

PUNYASHLOK AHILYADEVJI HOLKAR

SOLAPUR UNIVERSITY, SOLAPUR



Name of the Faculty: Science & Technology

Choice Based Credit System

Syllabus: Microbiology

Name of the Course: M.Sc. Part- I (Semester- I & II)

(NEW CBCS PATTERN W. E. F. JUNE, 2020-21)

9. Title of the Course: M. Sc. DEGREE COURSE FOR MICROBIOLOGY

Preamble:

Overall picture of student trends in selecting courses is very typical. Most of the science students aim at professional courses, particularly leading to studies in Medical sciences, Engineering. Comparatively less number of students opt for degrees in Biosciences. For several years now, the first preference of students desiring to enter the field of Life Sciences particularly, Microbiology, Botany, Zoology, and for last 4 to 5 years, it has shifted partly to Biotechnology course. This trend has been followed by chemical sciences. Both these disciplines viz. Microbiology and Biotechnology deal with overlapping interests. Microbial sciences focus more on study of the microbial world while Biotechnology focuses more on industrial applications relating to plants and animals.

The main theme of teaching these courses, however, remains the same i.e. application of basic principles of Life Science to develop into technology. Modern biology combines the principles of chemistry and biological sciences (molecular and cellular biology, genetics, and immunology) with technological disciplines (engineering, computer science) to produce goods and services and even for environmental management. The M. Sc. Microbiology course is aimed to develop the science based industries combining the curriculum based on science subjects. The Board of Studies in microbiology has identified the following thrust areas and prospective plans for syllabi reforms at postgraduate level: In addition, we feel that the students should be well acquainted with industrial techniques which include different skill developments in various related fields. The skills will help the students to develop themselves as entrepreneurs.

Introduction: This course provides a broad overview of microbiology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using microbiology. The course structure is biological centric where students basically learn microbiology and are taught necessary basic subjects for that purpose. In addition to disciplines like Virology, Immunology, Genetics, Molecular Biology, Enzymology, Biostatistics, Bioinformatics, Scientific Writing, Computer Science, Industrial Microbiology and waste management etc., topics introduced in the course of two year are in the field of microbiology.

Objectives of the course: A prime objective to maintain updated curriculum and providing therein inputs to take care of fast paced developments in the knowledge of Microbiology in relation to international context, a two year program is formulated for M.Sc. Microbiology to develop competent microbiologist to achieve desirable placements in the country and abroad. The program obliges students to read original publications and envisages significant inputs in the laboratory work, communication skills, creativity, planning, execution and critical evaluation of the studies undertaken. Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing business world.

- To develop awareness & knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.

- To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

- To provide an intensive and in-depth learning to the students in field of microbiology.

·Beyond simulating, learning, understanding the techniques, the course also addresses the underlying recurring problems of disciplines in today scientific and changing business world.

·To develop awareness & knowledge of different organization requirement and subject knowledge through varied subjects and training methodology in students.

·To train the students to take up wide variety of roles like researchers, scientists, consultants, entrepreneurs, academicians, industry leaders and policy.

· **Advantages of the Course:** Microbiology has tremendous job potential. The successful students will be able to establish trading, industrial and consultancy organizations in pharmaceuticals, paper, fermentation, food processing & preservation, agriculture, environment protection and also their own industry for micro propagation of commercially important plants in vitro, transgenic plants, vaccine production, clinical pathology, genetic counseling, human karyotyping etc.

· Multinational companies dealing with production of tissue cultured and genetically modified plants, food products, leather, dairy, beverages, pharmaceutical, chemical Industries, agribusiness, Environment protection.

· Medical & Scientific Research Organizations.

· Universities in India & abroad.

Eligibility of Course:

Eligibility: A Candidate possessing Bachelor Degree with Microbiology or life sciences as a principal subject and who have passed the entrance examination conducted by the PAH Solapur University shall be held eligible for admission to M. Sc. Course in Microbiology.

Students from other University with B.Sc. General Degree in life sciences and who have passed the entrance examination conducted by the University are also eligible.

- **Admission:** Merit list based on average of B.Sc. aggregate and entrance exam conducted by University. For other university student merit list only on basis of entrance examination conducted by University.

- **Duration:** The duration for this program is of 2 years with semester pattern (08 Semesters)

- **Medium of Instruction:** English

- **Structure of the Course:** Structure of M.Sc. course in faculty of Science has total of 8 semesters for 2 years.

- **M. Sc. I comprise of total two semesters and M. Sc. II comprises of total two semesters.**

- **Semester I** includes four theory papers (3 Hard Core and 1 Soft Core) and practical course as

pertheory papers.

- **Semester II & III** includes four theory papers (2 Hard Core, 1 Soft Core and 1 Open Elective) and practical course as per theory papers.

Semester IV includes four theory papers (3 Hard Core and 1 Soft Core) and a Major project substituting the practical course

- Each theory paper comprising of 4 units which are distributed in total 60 lecture hours having weightage of 8 credits.

- Practical papers are to be conducted at the end of their respective semester.

- Final year Major project work should begin in III semester and the completed thesis should be submitted at the end of the IV semester.

· Student would have to present his/her project work during the project report submission which would be evaluated by the internal as well as the external examiners.

· As per the credit system, the assessment of Theory paper of 900 marks weightage will be as: 60 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA). For internal assessment of candidate, periodical tests/seminars/ viva/oral / quiz etc. may be suitably adopted.

· As per the credit system, the assessment of practical paper of 900 marks weightage will be as: 60 marks practical assessment by University examination (UA) and 30 marks internal assessment by the college (CA). In each semester students has to give compulsorily 9& tutorials (8 tutorials per theory paper) with weightage of 24 marks (9 credit)

The overall structure of the course for M SC I Sem I and SemII to be implemented from the academic year 2020-2021 onwards is as follows:

M.Sc. MICROBIOLOGY.C B C S w.e.f.2020-21(REVISED)									
Sem	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
			Thr	IA	Total				
I		Hard Core							
MSc	HCT1.1	Cytology and Taxonomy of Microorganisms	20	20	400	8			8
	HCT1.2	Microbial Chemistry, Physiology and Enzymology.	20	20	400	8			8
	HCT1.3	Recent trends in Virology	20	20	400	8			8
Soft Core(Any one)									
	SCT1.1	Research methodology and Scientific Writing	20	20	400	8			8
	SCT1.2	Biophysics and Bioinstrumentaion	20	20	400	8			
		Tutorial/Seminar			24		9		9
Practical									
	HCP1.1	Practical Course HCP1.1	80	90	40			2	6
	HCP1.2	Practical Course HCP1.2)	80	90	40			2	

