and Immunotechnology. RajasekaraPandian M and Senthilkumar B (2007). Panima Publishing Corporation , New Delhi.

SCTA 2.1 Medical Microbiology – I (bacteriology and parasitology)

Unit I **10**

Human bacterial infections :

Different routes of infections. Mechanisms of invasion. Agents causing common infections – Bacteria, Viruses, Fungi and Parasites.

Diagnostic Microbiology : Sample collection. Transportation

Microscopy – wet mount, Gram stain, dark ground microscopy, Fluorescent microscopy. Isolation - media used. Identification – Biochemical tests, serological tests.

Antibiotic susceptibility testing. Sero-diagnosis - Antigen & antibody detection.

Unit II **10**

1. Recent diagnostic methods for bacterial and parasitic infections

A] Recent advances in detection of M. tuberculosis, diarreagennic *E.coli, Vibrio cholera, Chlymydia trachomatis, Neisseria gonorrhoeae, Leptospira*

B] Recent advances in diagnosis of *Leishmaniasis, Trepanosoma* cruzi, *Plasmodium* infection

2. Recent diagnostic methods for Emerging & reemerging infections :

Cholera, Meningococcal meningitis, *Escherichia coli* [hemorrrahagic colitis], Plague, *Acinetobacter baumannii*, VRSA *Staphylococcus aureus*

Unit III **10**

Bacterial diseases with respect to etiological agent, mode of transmission, symptoms, epidemiology, laboratory diagnosis, prophylaxis, treatment

1. Bacterial diseases of skin: Staphylococcal, Streptococcal, Pseudomonas infections
2. Bacterial diseases of nervous system: meningitis
3. Bacterial diseases of digestive system: peptic ulcer by *Helicobacter*, staphylococcal food poisoning
4. Bacterial diseases of respiratory system: Diptheria, Mycoplasmal pneumonia, Legionellosis, Streptoccocal pharangitis
5. Bacterial diseases of cardiovascular & lymphatic system: epidemic & endemic typhus fever, anthrax, brucellosis, plague, rheumatic fever
6. Bacterial diseases of urinary& reproductive system: Cystitis, gonorrhea

Unit IV parasitic diseases with respect to etiological agent, mode of transmission, symptoms, life cycle of parasite, laboratory diagnosis, prophylaxis, treatment

Parasitology I :

Protozoal diseases -*Entamoeba hostolytica, Giardia lamblia, Plasmodium. Toxoplasma gondii, Cryptosporidium parvum*

Unit V **10**

Parasitology II

Cestodes diseases : *Taenia saginata, Taenia solium, Ecchinococcus granulosus*.

Nematodes : *Ascaris lumbricodes, Ancylostoma duodenale, Wucheraria bancrofti.*

SCTA 2.2 Food and Dairy Microbiology

Unit-I **10**L

1. Food as substrates for microorganisms. General principles underlying spoilage of foods.

2. Microbiology of food spoilage: Microbiology and spoilage of i) meat and meat products ii) fish and poultry iii) fruits and vegetables iv) sugar and sugar products, and v) canned foods.

3. Microbial food infections and poisoning, investigation of food born outbreaks, prevention and control.

Unit-II **10L**

1. General principles underlying food preservation and different methods of food preservation, process of canning.

2. Microbial flavors in food and dairy industry.

Unit-III **10 L**

1. Microbiology of Milk and milk products: Composition and nutritive value of milk.

2. Spoilage of milk and milk products: Khoa, paneer, cream, basundi, ice creams,

3. Milk borne diseases: Antimicrobial systems in milk, sources of contaminations of milk, prevention and control of milk borne diseases.

4. General principles underlying preservation of milk: Pasteurization, Flash Pasteurization, Kinetics of pasteurization & phosphatase test.

