SOLAPUR UNIVERSITY
SOLAPUR

M.Sc. Part II Semester III & Semester IV

Microbiology

CBCS True Spirit
Syllabus
(With effect from June 2017)

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

2. 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.

3) 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.

4) 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 karyo typing 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 & aboard.

5) Eligibility of Course:

Eligibility: A Candidate possessing Bachelor Degree with Microbiology /. Or life sciences as a principal subject (Microbiology), and who have passed the entrance examination conducted by the 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.

6) Duration: The duration for this program is of 2 years with semester pattern (04 Semesters)

7) Medium of Instruction: English

8) Structure of the Course:

• Structure of M.Sc. course in faculty of Science has total of 4 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 per theory 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 5 units which are distributed in total 60 lecture hours having weightage of 4 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 100 marks weightage will be as: 70 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 100 marks weightage will be as: 70 marks practical assessment by University examination (UA) and 30 marks internal assessment by the college (CA).

• In each semester students has to give compulsorily 16 tutorials (4 tutorials per theory paper) with weightage of 25 marks (1 credit)

M.Sc.II (Sem. III&IV)

The internal assessment will be based on Unit tests, Home assignment, viva, practical, Project Work etc as given below. Practical examination of 200 marks for 4 practical courses shall be conducted at the end of III rd & IVth semester. The practical examination of 200 marks shall consist of 140 marks for University practical assessment and 60 marks for college internal assessment for each semester.

For University practical examination, there shall be appointment of four examiners two examiners shall be external and two shall be internal appointed by the University. The internal practical assessment shall be done as per scheme given below.

5. **Scheme of evaluation:**

As per the norms of the **Credit System** of evaluation, out of 100 Marks, the candidates have to appear for College internal assessment of 30 marks and external evaluation (University Assessment) of 70 marks. Assessment scheme is given below.

Semester - III:Theory: (100 marks)

University Examination (70 Marks): Number of Theory papers: 4 Papers, out of which Three papers MIC 301 MIC 302 MIC 303 are compulsory & **paper no four (MIC 304**) is Choice Based.

Internal Continuous Assessment (30 Marks):

Scheme of Marking: 20 Marks: Internal Test

10 Marks: Home assignment/Tutorials / Group discussion/ Viva/Field visit/.

Seminar: 25 Marks

Semester - IV:

Theory: (100 marks)

University Examination (70 Marks): Number of Theory papers: 4, out of which Three papers MIC 401 MIC 402 MIC 403 are compulsory & **paper no four (MIC 404**) is Choice Based.

Internal Continuous Assessment (30 Marks):

Scheme of Marking: 20 Marks: Internal Test

10 Marks: Home assignment/Tutorials/ Group discussion/ Viva/ Field visit.

Practical Examination: University Examination (200 Marks**)**:

No of Practical courses: **4 Practicals each course with 50 marks**

The university practical examination shall be of four days per batch per semester (at least of five hours duration each day. Each candidate must produce a certificate from the Head of the Department in his/her college, stating that he/she has completed, in a satisfactory manner, a practical course on the lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the laboratory journals have been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and a written report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of each semester. Candidates are to produce their journals at the time of semester practical examination. There shall be 20 (Twenty) marks for each journal of semesters I, II, III each and 10 (Ten) marks for journal of semester IV. Students shall have to undertake an academic tour for the period of 5 to 8 days to visit places of academic interest like industries, research institutions, R & D departments during semesters II and IV each. The students should submit the tour report at the time of practical examination. The tour report should be duly certified by Head of the department. There shall be 10 (Ten) marks for the tour report.

Internal Continuous Assessment (60 Marks): Internal Test on any four practical, 30 Marks. Viva, attendance, attitude tour report etc. 30 Marks

4. Project Work*/Industrial Training (50 Marks)**

The overall structure of the course to be implemented from 2017 onwards is as follow

Semister III M.Sc. MICROBIOLOGY.C B C S w.e.f.2017-18 (REVISED)									
	Code	**Title of the Paper**	**SemesterExam**			**L**	**T**	**P**	**Credits**
M Sc II		**Hard Core**	Thr	IA	Total				
	HCT3.1	Molecular Biology and Genetic Engineering	70	30	100	4			4
	HCT3.2	Bioprocess Technology and Fermentation Technology	70	30	100	4			4
Soft Core (Any one)									
	SCT3.3A	Immunology and Immunotechnology	70	30	100	4			4
	SCT3.3 B	Bioenergetics and Molecular Enzymology	70	30	100	4			4
Open Elective (Anyone)									
	OET3.4A	Agricultural Microbiology	7 0	30	100	4			4
	OET3.4B	Environment and Waste Management Technology	7 0	30	100	4			
		Seminar			25		1		1
Practical									
	HCP3.1	Practical Course HCP 3.1	35	15	50			2	4
	HCP3.2	Practical Course HCP 3.2	35	15	50			2	
Soft Core (Any one)									
	SCP3.1 A	Practical Course SCP 3.1	35	15	50			2	2
	SCP3.2 B	Practical Course SCP 2.2	35	15	50			2	
Open Elective (Anyone)									
	OEP3.1A	Practical Course OEP 3.1	35	15	50			2	2
	OEP3.1B	Practical Course OPEP3.2	35	15	50			2	
Total for Third Semester			**420**	**180**	**625**				**25**

Semister IV MICROBIOLOGY.C B C S w.e.f.2016-17(REVISED)									
Sem IV	Code	Title of the Paper	Semester Exam.			L	T	P	Credits
		Hard Core	Thr	IA	Total				
MScII	HCT4.1	Pharmaceutical Microbiology	70	30	100	4			4
	HCT4.2	Food and Dairy Microbiology	70	30	100	4			4
	HCT4.3	Principles of Bioinstrumentation and Techniques	70	30	100	4			4
Soft Core (Any one)									
	SCT4.1A	Health care and Diagnostic Microbiology	70	30	100	4			4
	SCTI4.1B	Recombinant DNA Technology	7 0	30	100	4			
		Seminar			25		1		1
Practical									
	HCP 4.1,4.2,4.3	Practical Course for HCT4.14.1,4.2,4.3	70	30	100			2	4
Soft Core (Any one)									
	SCP1.1	**Practical Course on** SCT4.1A	35	15	50			2	2
	SCP1.2	SCTI4.1B							
Project/In plant training			**35**	**15**	**50**			**2**	**2**
Total for Forth Semester			420	180	625				25
Total for **I ,II, III 7IV** Semester			1680	720	2500				100

M.Sc. MICROBIOLOGY (SEM.III) (CBCS)

HCT 301: Molecular Biology and Genetic Engineering

UNIT – I **10L**

1. Methods of studying DNA: Southern blotting, Northern blotting, labeling- radioactive and non-radioactive labeling, and Isopycnic separation.