	HCP1.3	Practical Course HCP1.3	80	90	40			2	
Soft Core (Any one)									
	SCP1.1	Practical Course SCP1.1	80	90	40			2	2
	SCP1.2	Practical Course SCP1.2	80	90	40			2	
Total for First Semester			820	960	624				24
Semester II									
	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
MS		Hard Core	Thr	IA	Total				
	HCT2.1	Microbial Genetics	60	20	900	8			8
	HCT2.2	Microbial Ecology and Diversity	60	20	900	8			8
Soft Core(Any one)									
	SCT2.1	Microbial Physiology and Metabolism	60	20	900	8			8
	SCT2.2	Medical Microbiology	60	20	900	8			8
Open Elective(Anyone)									
	OET2.1	Bioinformatics & Biostatistics	60	20	900	8			8
	OET2.2	Microbial Nanotechnology	60	20	900	8			
		Tutorial			24		9		9
Practical									
	HCP2.1	Practical Course HCP2.1	80	90	40			2	8
	HCP2.2	Practical Course HCP2.2	80	90	40			2	
Soft Core(Any one)									
	SCP2.1	Practical Course SCP2.1	80	90	40			2	
	SCP2.2	Practical Course SCP2.2	80	90	40			2	2
Open Elective(Anyone)									
	OEP2.1	Practical Course OEP2.1	80	90	40			2	2
	OEP2.2	Practical Course OEP2.2	80	90	40			2	
Total for Second Semester			820	960	624				24

HCT. 9.9: Cytology and Taxonomy of microorganisms.

No. of lectures.

UNIT: I Bacterial cytology

90

9. Surface properties of bacteria and its significance

२. Cell division, Cell cycle and differentiation in bacteria.
३. General characteristics and molecular architecture of Cyanobacteria
४. General characteristics and molecular architecture of Mycoplasmas.
५. General characteristics and molecular architecture of Rickettsias and Chlamydia.

UNIT: II Microbial cytology १०

१. General characteristics and structure of algae, and micro algae
२. General characteristics and structure of fungi.
३. General characteristics and molecular architecture of Actinomycetes.
४. General characteristics of Lichens and Mycorrhizae.

UNIT: III Microbial Taxonomy १०

१. Outline Classification of fungi.
२. Outline classification of algae, micro algae.
३. Outline classification of Cyanobacteria
४. Outline classification of Rickettsias and Chlamydia.
५. Outline classification of Actinomycetes.

UNIT: IV Bacterial nomenclature १०

१. Bacterial nomenclature and classification:
२. Principles of bacterial nomenclature.
३. Outline classification of prokaryotic organisms.

UNIT: V Bacterial Taxonomy १०

१. Introduction to Bergey's manual of Determinative Bacteriology and Bergey's Manual of Systemic Bacteriology

२. Numerical taxonomy, chemotaxonomy, phylogenetic and serological Methods used in classification.

References

१. Bacterial cell structure by Rogers, ASM publications.
२. General Microbiology by Stanier et al, ५th Edn.
३. Microbial Ultra structure by Fuller R.
४. Chemical Microbiology by Rose.
५. Microbial and Plant Protoplasts by Peberdy et al.
६. Biology of Mycoplasma by Smith P. I.
७. Introduction to Fungi by Alexopoulos.
८. Bergey's manual of systematic bacteriology Vol. १, २, ३, ४ Williams, Wilkins & Baltimore, Academic Press.
९. Bergey's manual of Determinative Bacteriology Williams, Wilkins & Baltimore, Academic Press.
१०. A Manual of Soil Fungi § Gilman J. C. (१९६७) Oxford & JBH Publications.

HCT. १.२: Microbial Chemistry, Physiology and Enzymology

Unit-I

१०

Microbial chemistry

१. Protein Chemistry: a) Amino acids- Classification, structural features and Chemical reactions.
b) Reverse turns, Ramchandran plot, helix coil transition.
२. Carbohydrates Chemistry- Nomenclature, types and structures.
- ३ Lipid Chemistry: a) Fatty acids- types and nomenclature's) Types of lipids and structural aspects.c) Steroids, Terpenes and Prostaglandins.
४. Vitamins: a) Water and fat soluble. b) Structures and functions of vitamins.
५. Chemistry of Porphyrins, Chlorophylls, Cytochromes, Haemoglobin, leg haemoglobin and Bacteriorhodopsin.

Unit-II

90

Kinetics of Enzyme activity: a) Introduction of Chemical kinetics. b) Kinetics of Single substrate enzyme catalyzed reactions—Wilhelmy's and Brown's work, Henri and Michaelis and menten derivations, Briggs and Halden modification. c) Significance of the M-M equation and K_m . d) Modification of M-M equation—Lineweaver—Burk, Eadie—Hofstee, Hanes and Eisenthal and Cornish—Bowden. e) Kinetics of multi substrate reactions. f) Inhibition—Basic concepts, kinetics, examples and significance of reversible and irreversible inhibition.

Unit-III

90

Catalytic power of enzymes:

1. Basic concept of catalysis—activation energy barrier and the transition state theory
2. Catalytic mechanism in chemistry and in enzymes—acid & base, covalent and electrochemical reactions.
3. Factors enhancing the catalytic efficiency of enzymes proximity and orientation, orbital steering, distortion and strain.
4. Functional groups involved in the catalytic mechanism— a) Amino acids b) Co factors— Prosthetic groups, coenzymes, co substrates. c) Metal ions in enzyme function.—their role, metal activated and metallo—enzymes, ternary complexes.
5. Some examples of enzyme function— Chymotrypsin, Lysozyme and Isomerase.

Unit-IV

90

Regulation of Enzyme function:

1. Control of enzyme activity by— a) Changes in covalent structure— irreversible and reversible b) Ligand induced conformational changes—Allosteric enzymes— Basic concepts Cooperativity, model proposed to explain the mechanism of functioning (MWC and KNF) structural aspects of aspartate carbomyl transferase, role of allosteric enzymes in metabolic regulation (feed back inhibition).
2. Enzymes in organized systems and their role in control function a) Multienzyme system— Basic concepts, significance and types with examples, structural aspects of pyruvate dehydrogenase and fatty acid synthesis.

Unit V 90

1. Oxidation of hydrocarbons and Drug metabolism:

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

2. Osmosis, Oxygen toxicity and Microbial hormones

- a Osmosis § definition, microbial response to osmotic stress, avoidance of osmotic stresses, responses of microbial § plasma § membrane § to- osmotic § stresses. Reverse osmosis.
- b Oxygen toxicity § catalase, peroxidase, super oxide dismutase, mechanism of O toxicity
- c Microbial hormones and their significance.