Unit-IV **10** L

1. Fermented milk products: Types, Production and Defects in:

a) Cultured butter milk, dahi, butter and cheese, paneer, chakka, shrikhand, creams, basundi and ice creams

b) Kefir, kumiss, yoghurt, Bulgarian sour milk,

2. Fermented food products: Types, Production and Defects in:

a) Jilebi, punjabi warri, dhokla, **b)** lime and mango pickles.

Unit-V **10 L**

1. Chemical and microbiological examination of food &milk, grading of food &milk.

2. Food adulterations and contaminations of foods with harmful microorganisms.

3. Food laws and standards, Indian and international food safety laws and standards. BIS Laboratory Services, BIS product certification and licensing, BIS Quality Systems certification.

4. Quality and safety assurance in food and dairy industry, Sanitation and regulation in food and dairy industry, food and dairy arithmetic standardization of products & costing.

REFFERENCES:

1) The Technology of Food Preservation: 4thEdi. Norman N. Potter (1987) CBS Publi.
2) Milk and Milk Products: 4thEdi. Clasence Hanry. TMH Publications.
3) Food Processing: Biotechnological Applications (2000). S.S.Marwaha and Arora. Asiatech publications, New Delhi.
4) Food Microbiology: Frazier.
5) Food Microbiology: James De and De.
6) Dairy Technology: Sukumar De. Food Science: 5th Edi, Norman N. Potter (1996).

OETA 2.1 IPR and Scientific writing

Unit I Intellectual Property Right **10**

Definition of IPR, function, forms of protection, importance of IPR, Patentable subject matter, Novelty, IPR and Developing World, Intellectual Property Management. International conventions and Treaties (WIPO), Introduction of Patents and patent application process (national and International), Trade Secrets, Copy Rights, Geographical Indicators, Trade Marks, PBR in UPOV, GATT and TRIPS, Patent applications- national and international, Patent infringement, Patent Claims and Legal decision-making process.

Unit II Basic concept of Scientific Writing **5**

History and basic concept of scientific writing:
Basic grammar: Tenses, Voices, Propositions and conjunctions, Conditional sentences, count and non-count nouns; concord, Punctuations.

UNIT: III **10**

Effective written presentations: Order of sentences in paragraph; sentence connection, cohesion and coherence; Contradiction, tautology, semantic anomaly, circumlocution. Using dictionary and the thesaurus Spell check, grammar check, logical sequence, connectivity and relevance in scientific writing.

UNIT: IV **10**

Scientific methods and documentation.

1**.** Scientific methods: concept, hypothesis, theory, law, Design of experiment; Inductive and deductive reasoning

2. Different types of scientific documents, review paper, book reviews, research paper, thesis, project reports and conference report.

Unit V **15**

3. Components of research paper, IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations,
4. Preparation for publications-Submission of manuscript, ordering reprints
5. Presentation of research: Oral and poster presentation, presentation in conferences and symposia. Preparation and submission of proposals to the funding agencies

References

1.Day D.A., Sakaduski N, Day N. (2011) Scientific English: A guide for scientists and other professionals. ABC-CLIO Publications.
2.Day R.A. & Gastel B 6th Edition (2006) How to write and publish a scientific paper, Cambridge University Press.
3..Alley M (1996). The craft of scientific writing. Springer Publication.
4..Day R.A. (1988) How to write & publish a Scientific paper, Cambridge University Press.
5. Intellectual Property Rights: Legal and Economic Challenges for Development: Cimoli
6. Indian Patent Laws: Kankanala KC, Narasani AK
7. P Ganguly, Intellectual Property Rights, Tata McGraw Hill, 2007

OETA 2.2: MICROBIAL BIOTECHNOLOGY

Total Hours: 50

Unit I **2**

Introduction: Principle, applications, economics and milestones in microbial technology.