2. DNA sequencing: Direct sequencing, indirect sequencing, Maxam and Gilbert method, Sanger's Method, RNA sequencing, PCR sequencing.

3. Nucleic acid hybridization: Design and construction of probes, nick translation, chemical synthesis, hybridization, liquid hybridization, solid hybridization, determination of stringency conditions. Applications of nucleic acid hybridization.

UNIT – II **10L**

1. Mutations – Nature and types, mutagenic agents- physical, chemical and biological. Phage mediated mutagenesis, site directed mutagenesis. Fluctuation test
and replica plate technique, isolation of mutants, mutagenecity and carcinogenecity testing (Ames test, inductive test and muta test).

2. Gene transfer in bacteria transformation, transduction, conjugation,transfection, protoplast fusion, electroporation, restriction and modification of DNA, recombination enzymes involved.

UNIT-III **10L**

1. Molecular biology of Oncogenesis, Neoplastic transformation, theories of Oncogenesis

2. Molecular biology of Nitrogen fixation.

3. Law of DNA constancy and redundancy, dosage compensation, genetic load, C-value paradox, Cot curves and DNA reassociation constant.

UNIT – IV **10L**

General Strategy of gene cloning

1. Vectors in Genetic engineering

a. Plasmid vectors – Use of natural plasmids as vectors, artificial plasmid vectors, pSC101, R1, pBR322, pUC18, Ti plasmid vectors.

B.Bacteriophage vectors – Insertion vectors, replacement vectors, Cosmid vectors, phagemid vectors, shuttle vectors, M13 based vectors.

2. Restriction endonucleases – Type I, II and III, restriction mapping, RFLP and RAPD

3. 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, monitoring restriction and ligation.

4. Insertion of recombinant DNA – Host selection, transformation, transfection electroporation, lipofection

5. Screening of recombinants

6. DNA libraries –Genome libraries and cDNA libraries.

UNIT – V **10L**

Protein engineering & metabolic engineering:

Proteins- cellular storage and secretions, protein sequencing and protein Engineering – Methodology and Applications.

Metabolic engineering-Essence of metabolic engineering, examples of pathway manipulations, metabolic engineering in practice, metabolic flux analysis and its applications, synthesis low molecular weight compounds

2. Applications of Genetic engineering & legal aspects in genetic engineering.

References:

1. Turner P.C. et al, 2001, Instant notes on Molecular Biology, Viva BooksPvt.Ltd.

2. Gerard Krap, 1999, Cell and Molecular Biology, John Wiley & Sons Inc. NewYork.

3.Miller G., et al, 1996, An Introduction to genetic analysis, Freeman & Co., New York.

4. Glick & Pasternak 1998, Molecular Biotechnology and Applications of Recombinant DNA, ASM Press.

5.Hyone Myong Enn. 1996, Enzymology Principles for Recombinant DNA Technology, Academic press.

6. Watson J.D. et al, 1992, Recombinant DNA, Scientific American Books.

7. Desmond S.T. & Nicoll, 1994, An introduction to Genetic EngineeringCambridge Univ. Press.

8.freifelder D. & Malacinski G.M., 1993, Essentials of molecular Biology, Jones & Bartlet Publ.Inc.

9.Glazer & Nikaido, 1995, Microbial Biotechnology – Fundamentals of Applied Microbiology, Freeman publ.

10. Nicholl D.S.T.1994, An Introduction to Genetic Engineering, CambridgeUniv. Press.

11. Old R . W . & primrose S.B., 1986, Principles of Gene Manipulations, Blackwell Sci. Publ.
12. Brown T. A. Ed.Homes B.D. & Richwood D. 1998 Molecular Biology: LABFAX, Academic

HCT 302: Bioprocess technology and Fermentation Technology

Unit-I **10L**

1. Bioreactor Design and Operation.

a) Design aspects, the dimensional ratio of the outer shell and operational aspects such as working volume, baffles and impellers. The configuration (placement) of impellers in vessel and different types of impellers.

b) Different types of fermenters.

c) Facilitation for maintaining all parameters during fermentation.
Aeration, Agitation.

d) Sterilization of fermenter and other mechanical system of fermentor

2. Monitoring of process variables.

a) Fermentation broth rheology and power requirement for agitation.
Concept of Newtonian and Non-Newtonian fluids, effect of broth rheology on heat, nutrient and oxygen transfer, Reynolds number, power number, Aeration number, working out examples with different softwares.

b) Use of various types of sensors and biosensors for maintaining environmental parameter(pressure, pH, temperature, DO, DCO_2)

c) Operational modes bioreactor, batch, feed batch, continuous.

d) Automation in fermentation industry.

Unit-II **10 L**

1. Growth and product formation concept during fermentation.

a) Concept of primary and secondary metabolites and their control, kinetics of growth and product formation.

b) Control of metabolic pathways, environmental and genetic control.

c) Effect of type of growth on fermentation.

d) Mycelial pellet form, mycelial filamentous form, free cells, cell producing exopolymers, affects mass transfer of nutrients, oxygen and heat: as cell proliferation.