References :

HCT. 1.2: Microbial Chemistry Physiology and Enzymology

1. Biological Chemistry by Melhar H.R. and E.H. Cord 1964 Harper and Row Publisher inc New York
2. Biochemistry by Stryer, L. 1979 2nd edition, W.H. Freeman and company, Sanfrancisco.
3. Biochemistry by Stryer, L. 1988 3rd edition, W.H. Freeman and company, Sanfrancisco
4. Enzyme nomenclature- International Union of Biochemists (IUB) Academic press.
5. Understanding enzymes- Trevor Palmer Ellis Harwood Publications.
6. Fundamentals of Enzymology- N.C. Price and L.Stevenson, Oxford University Press.
7. Enzymes P.Boyer, Academic Press.
8. The Enzymes M. Dixon and E.C. Webb.
9. Advances in Enzymology- Series edited by N.O. Kaplan, Academic Press.
10. Enzyme structure and Mechanism- A. Fersht, Freeman, USA.
11. Biochemistry by Lehninger A.L. Kalyani Publisher, New Delhi
12. Principles of Biochemistry by Lehninger A.L. 1988 1st Indian edition, LBS Publisher and Distributor Pvt. Ltd, New Delhi.
13. Basic Biochemistry 2nd Edition § Lehninger, A. L. (1988) Kalyani Publications, Ludhian, New Delhi.

၁၈. Textbook of Biochemistry, ၈th Edition § West E.S.W.R. Tood, H.S. Mason, J.T.V. Burgen (၁၉၆၆) Macmillan Company, New York.
၁၉. Principles of Biochemistry ၄th Edition § White A. P. Handler, and E. L. Smith (၁၉၆၃) McGraw Hill Koga Kusha Ltd., Tokyo.
၂၀. Biochemistry § by Zubay
၂၁. Bacterial Physiology and Metabolism by R. J. Sokath.
၂၂. Metabolism by Doelle, Academic Press, London.
၂၃. Microbial Physiology § Dawes I. W., and Sutherland J. W, (၁၉၆၆) Halsted press
၂၄. Microbial Physiology – Albert G. Moat, John W. Foster John John Wiley & Sons

HCT၁.၃ Recent trends in Virology

Unit: I: Classification and Morphology of Viruses. ၁၀

၁. Brief outline of discovery of viruses.
၂. Morphology and ultra-structure of viruses, viroids and prions.
၃. Classification and nomenclature of animal and plant viruses.
၄. Cataloging the viruses through virus classification schemes of ICTV / ICNV

Unit: II: Cultivation and assay of viruses ၁၀

၁. Cultivation of viruses using embryonated eggs, experimental animals and cell cultures.
၂. Purification of viruses by adsorption, precipitation, enzymatic and serological methods § haemagglutination and ELISA.
၃. Assay of viruses § Physical and Chemical methods. Infectivity Assays.
၄. Genetic analysis of viruses by classical genetic methods.

Unit: III: Viral Multiplication ၁၀

၁. **Bacteriophages** § Lytic and lysogenic interactions
၂. **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.

Unit: IV: Pathogenesis of Viruses ၁၀

၁. Host and virus factors involved in pathogenesis,
၂. Pathogenesis of animal viruses: Adeno virus, Herpes virus, Picorna virus, Poxvirus and Orthomyxovirus,

3. Pathogenesis of plant viruses [TMV], Satellite viruses and their role in plant virus replication. Insect viruses [NPV]
8. Host cell transformation by viruses, oncogenesis by DNA and RNA viruses.

Unit: V: Control of Viruses and Emerging Viral infections 90

9. Control of viral infections with vaccines and antiviral drugs, antibody and interferons.
2. **Emerging viral infections:**SARS.EBOLA,Coronavirus.Zika virus, Influenza viruses, Chikungunya, Nipah virus.

References

MIC § 9.3: Recent trends in Virology

9. Bacterial & Bacteriophage Genetics by Edward A. Birge.
2. Principles of Bacteriology, Virology & Immunity 4th edition (Vol. 8) by Topley & Wilson's.
3. General Virology § Luria.
8. Introduction to Plant Virology § Bos I. (1983) Longman, London & New York..
4. Animal Virology § Fenner, F & White, D. O. (1978) Academic Press Inc., New York.
6. Chemistry of Viruses (2nd edition) § Knight C. A. (1974) Springer Verlag Inc. New York.
9. Virology § Dulbecco R. and Ginsberg H. S. (1980), Harper and Ravi Publishers Inc. New York.
2. Introduction to modern virology by Dimmock. Fourth Edition. Blackwell Scientific Publication, Oxford.
9. Virology by Conrat, Kimbal and Levy, Third Edition, Englewood Cliff New Jersey Publication.
90. Principles of virology by Edward Arnold. 2000.
99. Medical virology by Morag and Tim, 90th Edition. Churchill Livingstone publication, London.

Soft Core (SCT) (Any one)

9. Research Methodology and Scientific Writing

Unit I 90

Scientific Writing: Historical Account

9. Choosing a mentor/guide, laboratory and research questions; maintaining a lab notebook.

२. History and basic concept of scientific writing. Types of presentations: Oral, poster, written, audio-visual, Aids for presentation.

३. Empirical science, Scientific methods, manipulative experiments and control; concept, hypothesis, theory, law, Design of experiment; Descriptive science, Inductive and deductive reasoning. Reductionistvsholistic biology.

Unit II 90

Research Methodology

१. Preparing the manuscript, guidelines for authors, The IMRAD format.

२. Title, byline, abstract and Summary; keywords

३. Introduction: Defining the problem, Literature survey; Justification of study.

४. Material and Methods: Contents, sources, procedures, techniques, reproducibility, Units of measurements, metric system and SI units. Basic statistical techniques, confidence limits, tests, probability, significance.

५. Results: Text; How to present data; Tables and illustrations. Writing captions, labels and legends.

६. Discussion: components and sequences. Analysis, comparison and integration of data. Likely sources of errors in Results; Conclusions and significance. Implications for further study.

७. Acknowledgements: Literature citation system. Sources of references: Journals, books, bibliographies, abstracting journals; databases

८. Preparing and submitting the manuscript. Revising, editing, proofreading

Unit III

Literature survey using internet

Use of search engines like Google / NCBI / PUBMED and other resources for searching literature

Unit IV

92

Scientific communication

Types of reports, layout of format reports, writing skills, importance of communication science, problem while writing scientific document, plagiarism, software for plagiarism, Scientific publication writing paper. Peer review process and problems, recent developments such as an open access and non-blind review, plagiarism, characters of effective technical communication, scientific presentations, ethical issues, scientific misconduct. Barriers in effective communication.

Unit V

93

1. Making oral presentations: Pronunciation, accent, intonation, clarity, speed, fluency, eye contact

2. Enrichment of vocabulary: words forms and derivations, prefixes and suffixes, other processes of word formation, scientific and technical vocabulary, spellings, frequently confused words.

3. Basic grammar: Tenses, Voices, Propositions and conjunctions, Conditional sentences, count and non-count nouns; concord, Punctuations.

8. Effective written presentations: Order of sentences in paragraph; sentence connection, cohesion and coherence; Contradiction, tautology, semantic anomaly etc.