Unit II **12**

Commercial Microbial products:

Industrial production of

1) Streptomycin, Amylase, Vitamin B12, L-Lysine,
2) Microbial production of nucleosides, nucleotides, pigments.
3) Production and applications of biopolymers, Xanthan gum, dextran, pullulan, mannan, curdlan and Alginate.
4) Industrial production of distilled alcoholic beverages. Whisky and Brandy.
5) Commercial production of immunoactive products. Vaccines, Antisera, Interferon etc.

Unit III **10**

Microbial enzymes: Industrial production of protease & asparaginase.

Enzymes in - starch processing, food, textile, detergent, leather, breweries, pharmaceuticals, therapeutics, and diagnostics. Recombinant enzymes.

Immobilized enzymes and cells: Techniques and types of immobilization, industrial applications of immobilization: merits and demerits.

Unit IV **8**

Microbial transformation and organic synthesis:

Transformation of steroids and sterols, over production of glutathione by genetically engineered cells.

Metabolic engineering for vitamin C production,

Unit V Biosafety, Bioethics and IPR

a) Guidelines for safety in microbiological processes, Good manufacturing practices, biosafety levels of infectious agents.
b) Regulatory practices, process validation, Quality assurance.

c) Bioethics – concept, case study, stem cells, GM foods and Nanobiotechnology. Intellectual property rights. Basic concept, patents, trade secrets, Copyrights,

d) Trademarks. Patent regulatory bodies at National and International level.

References:

1. Moo-Young M, Butler MM , Colin Webb C, Moreira A, Grodzinski B, Cui ZF & Agathos S. 2011. Comprehensive Biotechnology, 2nd Edn. Elsevier.
2. Hui YH, Meuiner-Goddick, Hansen AS, Josephsen J, Nip W, Stanfield PS and Toldrih F. 2011. Handbook of food & beverage fermentation technology. CRC Press.
3. Grewal S and Mutha P. 2010. Enzyme technology. The Book Planet.
4. Zheng R, Zheng Y, and Shen Y. 2010. Acrylamide, Microbial Production by Nitrile Hydratase. Wiley.
5. Elnashar MMM. 2010. Immobilized Molecules Using Biomaterials and Nanobiotechnology. J Biomaterials Nanobiotechnology.

6. Honda K, Ishige T, Kataoka M and Shimizu S. 2007. Microbial and Enzymatic Process for production of chiral compounds. Biocatalysis in the Pharmaceutical and Biotechnology Industries. Book chapter 20.
7. P. S. Teng. 2008. Bioscience entrepreneurship in Asia: creating value with biology. World scientific publishing Co.
8. Rastall RA. 2007. Novel enzyme technology for food applications. CRC press.
9. Wayne Goddard, Stuart Melville. 2007. Research Methodology: An Introduction. Juta and co. Lansdowne.
10. Mansoori GA. 2005. Principles of Nanotechnology. World scientific books
11. Wilson M, Kananngara K, Smith G, Simmons M and Raguse B. Nanotechnology: Basic Science and Emerging Technologies. 2004.Chapman & Hall/CRC.

SEMESTER II PRACTICAL

HCTA 2.1: Practical Course HCTA 2.1

1. Selection of recombinants by selectable markers.
2. Agarose Gel Electrophoresis restricted DNA
3. SDS-PAGE
4. RAPD.
5. Isolation of RNA and analysis by formaldehyde gel electrophoresis
6. Blotting techniques
7. Preparation of competent cells using $CaCl_2$.
8. Ligation reaction of restriction digested Vector and Insert.
9. Transformation of recombinant DNA.
10. PCR amplification of gene of interest.
11. Reverse transcriptase PCR.
12. Restriction Fragment Length Polymorphism (RFLP) analysis
13. Quantitative Real Time –PCR(Demonstration)