2. Development of microbial processing.

a) Fermentation media and microbial growth, media composition, types of media, sterilization of media, screening of media

b) Growth & development o f microorganisms, synchronous and synchronized, growth yield, effect of limiting factors.

c) Screening, strain improvement, scale up, inoculums preparation, stock culture maintenance, contamination problems

Unit-III **10L**

Downstream processing and Quality control.

a) Product recovery and purification. Centrifugation, Filtration, Precipitation, Solvent extraction, Chromatography, Ultra Filtration, Crystallization and whole broth processing.

b) Quality control in fermentation industry. Assay testing, Sterility testing, Pyrogenicity testing, Toxicity and Allergy, Carcinogenicity testing.

Unit-IV **10L**

Industrial production of:

1) Streptomycin, Amylase, Vitamin B_{12}, L-Lysine,

2) Microbial transformation of antibiotics and steroids.

3) Microbial production of nucleosides, nucleotides, pigments.

4) Production and applications of biopolymers, Xanthan gum, dextran, pullulan, mannan, curdlan and Alginate.

5) Production of Mushroom, production steps, harvesting and preservation, nutritive value

6) Industrial production of distilled alcoholic beverages. Whisky and Brandy.

Unit-V **10L**

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.

d) Intellectual property rights. Basic concept, patents, trade secrets, Copyrights, Trademarks. Patent regulatory bodies at National and International level.

References:

1. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall.1995., Pergaman. McNeul and Harvey.

2. Fermentations - A practical approach. IRL.

3. Bioprocess Technology: Fundamentals and Applications. Stockholm KTH.

4. Biochemical Reactors by Atkinson B., Pion, Ltd. London.

5. Biotechnology - A Text Book of Industrial Microbiology by Cruger.

6. Fermentation Biotechnology: Industrial Perspectives by Chand.

7. Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.

8. Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. Verlag Chemie.1983.

9. Advances in Biochemical Engineering by T.K. Bhosh, A.Fiechter and N.Blakebrough. Springer Verlag Publications, New York.

10. Bioprocess Engineering Kinetics, Mass Transport, Reactors, and Gene expressions by Veith, W.F., John Wiley and Sons.

11. Applied Microbiology Series.

12. Industrial Microbiology by L.E. Casida, Wiley Eastern

13. Bioseparation: Downstream processing for Biotechnology by Belter, P.A.Cussler, E.L.and Hu, W.S., John Wiley and Sons, N.Y.

14. Separation process in Biotechnolgy by Asenjo, J.A. Eds. Marcel Dekkar, N.Y.

15. Bioprocess Engineering Principles by Doran, Acad. Press, London.

16. Bioreaction Engineering Principles by Nielsen, J. and Villadsen, plenum Press, N.Y.

17. Fermentation, Biocatalysis and bioseparation, Encyclopedia of Bioprocess Technologyby Chisti, Y., Vol. 5, John Wiley and Sons, N, Y

SCT 303: SCT A: Immunonology & Immunotechnology

UNIT – I **10L**

1. Immunity: Innate and acquired immunity, Cells of immune response, Structure, types and functions of lymphoid organs, lymphatic system

2. Biology of immune cells:B cells – development, maturation and their surface molecules, T cell structure, development, maturation, and differentiation and their surface molecules, Subsets of T-cells. NK cells, Antigen presenting cells,

3. Clinical Immunology

Immune response to infectious diseases, viral, bacterial, protozoan and parasitic infections, Immunodeficiency disorders – Phagocytic deficiencies, humoral deficiencies, cell mediated deficiencies and combined deficiencies, complement deficiencies, Autoimmunity, Rheumatic diseases: Systemic lupus erythomatosus, Rheumatoid arthritis, Multiple myeloma.

UNIT – II **10L**

1. Major histocompatibility systems:

The H2 and HLA complex, H-2 haplotypes of mouse strains, MHC and antigen presentation, structure of class I and class II molecules, polymorphism of MHC molecules, MHC and disease association, methods of HLA typing.

2. Cytokines:

Cytokines – general properties, structure and function (Tumor Necrosis Factor, Interleukins, Interferon etc.), cytokines in disease, immunoregulatory role of cytokines.

UNIT – III

1. T-Cell Receptor **10L**

Structure and function of T cell receptor (TCR), T cell accessory membrane molecules (CD and adhesion molecules), and signal transduction by TCR/CD3.

2. Regulation of Immune Response:

Antigen as regulatory mechanism, network theory, internal images and anti-images, role of cytokines in regulation of immune response, mechanism of tolerance induction, regulation of complement system, Immunomodulation – by Biological Response Modifiers (BRMs) and by cytokines

3. Basis of antibody diversity :multi gene organization and expression of immunoglobulin genes, immunoglobulin class switching,Freeman hybrid antibodies, immunoglobulin gene libraries, inheritance of MHC antigens

UNIT – IV **10L**

Experimental Immunology

In vitro systems- Principles and kinetics of antigen antibody reactions, detection and quantitation of cytokines, FACS, western blotting, cell culture systems, haemolytic plaque

assay.In vivo systems – Experimental animals in immunology research,models for autoimmunity and other immunopathological conditions.Experimental systems for: Cell mediated immune responses, Transplantation and adoptive transfer, Cell to cell interactions, Functional assays of cytokines.

UNIT – V **10L**

1. Immune system evolution: Evolution of immune system in invertebrates and vertebrates, occurrence of immune system components in invertebrate and vertebrates, evolution of immunoglobulin heavy and light chain classes and subclass.

2. Tumor Immunology: Cellular adaptations and properties of cancer cells, escape mechanisms of tumor from host defense, immune response to tumor – role of cells of immune system, Immunosurveillance theory, tumor antigens, cancer immunnotherapy, immuno-diagnosis of tumors (detection of tumor markers, e.g. alpha fetoprotein, carcino-embryonic antigen etc.)

References:

1. Chatterji C.C. (1992) Human Physiology Vol. 1 and 2, Medical AlliedAgency, Calcutta,

2.Guyton A.C. and Hall J.E. (1996) Text Book of Medical Physiology, GoelBook Agency, Bangalore.