4. Using dictionary and the thesaurus

ξ. Writing the curriculum vitae/biodata.

Reference books:

၁. Gopen GD, and Smith JA. The Science of Scientific Writing. American Scientist, ၉၂, (Nov-Dec. ၁၀၃၀), ၄၄၀-၄၄၂.
၂. Day D.A., Sakaduski N, Day N. (၂၀၁၁) Scientific English: A guide for scientists and other professionals. ABC-CLIO Publications.
၃. Day R.A. & Gastel B ၆th Edition (၂၀၀၆) How to write and publish a scientific paper, Cambridge University Press.
၄. On Being a Scientist: a Guide to Responsible Conduct in Research. (၂၀၀၅) Washington DC, National Academies Press.
၅. Alley M (၁၉၉၆). The craft of scientific writing. Springer Publication.
၆. Valiela I. (၂၀၀၅). Doing Science: Design, Analysis and Communication of Scientific Research. Oxford: Oxford University Press.
၇. Day R.A. (၁၉၂၂) How to write & publish a Scientific paper, Cambridge University Press.
၈. Movie: Naturally Obsessed, The making of Scientist. Day R.A. & Gastel B ၆th Edition (၂၀၀၆) How to write and publish a scientific paper, Cambridge University Press.
၉. Alley M (၁၉၉၆). The craft of scientific writing. Springer Publication.
၁၀. Day R.A. (၁၉၂၂) How to write & publish a Scientific paper, Cambridge University Press

SCT: ၁.၂ Biophysics and Bioinstrumentation

Unit-I **90**

Laboratory instruments § Principle and working.

- a pH meter
- b Colorimeter, Spectrophotometer.
- c Laminar air flow and Bio-safety cabinet.
- d Centrifuge machine
- e Electron microscope, fluorescence, dark field and phase contrast microscope.

Unit-II **90**

Analytical techniques

- a Radio-isotopic techniques- nature of radioactivity, methods of detection and measurement, methods of application § tracer, autoradiography.
- b Chromatographic techniques
- c Electrophoretic techniques

Unit-III **90**

Spectroscopy

- a IR and NMR, fluorescence and atomic absorption
- d Principles, instrumentation and applications UV § visible spectrophotometry, turbidometry and nephelometry, fluorimetry, luminometry, atomic absorption and mass spectroscopy.
- b ORD and CD spectroscopy

Unit-IV **90**

Electrochemical Techniques

- a Electrochemical techniques § electrochemical cells, potentiometry and voltammetry.
- b Principles and applications of ion selective and gas sensing electrodes, pH, oxygen electrodes and redox couples.
- c Principles, apparatus, functioning and applications of nanometry.

Unit-V

90

Molecular Biophysics Physical and chemical properties of amino acids and polypeptides, theoretical and experimental methods for determination of sizes of proteins, physical nature of non-covalent interactions, conformational properties of proteins, Ramchandran plot, secondary, super secondary, tertiary and quaternary structure of proteins.

- 9. Protein structure determination by X-ray diffraction.

References: SCT9.2 Biophysics and Bioinstrumentation

- 9. Principles of Physical Biochemistry § Van Holde, et al., Prentice Hall.
- 2. Crystallography made crystal clear § G. Rhodes, Academic Press.
- 3. Introduction to Protein Structure § Branden and Tooze, Garland Publishing Co.
- 8. Methods in Modern Biophysics -Bengt Nölting, 2nd Edition Springer 2008
- 4. Biophysics § VasanthaPattabhi N. Gautham Narosa Publishing House.
- 6. Principles of Protein X-Ray Crystallography – Jan Drenth Third Edition.
- 9. Instrumental methods of chemical analysis by Chatwal and Anand, Himalaya Publication House, Mumbai.

Practical Courses SEMESTER §I

HCP9.9: on (HCT9.9 Cytology and Taxonomy of Microorganisms)

१. Demonstration of: Bacterial and yeast DNA
२. Preparation of yeast protoplasts.
३. Isolation and purification of lysozyme from egg white and preparation of bacterial protoplasts.
४. Isolation of bacterial cell wall and study of cell wall polysaccharide by chromatographic technique
५. Single cell and single spore isolation techniques.
६. Study of magnetic and electric field on behavior of microorganisms.
७. Isolation and identification of reserved food material from *Bacillus megaterium* .
८. Isolation and morphological studies of §
 - i. Algae § Spirulina, Spirogyra, Nostoc and Anabaena spp.
 - ii. Fungi- Aspergillus, Penicillium, Rhizopus, Fusarium, Trichoderma and Saccharomyces.
 - iii. Protozoa § Paramecium and Plasmodium and Entamoeba.
 - iv. Mycorrhiza § VAM fungi § demonstration.
 - v. Lichen- demonstration.
९. Induction of ascospore in yeasts of *Saccharomyces cerevesiae*.

HCP 1.2: Practical Course on (Microbial Chemistry, Physiology and Enzymology)

1. Estimation of total carbohydrates, proteins, lipids.
2. Preparation of Buffers- Phosphate, Acetate, Citrate etc.
3. Studies on enzyme Amylase-
 - a) Precipitation of enzyme by solvent & salt and partial purification by dialysis.
 - b) Quantitative estimation of the enzyme and enzyme activity.
4. Effect of following factors on amylase activity
 - a) Substrate concentration (S_0)- determination of V_{max} and K_m .
 - b) pH for amylase activity
 - c) Temperature for amylase activity.
 - d) Metal ions for activity.
5. Immobilization of amylase in Na- alginate.
6. Studies on
 - a) Stability- thermal storage - wet and dry
 - b) Effect of Substrate concentration, temperature, pH on immobilized amylase/protease.
7. Study and detection of levels of lactate dehydrogenase, alkaline phosphatase in serum.
8. Assay of Protease.

HCP 1.3: Practical Course on (Recent trends in Virology)

1. Isolation, titration and high titer stock preparation of *E.coli* phages from sewage.
2. Phage typing of *E.coli* and *Salmonella* strains.
3. Infectivity Assays (Plaque and end-point)

- ۛ. Infectivity Assays of plant viruses
- ۜ. Study of one step growth curve of phage Tۛ
- ۝. Study of Egg inoculation techniques.
- ۞. Cultivation of animal viruses in embryonated eggs.
- ۟. Purification of viruses by serological methods § haemagglutination and ELSA.

SCPۛ.ۛ: Practical Course on (Research Methodology and Scientific Writing)

Practicals:

- ۛ. Writing suitable title (analysis) of research paper.
- ۜ. Assignments on search of scientific paper using key words, author etc on PUBMED.
- ۝. Writing abstract of research paper.
- ۞. Search of authors instruction from website of a scientific journal and its analysis / comparison, characteristics of journal.
- ۟. Assignment on analysis of Data / Results / Conclusion.
- ۠. Assignment on Google search for scientific purpose.
- ۡ. Assignment on search Impact factor of scientific journal from Internet.
- ۢ. Assignments on NCBI/PUBMED.
- ۣ. Detection of plagiarism using plagiarism software.
- ۤ. Presentation and analysis of a published paper.