HCPA 2.2 Practical Course HCPA 2.2

Practical

1. Separation of serum and plasma and its storage
2. immunoelectrophoresis of serum
3. perform radial immunodiffusion assay.
4. perform rocket immunoelectrophoresis.
5. stain a tissue by immunohistochemical reaction .
6. To study quantitative precipitation assay
7. To perform ELISA and determine Antibody titre by ELISA method.
8. To perform latex agglutination test
9. To perform western blotting.
10. Blood smear identification of leucocytes by Giemsa stain/Leishman method
11. Determination of phagocytic index
12. Immunoflourescent Technique for cancer marker
13. Immunodiagnostics using commercial kits

SCPA 2.1 Practical Course SCPA 2.1

Microbiology I.
Practicals :
1) Principle, method and uses of Gram staining. Modifications of Gram staining.
2) Principle, method and uses of Zeihl – Neelsen staining. Its uses.
3) Fluorescent microscopy – principle and uses.
4)Demonstration of morphology of bacteria using microscopic slides.
Staphylococcus.
Streptococcus
Pneumococcus.
Gonococcus.
Meningococcus.
Corynebacterium diptheriae.
Bacillus anthracis.
Clostridium welchii.
Clostridium tetani.
Gram negative bacilli.
Comma shaped bacilli.(vibrios).
Mycobacterium tuberculosis.
Mycobacterium leprae.
Treponema pallidum.
(3hours)
6)Media :Demonstration and classification of commonly used culture media, their constituents, preparation method, uses.
Liquid media - Nutrient broth.
Glucose broth.
Peptone water.
Bile broth.
Brain –heart infusion broth.
Blood culture bottle.
Selenite broth.
Carry-Blair medium.
Solid media.: Nutient agar, Sheep Blood agar. Chocolate agar MacConkey agar. DCA. TCBS medium. Monsur's medium. SS agar. Wilson & Blair medium. Loeffler serum slope. Potassium tellurite blood agar. Lowenstein –Jensen medium
7) Demonstration and description of colony characteristics of common pathogens on various culture media..
8) Serological tests demonstartion.
Tube agglutination.
Slide agglutination.
Haemagglutination.
Latex agglutination.
Rapid Chromatographic tests.
ELISA.

9) Demonstration of antibiotic susceptibility testing.
Kirby –Bauer disc diffusion method.
Stokes and Modified stokes method.
Broth dilution MIC method.

SCPA 2.2 Practical Course SCPA 2.2

1. Detection of adulteration in common foods.
2. Detection of afla toxin in food and feed.
3. Physical analysis –specific gravity, different solids, tests for grading of milk.
4. Chemical analysis of foods-pH, colour, benzoate and sorbates.
5. Micobiological Analysis of food- MPN, Resazurin test
   Chemical- pH, fat, protein sugar and ash.
6. Platform tests in dairy industry- COB, alcohol precipitation, titrable acidity test, quantitative phosphatase, mastitis and BRT tests.
7. Production of lactose and casein from milk.
8. Microbiology of butter, cheese and idli batter
9. Isolation of bacteria from fermented food samples collected from market

OEPA 2.1 Practical Course OEPA 2.1

1. Writing suitable title (Analysis) of research papers.
2. Search of authors instructions from website of a scientific journal and its analysis/ comparison
3. Assignment on analysis of data/ Results/ Conclusion.
4. Assignment on Google search for scientific purpose.
5. Writing abstract for research paper
6. Preparation of a research article for publication in a journal
7. Preparation of an application to file a patent
8. To enlist Indian journals in Microbiology field with their impact factors

OEPA 2.2 Practical Course OEPA 2.2

1. Bioassy of streptomycin by plate assay method or turbidiometric assay method
2. To determine MIC, LD_{50} of Beta-lactum/aminoglycoside/tetracycline/ansamycins
3. Sterility testing by *Bacillus stearothermophilus*.
4. Production of industrial alcohol using sugary materials
5. Estimation of alcohol by K2 Cr2 O7 method
6. Production of Wine from grapes
7. Production of protease by using bacterial isolate
8. Immobilization of enzyme by Alginate method
9. Production Amylase enzyme by using bacterial culture
10. Assay of Amylase in fermented broth