3. Baron D.N. Shhort Text book on Chemical Pathology, ELBS, London.

4.Austyn J.M. and Wood K.J. (1993) Principles of molecular and cellularImmunology, Oxford University Press.

5.Barrel James D. (1983) Text Book of Immunology, 4th Edition, C.V. Mosby and Co., London.

6. Boyd William C. (1966) Fundamentals of Immunology, Interscience Publishers, NY.

7. Pathak S.S. and Palan V. (1997) Immunology, Essential and Fundamental, Pareer Publications, Mumbai

8. Talwar G.P. (1983) Handbook of Immunology, Vikas Publishing Pvt Ltd, New Delhi.

9. Roitt M. (1984) Essentials of Immunology, P.G. Publishers Pvt. Ltd, New Delhi

10.Roitt M. (1988) Essentials of Immunology, ELBS, London.

11.Kuby J. (1996) Immunology Ed. 3 W.H. and Co

SCT 303 B. Bioenergetics and Molecular Enzymology

Unit : I **10L**

Carbohydrate catabolic pathways and microbial growth on C1 Compounds EMP, HMP,

ED, Phosphoketolase pathway, TCA cycle, methylglyoxal bypass. Anaplerotic sequences, catabolism of different carbohydrates, glycerol metabolism, regulation of carbohydrate metabolism, Pasteur effect. Substrate level phosphorylation. Microbial growth on C1 Compounds (Cyanide, Methane, Methanol, methylated amines and carbon monoxide).

Unit :II **10L**

Bacterial fermentations (biochemical aspects) and Biosynthesis Alcohol, lactate, mixed acid, butyric acid, acetone-butanol, propionic acid, succinate, methane,and acetate fermentations. Fermentation of single nitrogenous compounds [amino acids] – alanine, glutamate and glycine. Biosynthesis of Purines, Pyrimidines and fatty acids.

Unit:III **10L**

Endogenous metabolism and degradation of aliphatic and aromatic compounds. Functions of endogenous metabolism, types of reserve materials, enzymatic synthesis, degradation and regulation of reserve materials - glycogen, polyphosphates and polyhydroxybutyrate (PHB), PHB production and its futuristic applications. Microbial degradation of aliphatic hydrocarbons (microorganisms involved, mon-terminal, biterminal oxidation of propane, decane, etc.) and aromatic hydrocarbons and aromatic compounds (via catechol, protocatechuate, meta-cleavage of catechol and protocatechuate, dissimilation of catechol and protocatechuate, homogentisate and other related pathways).

Unit :IV **10L**

Properties of Enzymes Classification of enzymes into six major groups with suitable examples. Numerical classification of enzymes. Different structural conformations of enzyme proteins. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site, theories of mechanisms of enzyme action. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. Monomeric, Oligomeric and multienzyme complex, isozymes and allosteric enzymes. Extremozymes - thermostable, solventogenic and non- aqueous enzymes. Ribozymes and abzymes

Unit :V **10L**

Enzyme kinetics Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction.

References:

1. Understanding Enzymes by Trevor Palmer

2. Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York.

3. Enzymes by Dixon and Webb, 3 rd Edition 1979. Academic Press, New York

4. Biochemistry by Stryer 5th Edition WH Freeman 2001

5. Laboratory techniques in Biochemistry and Molecular Biology by Work and Work.

6. Principles of Enzyme Kinetics. 1976. By Athel Cornish - Bowden. Butterworth and Co.

7. Fundamentals of Enzymology. 3rd Edition by Price

8. Biochemistry by Chatwal

9.Methods in Enzymology by Drolittle

10.Biochemistry by Garrett

11. Principles of Biochemistry. 2 nd Edition by Horton

12. Biochemistry by Voet.

13. Methods of Biochemical Analysis by David Glick, John Wiley and Sons, New York

14. Understanding Enzymes by Trevor Palmer

15. Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York.

16. Enzymes by Dixon and Webb, 3 rd Edition 1979

17. Understanding Enzymes by Trevor Palmer

18. Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York. 3. Enzymes by Dixon and Webb, 3 rd Edition 1979. Acad

OET 3.4: A: Agricultural Microbiology

UNIT –I **10L**

Soil environment: Physicochemical and biological properties of soil ,soil microorganisms, soil enzymes, organic matter decomposition, microorganisms and soil fertility, biogeochemical cycles-C, N, S and P. Methods used in soil chemistry and microbiological studies, microbial products influencing plant growth

UNIT –II **10L**

Rhizosphere and Phyllosphere – Rhizospheric effect, nitrogen fixation in rhizosphere, root exudates, influence of rhizosphere on crop productivity, biological control within microbial communities of the rhizosphere, plant growth promoting rhizobacteria, siderophores, role

of antibiotics and siderophore in biocontrol of plant pathogens, phyllosphere and microorganisms.Frankia Induced Nodulation in Actinorrhizal Plants, Rhizobium-cultivated and wild legume plant root nodulation and significance

UNIT –III **10L**

Recycling of Agriculture and animal waste

Composting - different methods, anaerobic digestion, merits and the demerits of the processes, saccharification of cellulosic wastes

2) Plant Tissue Culture – Types, formulation of growth media, techniques and applications.

UNIT –IV **10L**

Biofertilizers

1.Historical development, concept, scope, merits and limitations of Biofertilize Systematic study of major groups of microorganisms as biofertilizers, Nitrogen fixing bacteria, Phosphate solubilizing microbes, blue green algae and mycorrhizae.

2.Production of biofertilizers, screening, selection of potential strains Laboratory and large scale production of bacterial, algal and fungal biofertilizers

3. Methods of application and evaluation of biofertilizers.

4.Green manure, organic matter, compost and composting, vermi-composting Production, economics and commercial viability of biofertilizers. Latest developments and future prospects of biofertilizer technology.