OR

SCPۛ.ۜ: Practical Course on (Biophysics and Bioinstrumentation)

- ۛ. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using thin layer Chromatographic techniques.

२. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using column chromatographic techniques
३. Electrophoretic separation of proteins and nucleic acids by agarose gel electrophoresis .
४. Electrophoretic separation of proteins and nucleic acids by polyacrylamide gel electrophoresis.
५. Electrophoresis of polysaccharide and glycoprotein, lipoproteins etc.
Studies on the principles of light spectroscopy § Beer and Lambert`s laws, extinction coefficient and molar extinction coefficient.
६. UV § visible spectrophotometry & atomic absorption spectroscopy.
७. Immunochemical techniques: Immunodiffusion, immune–electrophoresis, radioimmunoassay, enzyme linked immunosorbent assay , immunoblotting, immune–histochemistry

References for practical courses:

१. Practical Microbiology by R.C.Dubey and D.K.Maheshwari. S.Chand & Co.
२. Experimental Microbiology by R.J.Patel. Aditya Publishers, Ahmedabad
३. Identification Methods for Microbiologists by B.M.Gibbs and F.A.Skinner. Academic Press
४. Laboratory Microbiology by L.Jack Bradshaw. W.B.Saunders & Co.
५. Benson`s Microbiological Applications Laboratory Manual in General Microbiology by Alfred E.Brown.
६. Methods in Microbiology (Vol. ५ Band Vol. ३A) by Norris and Ribbons. Academic Press
७. Bergey`s Manual of Systematic Bacteriology
८. Microbiological Methods by Michael Collins
९. Handbook of Microbiological Media by R.M. Atlas. CRC Publications

Semester: II

HCT२.१ Microbial Genetics

No. of lectures.

Unit § I Structure, Characteristics and forms of DNA

१०

- १) Evidences of DNA and RNA as genetic material:-Griffith's Experiment, identification of Transforming Principle by Avery, MacLeod and McCarty, Hershey and Chase Experiment.
- २) Differences in organization of prokaryotic & Eukaryotic Genome.
- ३) Primary structure - Secondary structure- (Watson and Crick model), Tertiary Structure: negative and positive superhelices.
- ४) 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.
- ५) Forms of DNA: A, B, C and Z forms.
- ६) Types of DNA molecules-linear single stranded and duplex, closed circular duplex.

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

१०

- १) DNA Replication § Steps involved with enzymes in DNA replication, theta and rolling circle model.
- २) DNA Modification § Post-Replicative modification, Restriction endonucleases and methylases.
- ३) Mutations at Molecular Level § Types of mutations (Base pair substitution, frameshift, missense, nonsense, silent, mutation in termination codons), Induced

and spontaneous mutations (Tautomerism, mutations caused by physical and chemical agents), Genetic suppression

- 8) Ames and other toxicity testing, Role of mutation in evolution and antibiotic resistance
- 9) DNA damage and repair- types of damages, damaging agents,
- ε) Repair mechanisms- Photoreactivation, dark repair, post replication recombination repair, SOS repair

Unit III Gene transfer, Transposons and Plasmids

90

- 9) Gene transfer § transformation, Conjugation & transduction, overview of bacterial genetic mapping.
- 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.
- 8) Genetics of fungi-alteration of generation, induction of mutation in *Neurospora crassa* and yeast.

Unit IV Molecular aspects of gene expression and regulation, Genomics

90

- 9) 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.
- 8) Operon models - Lactose, tryptophan and arabinose.
- 9) Genomics: Genome analysis, Complete genomics, Functional genomics, structural genomics, Epigenomics, Metagenomics, Applications of genomics.

ξ) DNA fingerprinting.

Unit V Phage Genetics

90

- 1) T ϕ virulent phage- structure, life cycle, genetic map , properties of T ϕ DNA, Structure of T ϕ replisome, Silent features of T ϕ 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 cl Repressor, Induction of lysogen, Immunity to superinfection
- 3) Filamentous bacteriophages- M ϕ 3- Structure, life cycle (pattern of DNA replication), Structure and replication of phage Φ x198.
- 4) Molecular recombination in phages, Applications of phages in molecular biology (Role in recombination and gene cloning).

References:

1. Gene IX by Benjamin Lewin, Jones and Bartlett Publishers. 2009.
2. Molecular Biology by R.F. Weaver, 8th edition. McGraw Hill, USA. 2009.
3. Molecular Biology of the Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick, 8th edition. Benjamin Cummings. 2009.
4. Modern Microbial Genetics edited by U.N. Streips, R.E. Yasbin. 2nd edition. Wiley-Liss Publishers. 2002.
5. Microbial Genetics by D. Freifelder 8th edition
6. Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter. 4th edition. Garland Science, New York and London. 2009.
7. Biochemistry by J.M. Berg, J.L. Tymoczko, L. Stryer, 4th edition. W.H. Freeman and Company, USA. 2004.
8. Current Protocols in Molecular Biology edited by: F. M. Ausubel, R. Brent, R.E. Kingston, D. D. Moore, J. A. Smith, K. Struhl. John Wiley and Sons, Inc. 2009.
9. Bacterial and Bacteriophage Genetics. 8th Editions by Birge.

HCT२.२: Microbial Ecology and Diversity

No. of lectures.

Unit-I

१०

Microbial Ecology

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

Unit-II

A. Microbial Diversity:१०

१. Levels of microbial diversity: Genetic, species and ecological
२. Types of Microbial Diversity
 - a. Taxonomic Diversity
 - b. Functional Diversity
३. Techniques for assessing Microbial Diversity
 - a. Culture dependent methods
 १. Conventional approaches
 २. Molecular based approaches
 - b. Culture dependent methods
 १. Whole genome sequencing
 २. Metagenomics

३. Metproteomics

४. Proteogenomics

५. Metatranscriptomics

४. Importance of conservation of microbial diversity

B) Microbial Ecology:

१. Concept, niche, habitat, ecosystem

२. Environmental sample collection and processing:-food, soil, air, detection of microbes on fomites

Unit-III

१०

Anoxygenic and Oxygenic photosynthesis:

- १) Anoxygenic photosynthetic microbes-General characteristic of purple and green sulphur bacteria
- २) Oxygenic photosynthetic microbes- General characteristics of Cyanobacteria and Prochlorales
- ३) Methanogenic Archeobacteria-General characteristics

Unit-IV

१०

Bioluminescence nitrogen fixation Microbial fossils and uncultured organisms:

- १) Bioluminescent and nitrogen fixing bacteria- A high energy spending bacteria
- २) Magnetotactic bacteria
- ३) Microorganisms in prospecting of oils
- ४) Microbial fossils
- ५) Identification of uncultured organisms

Unit-V

१०

Extremophiles:

- १) 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 biodeterioration

References: HCT2.2: Microbial Ecology and Diversity

- 1) Extremophiles–(2000) By B.N.Johari Springer Verlag, New York.
- 2) Microbial diversity (1999) by D.Colwd Academic press.
- 3) Bergy's Manual of Systematic Bacteriology (1998). Vols. I and III .Williams and Wilkins, Baltimore Academic press
- 4) Microbial life in extreme environments (1998) by D.s.Kushner Academic press Inc. New York
- 5) Microbial ecology (1999) by J.M.Lynch and N.J.Poole .Blackwell Scientific Publications, Oxford.
- 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 (1999). by B. Atkinson et al. Macmillan

SCT2.9 Microbial Physiology and Metabolism

No. of lectures.