UNIT –V **10L**

BIOPESTICIDES

1. Biological control, its importance in crop pests and disease management, merits and demerits of biological control, history, distribution of biopesticides, role and status of biopesticides in pest control.

2.Pest control for crop protection by using biocontrol agents like bacteria (spore formers and non-spore formers) with special reference to *B.thuringiensis* and *B. sphericus*, mosquito control by fungi (culicinomyces, langenidium and coelomomyces), NPV of *Heliothis sp.*

3.Toxin produced by bacteria anfd fungi, their chemistry, mode of action, pest control and safety.

4**.** Commercial production of *B.thuringiensis,* NPV, fungal pathogens, their formulations and applications.

5. Development of genetically modified crop plants for control of insect pests, *B.thuringiensis* gene transformation, transgenic crop plants.

6. Economic and future prospects of biopesticides.

7. Biopesticides, their use and significance in the developing era of ecological approaches of insect control and plant protection.

REFRRENCES

1.Subba Rao. 2000. Soil Microbiology 4th Ed Oxford & IBH

2.Subba Rao. Biofertilizers in Agriculture. Oxford & IBH

3.Subba Rao. Recent Advances in Biological Nitrogen Fixation. Oxford & IBH.

4. Rangaswamy and Bagyraj. Agriculture Microbiology.

5. Smith S E and Read D J. Mycorhizal symbiosis. 2nd Ed.

6. Alexendra and Bold. 1999. Introduction to Mycology. Academic Press

7. Sundara Rajan S. Practical Manual of Fungi.

8. Saminathan M S. Biotechnology in Agriculture. McMillan.

9. Steinhaus 1963. Insect Pathology. Vol I & II. Academic Press

10. Burges H D and Hussey N W. 1971. Microbial Control of Insect and Mites. Academic Press, New York.

11. Burges H D: Microbial Control of Pests and Plant Disease

12. Soil Microbiology – Alxander Martin.

13. Soil and soil microorganisms – Subbarao

OET 3.4 B: Environment and Waste Management Technology

UNIT –I **10**L

1. Environment and Ecosystems: Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics, structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

2 Eutrophication Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of

degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication

UNIT –II **10L**

1. Characterization of Industrial wastes: Types of industrial wastes, General Characteristics of different wastes- pH, Suspended solids, volatile solids, BOD, COD, Organic Carbon etc.

2.Microbiology and biochemistry of waste water treatment:

a. Introduction, types of biological treatments, impact of pollutants on bio- treatment, bio-augmentation, basic concepts of waste water treatment

b. Microorganisms in waste water treatment: source of organisms, enrichment and acclimatization, isolation, treatability tests, mass scale production, mixed cultures.

c. genetically engineered microorganisms, preservation, applications and future prospects

UNIT –III **10L**

Working of treatment systems and their analysis:

a. Reaction and kinetics, mass balance analysis, reactor types, hydraulic characters of reactor, selection of reactor type

b.Critical operation parameters like DO, HRT, Mean Cell Residence Time (MCRT), F/M ratio, tank volume, flow rate, BOD, COD, temperature. Malfunctioning of treatment systems due to shock loading, hydraulic loading and remedial measures adapted.

C.Hazardous waste management, low cost waste treatment systems, treatment of distillery, textile, paper and Pulp and cyanide wastes.

UNIT –IV **10L**

1.Waste disposal control and regulations:

a. Water pollution control, regulation and limits for disposal intoLakes, rivers, oceans and land.

b.Environmental Impact Assessment (EIA), Environmental Audit (EA) c.Water Tracing: need, tracing problems, criteria for selection of tracer, tracing method, significance.

UNIT –V **10L**

1 Novel Methods of Pollution Control : Vermicomposting, treatment using aquatic plants, root zone process

2. Eutrophication, El Nino, global warming, acid rains and significance

3. Enzymes and Pollution – Monooxingenases, aminotransferases, bioenergetic enzymes, other metabolic enzymes, enzymatic Rectifications.

REFERENCES:

1. Environmental biotechnology (Industrial pollution Management). Jogdand S.N., Himalaya publishing house.

2. Waste water treatment – Rao M.N. and A.K.Datta

3. Industrial pollution Control, Vol. 1, E. Joe, Middle Brooks.

4. The treatment of industrial wastes, 2nd Ed. Edmund D. Besselievere and Max Schwartz.

5. Water and water pollution hand book, Vol. 1, Leonard L., Ciaccio

6. Treatment of Industrial Effluents- A.G. callely, C.F. Foster and D.A. Stafford

Practical Course HCP 3.1 50 MARKS

Practicals based on HCT 301: Molecular Biology and Genetic Engineering

1. Detection of polygene chromosomes chromosomal bands in chironomonas larval salivary gland cells
2. Determination of Genetic transformation in Bacteria
3. Study of transformation, transfection, conjugation, transduction, electroporation and protoplast fusion in bacteria
4. Isolation of restriction endonucleases from bacteria
5. Estimation of mutation rate in bacteria, site directed mutagenesis
6. Fluctuation test
7. Isolation of thiamine requiring mutants of *E.coli* using replica plate technique

Practical Course HCP 3.2 50 marks

(Based on Bioprocess technology and Fermentation Technology)

1. Bioassy of streptomycin, lovastatin Chloramphenicol and dounurubicin by plate assay method or turbidiometric assay method

2.Treatment of bacterial cells with cetrimide, phenol and detection of Leaky substances such as potassium ions, aminoacids, purines, pyrimidines and pentoses due to cytoplasmic membrane damage.

3. To determine MIC, LD_{50} of Beta-lactum/aminoglycoside/tetracycline/ansamycins

4.Sterility testing by Bacillus stearothermophilus.

Practical Course SCP 3.1 Based on SCT 303 A: 50 marks

1. Antibiotic sensitivity tests by Kirby-Bauer method.
2. Antibiotic sensitivity tests by Stocks comparative diffusion method
3. Determination of MIC (Minimal inhibitory concentration) by tube, disc and *plate m*ethod.
4. Isolation and Identification of pathogen belonging to Enterobacteriaceae at species level
5. Demonstration on animal inoculation by various routes.

Practical Course SCP 3.2 (Practicals based on SCT 303 B): 50 marks

1. Isolation and Identification of Reserve food material (Glycogen / polyphosphates, PHB) of B. megaterium and Azotobacter SP.
2. Quantitative estimation of amino acids by Rosen's method.
3. Quantitative estimation of sugars by Summner's method.
4. Demonstration of endogenous metabolism in B megaterium or E. coli and their survival under starvation conditions
5. Quantitative estimation of proteins by Folin-Lowry / Biuret method.
6. Production of fungal alpha amylase using solid-state fermentation/ production of protease by bacterial species and confirmation by determining the achromic point.
7. Purification of fungal alpha-amylase or bacterial protease by fractionation, chromatographic techniques and electrophoretic separation.
8. Studies on enzyme kinetics of alpha amylase/Protease [Optimization of parameters viz. Substrate, enzyme concentration, reaction temperature, reaction pH, Km, Vmax and metal ions as activators and inhibitors).

Practical Course OEP 3.1(Practicals based on OET 303 A): 50 marks

1. Detection of IAA by *Azospirillium* / *Pseudomonas*.
2. Detection of siderophore production by *Pseudomonas.*
3. Laboratory production of *Bacillus thuringiensis* Insecticide and testing of its efficiency.
4. Production of biomass of *Azotobacter,Rhizobium Azolla, Azospirilum, Blue green algae* and preparation of biofertilizer.
5. Production of biogas by using different Agricultural wastes and testing of its efficiency.
6. Enrichment, acclimatization and Isolation of organisms from wastes containing recalcitrant, xenobiotic compounds.
7. Preparation of Activated Sludge.

8.. Biofuel energy –electricity

Practical Course OEP 3.1(Practicals based on OET 303 B): 50 marks

1. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD/COD of different effluents.
3. Bacterial reduction of nitrate from ground waters
4. Isolation and purification of degradative plasmid of microbes growing in polluted environments.
5. Recovery of toxic metal ions of an industrial effluent by immobilized cells.
6. Utilization of microbial consortium for the treatment of solid waste [Muncipal Solid Waste].
7. Biotransformation of toxic chromium (+ 6) into non-toxic (+ 3) by Pseudomonas species.
8. Tests for the microbial degradation products of aromatic hydrocarbons /aromatic compounds
9. Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.
10. Microbial dye decolourization/adsorption.

Semester: IV

HCT4.1. Pharmaceutical Microbiology

Unit – I **10L**

Antibiotic and Synthetic Antimicrobial Agents

Antibiotics and synthetic antimicrobial agents(Aminoglycosides, ß lactams, tetracyclines, ansamycins, macrolid antibiotics)Antifungal antibiotics, antitumor substancesPeptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents.Chemical disinfectants, antiseptics and preservatives

Unit – II

Mechanism of Action of Antibiotics:

Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis)Molecular Principles of drug targeting Drug delivery system in gene therapyBacterial resistance to antibiotics Mode of action of bacterial killing by Quinolinone

Bacterial resistance to Quinolinone Mode of action of non-antibiotics antimicrobial agents

Penetrating defenses- How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

Unit –III

Microbial Production and Spoilage of Pharmaceutical Products

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization Manufacturing procedures and in process control of pharmaceuticals

Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase).

New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Unit –IV

Regulatory Practices, Biosensors and Applications in Pharmaceuticals

Financing R & D capital and market outlook, IP, BP, USP.Government regulatory practices and policies, FDA perspective Reimbursement of drugs and biological, legislative perspectiveRational drug design Immobilization procedures for pharmaceutical applications (liposomes).Macromolecular , cellular and synthetic drug carriers.Biosensors in pharmaceuticals**.**Application of microbial enzymes in pharmaceuticals

Unit –V

Quality Assurance and Validation

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry Regulatory aspects of quality control.Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification**.**Sterilization control and sterility testing (heat sterilization, D value, Z value, survival curve, Radiation, gaseous and filter sterilization)Chemical and biological indicators**.**Design and layout of sterile product manufacturing unit (Designing of Microbiology laboratory) Safety in Microbiology laboratory

References

1.Pharmaceutical Microbiology – Edt. By W. B. Hugo and A. D. Russell Sixth edition. Blackwell Scientific Publications.

2.Analytical Microbiology – Edt. By Frederick Kavanagh Volume I and II.

3.Quinolinone antimicrobial agents – Edt. By David C. Hooper, John S. Wolfson. ASM Washington DC.

4.Quality control in the Pharmaceutical Industry – Edt. By Murray S. Cooper Vol. 2. Academic Press New York.

5.Biotechnology – Edt. By H. J. Rehm and G. Reed, Vol. 4.VCH Publications, Federal Republic of Germany.

6.Pharmaceutical Biotechnology by S. P. Vyas and V> K. Dixit. CBS Publishers and Distributors, New Delhi.

7.Good Manufaccturing Practices for Pharmaceuticals Second Edition, by Sydney H. Willing, Murray M. Tuckerman, William S. Hitchings IV. Mercel Dekker NC New York.

8.Advances in Applied Biotechnology Series Vol. 10, Biopharmaceuticals in transition. Industrial Biotechnology Association by Paine Webber. Gulf Publishing Company Houston.

9. Drug Carriers in biology and medicine Edt. By Gregory Gregoriadis. Academic Press New York.

10. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan lal Ihhpunjani. CBS Publishers and Distributors, New Delhi.

HCT4.2 Food and Dairy Microbiology

Unit-I **10**L

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

2. Microbiology and 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 canned foods.

3. Microbial food poisoning and infections, 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 born diseases: Antimicrobial systems in milk, sources of contaminations of milk, prevention and control of milk born 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 andstandards.

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: 4 th Edi. Norman N. Potter (1987) CBS Publi.