Unit-I

90

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

90

- 1) ETC: Concept, components involved 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 systems across membrane, Atkinson's energy change.
- 4) Citric acid cycle: steps involved, amphibolic nature, anapleurotic reaction.

Unit-III 90

Biosynthesis

- 1) Purines and pyrimidines by de novo synthesis.
- 2) Saturated fatty acids.
- 3) Amino acid synthesis pathways

Unit-IV 90

Oxidation of hydrocarbons and Drug metabolism:

- 1) Alkanes and alkenes § alpha, beta, and omega oxidation.
- 2) Aromatic hydrocarbons § beta keto adipate pathway, valerate pathway, gentisate pathway.
- 3) Drug metabolism and detoxification.

Unit-V

90

Osmosis, Oxygen toxicity and Microbial hormones

- 1) Osmosis § definition, microbial response to osmotic stress, avoidance of osmotic stresses, responses of microbial § plasma § membrane § to- osmotic § stresses. Reverse osmosis.
- 2) Oxygen toxicity § catalase, peroxidase, super oxide dismutase, mechanism of O₂ toxicity
- 3) Microbial hormones and their significance.

References: SCT 2.9 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 & Son

SCTR.2: Medical Microbiology

No. of lectures.

Unit-I

90

Virulence & Epidemiology

- 1) Virulence: Entry, establishment, spread of microorganism in body, tissue damage and antiphagocytic factors, mechanism of bacterial adhesion; colonization and invasion of mucous membranes of respiratory; enteric and urinogental tracts; measurement of virulence, bacterial resistance to humoral defense; coagulase reacting factor; lysozyme; lactoferrin; transferrin, microbial toxins § characteristics and mode of action of Diphtheria, cholera, Vibrio parahaemolyticus, endotoxins of gram negative bacteria, plasmid mediated factors associated with bacterial virulence, Antigenic variation and bacterial virulence.
- 2) Epidemiology: Infectious disease cycle, Characteristics of infectious disease in population, epidemiological methods § descriptive, analytical and experimental epidemiology, measurement of infection rate.

Unit-II

90

Microbial diseases

Microbial diseases: morphological, cultural, biochemical, antigenic characters, pathogenesis, transmission, laboratory diagnosis, prevention and control of §

Helicobacter pylori, Leptospiraicterohaemorrhagiae, Balantidium coli, Wucheriabancroftii, Taeniasaginata, Ascarislumbricoides, Enterobiusvermicularis, Trichonellaspirealis, Herpes virus, Hepatitis B, Japanese encephalitis, Dengue fever, Rubella and Rubirola virus.

- १) Anaerobic bacterial infections in Human beings and therapy.
- २) Dental Caries and periodontal diseases and their infectious nature.
- ३) AIDS and prevalence of Tuberculosis, Mycoplasma and cryptococcal infections.

Unit-III

Medical Mycology

१०

Medical Mycology: Pathogenic fungi, structural dimorphism and pathogenesis of fungi, role of extracellular products in fungal infections

Unit-IV

१०

Clinical microbiology

१. Clinical microbiology - Collection, transportation and preliminary processing of clinical specimen, Rapid methods of identification of pathogenic microorganisms § API, ELISA, FAT, RIA and Western Blot.

२. Enzymes in medical diagnosis and therapy

Unit-V

Chemotherapy and animal Tissue Culture १०

Chemotherapy § different chemotherapeutic agents for Bacteria, fungi, viruses and protozoa,

Mechanism of action of different chemotherapeutic agents.

Animal Tissue Culture § types, formulations of media, methodology and applications.

References: SCT 2.2: Medical Microbiology

- 1) Medical Microbiology, 9th Edition by E. Jawetz, J.L. Melnick, E.A. Adelberg
- 2) Medical Microbiology, 8th Edition by S. Gupte, Jaypee Brothers Publications
- 3) Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen.
- 4) Medical Microbiology, by R. Cruickshank, J.P. Duguid, B.P. Marmion, R.H.A. Swain.
- 5) The Textbook of Microbiology, by R.C. Dubey and D.K. Maheshwari.
- 6) Textbook of Microbiology by R. Vasanthkumari.
- 7) Medical Microbiology by S. Rajan MJ Publishers.
- 8) Unsworth K. E. and David W. Holden, (2000), *Identification and analysis of bacterial virulence genes in vivo*, Phil. Trans. R. Soc. London B. **355**, 693-622
- 9) Woods D. E., (2002), *The use of animal infection models to study the pathogenesis of melioidosis and glanders*, Trends Microbiol, **10(11)**: 423-4
- 10) Eduardo A. Groisman and Howard Ochman, (1998), *How to become a pathogen*, Trends in Microbiology, **6(12)**: 229-238
- 11) Carpenter Philip L., (1994), *Saunders International Edition - Immunology and Serology*, W. B. Saunders and Co., London
- 12) Schlessinger David, Editor, *Mechanism of Microbial Virulence*, in Microbiology § 1999, American Society for Microbiology, Washington D. C., 99-230
- 13) Schlessinger David, Editor, *Biochemical Genetics of Pathogenicity*, in Microbiology § 1999, American Society for Microbiology, Washington D. C., 99-230
- 14) Mark J. Pallen & Brendan W. Wren, (2009), *Bacterial pathogenomics*, Nature Rev. **889/92**: 434-442

94) Hughes Eric A. and Jorge E. Galan, (2002), *Immune Response to Salmonella: Location, Location, Location?*, Immunity, 16: 324-332

95) Bhavsar Amit P., Julian A. Guttman and B. Brett Finlay, (2009), *Manipulation of host-cell pathways by bacterial pathogens*, Nature Rev 889/92: 29-38

96) David N. Fredricks and David A. Relman, (1996), *Sequence-Based Identification of Microbial Pathogens: a Reconsideration of Koch's Postulates*, Clinical Microbiology Reviews, 9: 333

97)

OET 2.9: Bioinformatics & Biostatistics

No. lectures.