2)Milk and Milk Products: 4th Edi. 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).

HCT4.3.Bioinstrumentation: Techniques and Applications 50 Lectures

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, confocal microscopy, cytophotometry and flow cytometry, Preparation samples for microscopy.

UNIT II: **10 L**

Principle Methodology and applications: Gel filtration, ion exchange and affinity chromatography, Thin layer and gas chromatography, High performance liquid chromatography, FPLC, 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 15 Lectures

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, phase contrast, polarizing, differential interference 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

Preparation of biological samples for light and electron microscopy: Sectioning, maceration, squash and clearing technique. Freeze etching and freeze fracturing.

Stains for light and electron microscopy.:Staining procedures and Photomicrography

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.

SCT4.1A: Health Care and Diagnostic Microbiology

UNIT – I **10L**

1.Determinants of microbial pathogenicity

Infection, Transmission of infection, infection process, Bacterial pathogenicity, Regulation of bacterial virulence factors, Bacterial virulence factors.

2.Virulence factors: mechanisms of adhesion, colonization and invasion of host tissues by bacterial pathogens

Microbial toxins: Mode of action and assay (in vivo and in vitro) of - diphtheria, cholera, tetanus toxins and endotoxins of gram negative bacteria

Mechanism of bacterial resistance to host and humoral defenses

UNIT – II **10L**

1.Microbiology of pharmacological industries

Study of major group of Pharmacologically active molecules of plant, animal and microbial origins

Physical and Chemical properties, metabolic activity, identification of drug target / receptors, elucidation of the mechanisms of drug action, Drug interactions, toxicity and adverse reactions, toxicity testing, assays for mutagenicity, carcinogenicity, pyrogenicity and allergy testing, Extraction, Purification and Characterization of bioactive molecules

1) Extraction: Hot and cold extraction methods, solvent extraction
2) Purification: Analytical and preparative techniques
3) Characterization: Physical and chemical characterization methods for alkaloids, steroids, flavanoids, terpenoids, saponins, proteins peptides and amino acids etc. Steps towards commercialization of a drug, Regulation of drugs, FDA.

UNIT – III

1 Antimicrobial agents and chemotherapy **10L**

1. Antimicrobial assays in liquid media - factors affecting assay techniques
2. Antimicrobial assays in agar media - gradient plate technique, disc/well diffusion techniques, and factors affecting diffusion tests.
3. Susceptibility testing for - anti-mycobacterials, anti-fungal, anti- parasitic, antiviral agents.
4. Laboratory evaluation of new antibiotics:

a) In vitro screening, experimental animal infection, animal models for activity.
b) Toxicity, tolerability, carcinogenecity, teratogenecity, and allergy testing.

5. Correlation between in vitro and in vivo sensitivity testing and clinical outcome

6. Lines of evidence to indicate the target of antimicrobial agents, methods for study of the mode of action and resistance to anti microbial agents:

UNIT-IV

10L

1.Mechanism of action of antibiotics

a) Affecting cell wall: Cycloserine, Vancomycin, Cerulenin, beta- lactams.

b) Affecting cell membrane: Polymyxins, Valinomycins, Monesin

c) Inhibitors of Nucleic acid and sysnthesis: Azaserine, DON, Bleomycin, Mitomycin C, Acridines, Chloroquin, Hydrophenyl azopyrimidine, Nalidixic acid

d) Inhibitors of protein sysnthesis - Chloromaphenicol, Erythromycin, Fusidic acid, Cycloheximide.

e) Synthetic antimicrobials: Nitrofurans, INH

f) Antifungal agents

g) Antiviral agents

h) Antiprotozoal agents

UNITV **10L**

1. Methods used in Diagnostic Microbiology

Use of various Antigen-antibody detection method/technologies used in medical diagnostics –Agglutination, Precipitation, Complement fixation test (CFT),PCR, real-time PCR, PCR Sequencing, Enzyme Linked Immunosorbant Assay (ELISA), Radioimmunoassay (RIA), Florescence In Situ Hybridization (FISH), Immunohistochemistry (IHC),Flow cytometry

2. Quality control in Microbiology laboratory

Role of microbiology laboratory, Specimen handling, laboratory records, safety regulation, basic procedure of diagnostic microbiology laboratory, Rapid methods for identification of microorganisms, Principles, working and applications of instruments in medical microbiology.

References

1. Jawets, Melnick and Adelberg's Medical Microbiology 24th Edition (2001)

2. Yu VL, Merrigan TC, Jr. Barrier SL (editors) – Antimicrobial Therapy and Vaccines, Williams and Wilkins, 1999.

3. R. Ananthnarayana, C.K. Jayaram Panikar's Text Book of Microbiology, 4th Edition 1992.

4. P. Chakraborty – A text book of Microbiology, 1st Edition, 1995.

5. Greenhood, D. Black RCB, Peutherer JF (Eds) 1992, Medical Microbiology 14th Edition, Edinburgh – Churchill Livingstone.

6. Ross PW, Peutherer JG 1987, Clinical Microbiology, Edinburgh – Churchill Linvingstone.

7.Sleigh JD, Tmbury MC 1990, Medical Bacteriology 3rd Edition Edinburgh – Churchill Lingingstone.

8. Parker MT. Collier LH (Eds) 1990) Topley and Wilson's Principles of Bacteriology, Virology and Immunology 8th Edn, London – Edward Arnold.

9. Wilson JD, Braunwald E, Esselbacher KJ, Petesrdorf RG, Martin JB, Fanci AS, Root RK, 1991, Harrison's Principles of Internal Medicine Vol 1 12th Ed, New York McGrow-Hill, Inc.

10. Salyers AA, Whitte DD, Bacterial Pathogenesis, 2nd Ed. American Society

SCT 4.1 B Recombinant DNA Technology

Unit :I **10L**

Techniques and enzymes in genetic recombination Core techniques and essential enzymes used in recombination: restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase its activity and mode of action. Chemical synthesis of DNA. Restriction digestion, ligation and transformation.