UNIT I: Introduction to Bioinformatics

90

- 1) Introduction to Bioinformatics: Use of bioinformatics in major research areas. Major Bioinformatics Resources: (National Centre for Biotechnology Information (NCBI), European Bioinformatics Institute (EBI), Expert Protein Analysis System (ExPASy). The knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, purpose and utility in life sciences.
- 2) Open access bibliographic resources and literature databases: Basic concept of open access bibliographic resources related to Life Sciences, the significance and need for such resources, the major content of the databases, how to search and use these resources/databases with special reference to PubMed, PubMed Central, Public Library of Sciences etc.

UNIT II: Taxonomy and phylogeny

90

- 1) Taxonomy and phylogeny: Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining; Probabilistic models and associated algorithms such as Probabilistic models of evolution and Maximum likelihood algorithm.
- 2) Cheminformatics, Pharmacogenomics § Application of Bioinformatics in drug discovery,

UNIT III: Sequence and Structure Databases

90

- १) **Sequence and Structure Databases:** Knowledge of the following databases with respect to: organization of data, contents and formats of database entries, retrieval of data using text-based search tools, sources of data (e.g. sequencing projects, individual scientists, patent offices etc.), method for deposition of data to databases.
- २) **Nucleic acid sequence databases:** GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL. Genome Databases at NCBI, EBI, TIGR, SANGER Viral Genomes Archeal and Bacterial Genomes
- ३) **Genomics and Proteomics.** Large scale genome sequencing strategies. Gene networks/basic concepts, computational model such as Lambda receptor and Lac-operon.
- ४) **Functional genomics:** application of sequence based and structure-based approaches to assignment of gene functions - e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases.
- ५) **DNA microarray:** understanding of microarray data and correlation of gene expression data to biological processes and computational analysis tools (especially clustering approaches).
- ६) **Protein arrays:** bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Prediction of 3D structure of proteins

Unit § IV § Biostatistics

१०

- १) **Biostatistics** -Basic concepts, definitions, statistics and biostatistics, sampling methods, merits and demerits of Random, deliberate or nonrandom, stratified, and cluster sampling. scales and variables, data organization, tabulation, graphical representation,
- २) **Collection and presentation of data:** primary and secondary data, collection of data § enumeration and measurement, significant digits, rounding of data, accuracy and precision, recording of data. Tabular and diagrammatic presentation § arrays, frequency distribution, bar diagrams, histograms and frequency polygons.
- ३) **Descriptive statistics:** measures of central tendency, dispersion, skewness and kurtosis, Normal, Binomial and Poisson distribution and their applications, test for goodness of fit. Standard error, Confidence interval

- 1) **Probability** – definition, elementary properties, types, rules, applications to biological problems, chi-square (χ^2) distribution and test.
- 2) **Hypothesis testing**: definition of hypothesis, hypotheses – null and alternate hypotheses, general procedure, decision about H_0 § one-tailed and two-tailed tests, type I and type II errors
- 3) **Analysis of Variance (ANOVA)**: basic concepts, experimental designs § CRD, RBD, factorial experiment, repeated measures, other designs, general method, F § test, multiple comparison tests.
- 4) **Correlation and Regression**

References: OET 2.9: Bioinformatics & Biostatistics

Bioinformatics

- 1) Bergeron, B. (2003) Bioinformatics Computing, Prentice-Hall of India Private Limited, New Delhi
- 2) Baxevanis, A. D. and Ouellette, B. F. F. (2009) Bioinformatics: A practical guide to the analysis of genes and proteins. Second Edition. John Wiley & Sons, New York.
- 3) Jean-Michel Slaveries and C. Notredame (2003) Bioinformatics: A Beginner's Guide Wiley Dreamtech India (P) Ltd., New Delhi
- 4) Khan, I. A. (2004) Elementary Bioinformatics, Pharma Book Syndicate, Hyderabad 500 094
- 5) Lacroix, Z. and Critchlow, T. (Eds.) 2003. Bioinformatics. Managing Scientific Data. Morgan Kaufmann Publishers.
- 6) Mount, D. W. (2009) Bioinformatics: sequence and genome analysis. Cold Spring Harbor Laboratory Press, New York.

- ୭) Narayanan, P. (୨୦୦୫) Bioinformatics a Primer, New Age International(P) Limited, Publishers, New Delhi § ୧୧୦ ୦୦୨
- ୮) Westhead, D. R., J. H. Parish and R. M. Twyman (୨୦୦୩) Bioinformatics (InstantNotes Series), Viva Books Private Limited, New Delhi, Mumbai, Chennai, Kolkata
- ୯) Zoe L. and Terence C. (୨୦୦୪) Bioinformatics: Managing ScientificData, MorganKaufmannPublishers, New Delhi

Biostatistics

- ୧) Daniel, Wayne (୨୦୦୭) Biostatistics A foundation for Analysis in the healthsciences, Edition ୭, Wiley- India edition.
- ୨) Davis, Charles S.(୨୦୦୨): Statistical Methods for the Analysis of Repeated Measurements
- ୩) Finney, D.J. (୧୯୭୧): Statistical Method in Biological Assays.
- ୪) Fleiss, Joseph L., Levin Bruce & Paik Myunghee Cho (୨୦୦୩): Statistical Methods for Rates and Proportions
- ୫) Irfan Ali Khan and AtiyaKhanum, Fundamentals of Biostatistics. ୨ndEd. Ukaaz Publications, Hyderabad.
- ୬) Montgomery D.C. § Design and analysis of experiments, John Wiley& Sons.
- ୭) Murthy M.N. § Sampling methods, Indian Statistical Institute, Kolkata.

OET୨.୨ Microbial Nanotechnology

Unit § 1୧୦

History § bionanotechnology § concept and future prospects § application in Life Sciences.

Terminologies § nanotechnology, bionanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles.

Unit § II 90

Molecular nanotechnology § nanomachines § collagen. Uses of nanoparticles § cancer therapy § manipulation of cell and biomolecules. Cytoskeleton and cell organelles. Types of nanoparticles production § physical, chemical and biological. Microbial synthesis of nanoparticles

Unit § III 90

Nanoparticles § types, functions § Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles § UVVis spectroscopy, Electron Microscopy § HRTEM, SEM, AFM, EDS, XRD.

Unit § IV 90

Uses of nanoparticles in biology : Drug delivery § protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanotechnology in health sectors. Toxicology in nanoparticles § Dosimetry.

Unit § V 90

Advantages of nanoparticles § drug targeting, protein detection, MRI, development of green chemistry § commercial viability of nanoparticles. Disadvantages § health risk associated with nanoparticles, inadequate knowledge on nanoparticles research.