Unit: **II**

10L

Plasmids Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, PBR 322 – its construction and derivatives, single stranded plasmids, promoter probe vectors, runaway plasmid vectors. Bacteriophage lambda (λ) as a vector: Essential features, organization of λ genome, general structure, rationale for vector construction, improved λ vectors, λ gt series, λ EMBL vectors, invitro packaging, cosmids, phasmids, filamentous phage vectors, λ zap, λ blue print vectors.

Unit- III **10L**

Specialized cloning strategies Expression vectors, promoter probe vectors, vectors for library construction, genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Miscellaneous applications of Genetically engineered micro organisms (GEMS) / genetically modified organisms (GMO's).

Unit :IV **10L**

PCR methods and Applications PCR methods and Applications DNA sequencing methods, Dideoxy and Chemical method. Sequence assembly. Automated sequencing.

Unit:V **10L**

Molecular mapping of genome Genetic and physical maps, physical mapping and map – based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome microdissection and microcloning, molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, varietal etc. animal trafficking and poaching: Germplasm maintenance, taxonomy and Biodiversity.

References

1Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.

2. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford 1995.

3. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers Oxford. 1994.

4. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.
5. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.
6. Biotechnology: A Guide to Genetic Engineering by Peters.
7. Genetic Engineering – 2000 by Nicholl.
8. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001.ASM Publications.
9. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2 nd Edition. 1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.
10. From genes to clones by Winnaker.
11. Manipulations and expression of recombinant DNA by Robertson. 12. Gene targeting – A practical approach by Joyner.

HCP 4.1,4.2,4.3 Practical Course for HCT4.1,4.2,4.3

HCP 4.1 on HCT4.1. Pharmaceutical Microbiology

1. Spectrophotometric / Microbiological methods for the determination of Griseofulvin.
2. Bioassay of Chloramphenicol by plate assay method or turbidiometric assay method.
3. Treatment of bacterial cells with cetrimide, phenol and detection of Leaky substances such as potassium ions, aminoacids, purines, pyrimidines and pentoses due to cytoplasmic membrane damage.
4. To determine MIC, LD_{50} of Beta-lactum/aminoglycoside/tetracycline/ansamycins
5. Sterility testing by Bacillus stearothermophilus
6. Sampling of pharmaceuticals for microbial contamination and load (syrups,suspensions, creams and ointments, ophthalmic preparations).
7. Determination of D value, Z value for heat sterilization in pharmaceuticals.Determination of antimicrobial activity of a chemical compound (Phenol, resorcinol, thymol, formaldehyde) to that of phenol under standardized experimental conditions

HCP 4.2 on HCT4.2: Food and Dairy Microbiology.

1. Detection of adulteration in common foods
2. Detection of afla toxin in food and feed.

3. Chemical analysis of foods-pH,benzoate,sorbates and colour.

4. Micobiological Analysis of food- MPN, Resazurin, Chemical-pH, fat, protein sugar and ash.

5. Physical analysis -sp.gravty, different solids, tests for grading of milk.

6. Platform tests in dairy industry- COB, alcohol precipitation, titrable acidity test, quantitative phosphatase, mastitis and BRT tests.

7.Production lactose and casein from milk.

8. Microbiology of butter, cheese and idli batter

HCP 4.3 on HCT4.3.Bioinstrumentation: Techniques and Applications

1.Chromatographic Separation of amino acids, sugars, dyes, and plant materials using paper

by paper Chromatographic techniques

2. Chromatographic Separation of amino acids, sugars, dyes, and plant materials using thin layerChromatographic 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: Immunodiffusion, immunoelectrophoresis, radioimmunoassay,enzyme linked immunosorbent assay , immunoblotting, immunohistochemistry

SCP1.1 Practical Course on SCT4.1 A 50 marks

Health Care and Diagnostic Microbiology

1. T and B rosette tests

2 .Isolation and cultivation of lymphocytes.

3. Animal tissues organ explants.

4. Studies on immunomodulation potential of plant material

5. Complement fixation test

6. Precipitation of Immunoglobulin by ammonium sulphate method

7. Serological tests-CRP, RA, ASO, SLE, Coomb's and Australia antigen test

SCP1.1B Practical Course on SCT4.1B

RECOMBINANT DNA TECHNOLOGY

1. Isolation of genomic DNA and its confirmation by southern blotting.

2. Isolation of plasmid DNA and its restriction digestion.

3. DNA sequencing by Sangers method / or other method.

4. DNA cloning using plasmid vectors and expression vectors.

5. RFLP analysis.

6. Isolation of poly-A + RNA

7. Amplification of DNA by PCR.

****SCP1.2Project Work*/Industrial Training** (In lieau of SCP1.2)**

*****Student is to undertake a research project (as part of the semester IV in lieu of practical course which is to be started in the beginning of semester III so as to give enough time for duly completion of project. In the first half of project dissertation, student is to write about scientific writing and presentation including basic concepts of preparation of scientific document ,its presentation and publication and in the second half student should prepare dissertation as a report of project in the format of research methodology (Introduction, Aims and Objectives,- Material and Methods, Results and Discussions, Conclusion and Bibliography) and the prepared dissertation of the project shall be submitted to the department 10 (ten) days before the commencement of semester IV examination and it is to be produced by the department at the time of semester IV practical examination.

For the research project work out of fifty marks, 35 marks shall be given by university examiners through assessment of dissertation at the time of semester IV practical examination.The remaining 15 marks shall be given by research guide0r internal examiner as an internal evaluation during research project work in progress. The method

and process of internal evaluation is to be formulated by the research guide and Department.

Industrial training cum industrial project

**The guide of student should locate the industry and depute the student in the industry for the period of one month. Student should complete his/ Her industrial training cum industrial project in the vacation period after semester II Student should study microbiological aspects in industry and submit its report in the form of dissertation dully signed by industry authority, concerned guide and Head of the Department of microbiology.