References: OET 2.2; Microbial Nanotechnology

- 1) Introduction to Nanotechnology, Isha Publication. Elisabeth Papazoglou and Aravind Parthasarathy, B.K. (2009)
- 2) **Bio nanotechnology**. Morgan & Claypool Publishers. Bernd Rehm (2006).
- 3) **Microbial Bio nanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures**. Horizon Scientific Press. David E. Reisner, Joseph D. Bronzino (2008).
- 4) **Bio nanotechnology: Global Prospects**. CRC Press. Ehud Gazit (2006). Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press.

Semester: II Practical Course

Practical Course

- 1) Isolation of DNA from bacteria and yeasts.
- 2) Isolation of bacterial and yeast plasmids (amplification, curing and purification)
- 3) Detection and location of DNA :Spectrophotometrically, Diphenyl amine test, agarose, gel electrophoresis
- 4) Estimation of DNA by Diphenyl amine
- 5) Hyperchromacity / UV absorption spectra study of chromosomal DNA using UV λ visible spectrophotometer.
- 6) Isolation and purification of RNA from yeast, Quantitative estimation of RNA by Orcinol test.
- 7) Studies on light and dark repair mechanisms in bacteria using UV radiations
- 8) Isolation of antibiotic resistant bacterial mutants by UV and chemical mutagenesis.
- 9) Isolation of vitamin / growth factor / thiamine requiring mutants of *E.coli* using replica plate technique
- 10) Study of transformation, transfection, conjugation, transduction, protoplast fusion in Bacteria
- 11) Testing of chemicals for mutagenicity by Ames test.
- 12) Demonstration of PCR and DNA fingerprinting

HCP 2.9 Practical Course : Microbial Genetics

- १) Isolation of DNA from bacteria and yeasts.
- २) Fluctuation test.
- ३) Isolation of RNA from yeasts.
- ४) Isolation of bacterial and yeast plasmids (amplification, curing and purification).
- ५) Study of transformation, transfection, conjugation, transduction, protoplast fusion in bacteria
- ६) Isolation of restriction endonucleases from bacteria.
- ७) Isolation of thiamine requiring mutants of *E.coli* using replica plate technique
- ८) Testing of chemicals for mutagenicity by Ames, lambda-muta test and Induct-test
- ९) Study of UV absorption spectra of Macromolecules (Protein, Nucleic Acid and Bacterial Pigments)

HCP २.२ Practical Course Microbial Ecology and Diversity

१. Enrichment and Isolation of anoxygenic phototrophic bacteria
२. Study of Bioluminescent bacteria.
३. Isolation microorganisms producing plant growth promoting substances Indol Acetic Acid & Gibberellins.
- ५ Isolation of of bacteria and other microorganisms producing catalase, peroxidases, dismutase.,
६. Isolation of of bacteria and other microorganisms producing alkaline lipase and proteases.
७. Isolation of chemolithotrophic bacteria like Nitrosomons and Nitrobacter spp.
८. Different cultivation techniques for Actinomycetes
- ९ Isolation of Methane bacteria from Biogas slurry
१०. Studies on Magnetotactic Bacteria
११. Isolation of Cyanobacteria from water sample

SCP.२.१: Practical Course: Microbial Physiology and Metabolism

१. Study of galactose transport in yeasts
२. Determination of specific growth rate and generation time of E. coli
५. Determination of protein content of bacteria
४. Determination of carbohydrate content of bacteria
५. Determination of nucleic acid (DNA, RNA) content of bacteria
६. Determination of phenol coefficient of test disinfectant
७. Effect of hypotonic and hypertonic solutions on cells

SCP२.२: Practical Course: Medical Microbiology

१. Antibiotic sensitivity tests by Kirby-Bauer method.
२. Antibiotic sensitivity tests by Stocks comparative diffusion method
३. Determination of MIC (Minimal inhibitory concentration) by tube, disc and plate method.
४. Detection of MIC μ g and MBC of an antibiotic.
५. Isolation of drug resistant microorganisms.
६. Isolation and Identification of pathogen belonging to Enterobacteriaceae at species level.
७. Demonstration on animal inoculation by various routes.
८. Preparation of glasswares, plasticwares, media and fine chemicals for animal cell cultures.
९. Culturing, maintenance and passaging of stock of animal cell cultures

OET२.१: Bioinformatics & Biostatistics

१. Assignment on Google for scientific information search by using Pub Med/Medline/Pub Med Central for biological information
२. Retrieving protein and nucleic acid sequences from databases

३. Assignment on Single and multiple Sequence alignment using BLAST, Clustal and Clustal W
५. Assignment on Gen Bank. and study of Nucleic acid and protein sequence data.
६. Studying protein ३D structure using RASMOL
७. Measures of central tendency § Mean, median and mode,
८. Measures of dispersion § variance and standard deviation
९. Estimation of confidence interval for a normal distribution
१०. ANOVA § CRD, RBD
११. Student's t-test and chi-square test on sample data
१२. Finding correlation and regression of the data using MS-EXCEL
१३. Entering biological data in MS-EXCEL and its use for statistical analysis.

OEP२.२: Practical Course: Microbial Nanotechnology

१. Preparation of nanoparticles using microorganisms and microbiological templates,
२. Preparation of various metal nanoparticles for the study of their biological activity
३. Estimation of antibacterial activity of metal nanoparticles
५. Synthesis of gold nanoparticles and its assembly/Conjugation with biomolecules i.e. BSA
६. SDS PAGE gel shift assay for study of nanoparticle-biomolecule assembly.
७. Preparation of PGLA-tetracycline functional nanoparticles using emulsion diffusion method/nano-precipitation/dialysis method
८. Conjugation between PGLA and tetracycline
९. Sunlight induced rapid and efficient biogenic synthesis of silver nanoparticles using aqueous leaf extract of *Ocimum sanctum*

References for practical courses:

१. Laboratory Techniques in Microbiology and Handbook of Techniques in Microbiology by A.S.Karwa, M.K.Rai and H.B.Singh. Scientific Publishers, Jodhpur
३. Laboratory Exercises in Microbiology by J.P.Harley and L.M.Prescott ५th Ed
४. Laboratory Manual in Biochemistry by J.Jayaraman. New Age International Publishers
५. Experimental Microbiology by R.J.Patel. Aditya Publishers, Ahmedabad
६. Molecular Cloning § A Laboratory Manual, Vol. १, २, ३ by J.Sambrook, E.F.Fritsch and T.Maniatis
७. Advanced Techniques in Diagnostic Microbiology by Yi-Wie-Tang and Charles W.Stratton, Springer
८. Molecular Biology Laboratory Manual by Denny R.Randall
९. Identification Methods for Microbiologists by B.M.Gibbs and F.A.Skinner. Academic Press
१०. Laboratory Microbiology by L.Jack Bradshaw. W.B.Saunders & Co.
११. Benson's Microbiological Applications Laboratory Manual in General Microbiology by Alfred E.Brown