SHIVAJI UNIVERSITY, KOLHAPUR
M. Sc. APPLIED MICROBIOLOGY SYLLABUS
Revised to be implemented from 2013-14
(Applicable to affiliated colleges only)

A. ORDINANCE AND REGULATIONS:

1. Ordinance: O. M. Sc. 1 -

1.1 Any person who has taken the degree of B. Sc. of this University or the degree of any other statutory University recognized as equivalent and has kept four terms in the University as a post-graduate student be admitted to the examination for the degree of Master of Science (M. Sc.) in Microbiology

1.2 A student shall be held eligible for admission to the M. Sc. Applied Microbiology Course provided s/he has passed the B. Sc. examination with Microbiology as a principal subject or with a subsidiary/interdisciplinary/applied/allied subjects and has passed the entrance examination conducted by the University.

1.3 The students with B. Sc. from other universities shall be eligible if they qualify through the entrance examination and they score minimum 55percent B+ marks in the subject at the B. Sc. examination.

1.4 While preparing the merit list for M. Sc. admission, the performance at B. Sc. III (Microbiology) and the performance at the entrance examination will be given equal weight age (50:50)

2. Regulation:

R. M. Sc. 2 –

The M. Sc. degree will be awarded only after successful completion of written and practical university examinations.

R. M. Sc. 4 –

4.1 The entire course of M. Sc. shall be of 2400 marks so that each semester shall have 600 marks i.e. 400 Theory + 200 Practical. There shall be internal evaluation of 20% for theory papers.

4.2 The examination shall be split up into four semesters

4.3 The commencement and conclusion of each semester shall be notified by the University from time to time

4.4 There shall be a University examination for theory and practicals at the end of each semester. The evaluation of theory and practicals examination be done by internal and external examiners (50:50).

4.5 In each semester there shall be four theory papers and two practical courses

4.6 A student who has passed in semester examination shall not be allowed to take the examination in the same semester again

4.7 Each theory paper in each semester as well as each practical course shall be treated as separate head of passing

4.8 The student is allowed to keep terms in the III semester even if s/he has failed in three papers

4.9 The result shall be declared at the end of each semester examination as per University rules

B. REVISED SYLLABUS FOR MASTER OF SCIENCE (M. Sc.):

1. **Title: Subject:- APPLIED MICROBIOLOGY**
   Compulsory under the Faculty of Science
2. **Year of implementation:**
   New syllabus will be implemented from June 2013 onwards
3. **Preamble: (Applicable to University affiliated college centers)**

Total number of semesters : **04**
(Two semesters per year)
Total No. of papers : **16**
Total no. of practical courses : **08**
No. of theory papers per semester : **04**
No. of practical courses per semester : **02**
Maximum marks per paper (practical) : **100**
Distribution of marks –
Internal evaluation : **20**
External evaluation : **80**
(Semester exam)
Total marks for M. Sc. Degree
Theory papers : **1600**
Practical course : **800**
2400

General Objectives Of The Course:

A prime objective to maintain updated curriculum and providing therein inputs to take care of fast paced developments in knowledge of Applied Microbiology and in relation to
International context, a two year programme is formulated for M.Sc. Applied Microbiology as per UGC guidelines and to develop competent microbiologists to achieve desirable placements in the country and abroad. The programme obliges students to read original publications and envisages significant inputs in the laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. In addition to disciplines viz. Virology, Immunology, Genetics, Molecular Biology, Enzymology, Biostatistics, Bioinformatics, Scientific writing, Computer Science etc. The overall structure of the course to be implemented from the academic year 2013 – 2014 onwards is as given below,
Students are required to undertake a research project in Semester IV (in lieu of Practical Course MIC(A)4006)at the Department/any University/Industry/Institution. In the project, the student is expected to study research methodology that includes literature survey, experimental work and report writing following the IMRAD (Introduction, Aims and objectives, Materials and Methods, Results and Discussion) system.

Students shall compulsorily deliver one seminar/research paper per year and submit a certificate from the Head of the Department regarding satisfactory completion of the same at the time of the practical examination (Sem – II and Sem – IV),

Students are also required to undertake a compulsory educational tour organized by the Department in each year (M. Sc. I and M. Sc. II) to various places of Microbiological

interest and submit a `tour report' duly signed by the Head of the Department, at the time of the Sem – II and Sem – IV practical examinations respectively.

2. Duration:

- The course shall be a fulltime course
- The course shall be of two years, consisting of four semesters

3. Fee Structure:

- **Entrance Examination fees :** as prescribed by Shivaji University, Kolhapur
- **Course Fee** : as prescribed by Shivaji University, Kolhapur

4. Eligibility For Admission:

- As per O. M. Sc. 1.2 for graduates of this University
- As per O. M. Sc. 1.3 for graduates from other Universities
- And Merit List of entrance examination result

8. Medium of instruction : English

9. Structure of the course:

Semester I

Theory Courses:

MIC (A) – 1001 Anatomy, Cytology & Taxonomy of Microorganisms.
MIC (A) – 1002 Virology
MIC (A) - 1003 Biomolecules and Bioenergetics
MIC (A) - 1004 Genetics

Practical Courses:

MIC (A) - 1005 Practical Course - I
MIC (A) - 1006 Practical Course – II

600 marks

Semester II

Theory Courses:

MIC (A) –2001 Bio-Instrumentation
MIC (A) –2002 Molecular Biology

MIC (A)–2003 Microbial Biochemistry

MIC (A)–2004 Immunology

Practical Courses:

MIC (A) 2005 – Practical Course - III
MIC (A) 2006 – Practical Course – IV

600 marks

Semester III

The students shall opt for three core papers and one elective from among the two

Theory Courses:

Core papers:

MIC (A) –3001 – Title and contents to be finalized
MIC (A) –3002 – Title and contents to be finalized
MIC (A) –3003 – Title and contents to be finalized

Elective papers:

MIC (A) –3004 (Elective-I) – Title and contents to be finalized
MIC (A)– 3004 (Elective-II) - Title and contents to be finalized

Practical Courses:

MIC (A) –3005 – Practical Course - V
MIC (A)–3006 – Practical Course – VI

600 marks

Semester IV

The students shall opt for three core papers and one elective from among the two

Theory Courses:

Core papers:

MIC (A) –4001 – Title and contents to be finalized
MIC (A) –4002 – Title and contents to be finalized
MIC (A)–4003 – Title and contents to be finalized

Elective papers:

MIC (A) –4004 (Elective-I) – Title and contents to be finalized
MIC (A) – 4004 (Elective-II) - Title and contents to be finalized

Practical Courses:

MIC (A) –4005 – Practical Course - VII
MIC (A) –4006 – Practical Course – VIII (Project work)

600 marks

10. System of Examination: applicable to University affiliated college centers

1. Scheme of examination:
   - Semester exam (both theory and practical examination) will be conducted by the University at the end of each term (Semester)
   - Theory paper of the external examination will be of 80 marks
   - The internal evaluation test for 20 marks will be conducted by the Department
     - There will be **two** tests for each course paper in the middle of the Semester
     - They will be `Surprise tests' during theory lecture
   - The two practical course examinations will be of 100 marks each
   - Question paper will be set in view of the entire syllabus and preferably covering each unit of the syllabus
2. Standard of passing:
   As per the rules and regulations of the university for the M. Sc. course
3. Nature of question paper and scheme of marking:
   a) External/University examination Theory paper: Maximum marks – **80**

- Total number of questions – **07**
- All questions will carry equal marks.
- Out of the seven questions, five are to be attempted of which Question 1 will be compulsory
- Question No. **1** will be of an objective type
  - Total No. of bits – **16**, Total marks – **16**
  - Nature of questions - multiple choice, fill in the blanks, definitions, true or false
  - These questions will be answered along with the other questions in the same answer book
- Remaining six questions will be divided into two sections, I and II.
- Four questions are to be attempted from these sections in such a way that not more than two questions are answered from each section.
- Both sections are to be written in the same answer book

b) Internal Examination Theory paper: Maximum marks – **20**
- Objective- multiple choice/True or false/ fill in the blanks/match the following
- Total number of questions will be **10** each carrying **01** mark

c) Practical Examination (External only) Maximum marks – **100**
- Equal weight age shall be given to the two units of the practical course
- Total number of questions – **06**
- All questions will be compulsory
- Questions 1 to 4 will have at least two (**02)** internal options

C. INTAKE CAPACITY:

1. 15 + 10 & Extra every year on the basis of entrance examination
2. The above includes 10 % students from other Universities

D. CREDIT SYSTEM:

1. Definition of CREDITS:

It is the workload of a student in College activities. This includes:

1. Lectures
2. Practicals
3. Seminars
4. Private study work in the Library/Home
5. Examinations
6. Other activities

2. Credits by lectures and practicals:

- Total instructional days as per norms of UGC = **180**
- One (**01**) credit is equivalent to **12** contact hours
- There are four (**04)** theory papers with **04** hours teaching per week
- Each theory paper consists of **04** units
- There are two (**02**) practical courses of **09** hours duration per week
- Each practical course consists of **02** units
- Therefore the distribution of credits (per semester) is –

Course type	Contact hours	Credits
Theory paper		
Unit – I	**12**	**01**

Unit – II	**12**	**01**
Unit – III	**12**	**01**
Unit – IV	**12**	**01**
	Total =	**04**
Practical course		
Unit – I		**02**
Unit – II		**02**
	Total =	**04**
Total credits per semester = 24		
Theory course -	**04 × 04 =**	**16**
Practicals course -	**02 × 04 =**	**08**

- As there are four (**04**) semesters to the M. Sc. course, the total credits form lectures and practicals will be - **04 × 24 = 96** credits

3. M. Sc. Course Work (credit system) for a student:

- A student has to take **96** credits to complete the course
  Theory courses : **16 × 04 = 64** credits
  Practical/Project : **08 × 04 = 32** credits
  (Project at the Department/any University/Industry/Institution: **04**;
  Practical course at the Department: **04**)
- Time course: **02** years minimum **or** till **96** credits are completed.

4. Class capacity:

Theory : maximum **60** students per class
Practical courses: **12** students per batch

5. Examination:

Theory Examination:

External: 80 marks per theory paper (examination at the end of the Semester)

- This will be conducted by the University as specified in section B.10

Internal: 20 marks per theory paper

- This will be conducted by the Department as per the norms specified in section B.10.3b above

Practical Examination:

- This will be conducted only by the University as specified in section B.10

Project evaluation:

External: 50 marks by the university examiners through observation of the Oral presentation and assessment at the time of the Semester IV Practical examination

Internal: 50 marks by the concerned project supervisor as the internal Examiner during progress of the project work.

6. Courses available in the Department:

Semester-I:

Theory courses: - MIC (A)-1001, MIC (A)-1002, MIC (A) - 1003, MIC (A)-1004
Practical courses: MIC (A) - 1005, MIC (A)-1006

Semester-II:

Theory courses: - MIC (A)-2001, MIC (A)-2002, MIC (A)-2003, MIC (A)-2004

Practical courses: MIC (A)-2005, MIC (A)-2006

Semester-III:

Theory courses: - MIC (A)-3001, MIC (A)-3002, MIC (A)-30)3, MIC(A)-3004 (Elective – I)

Practical courses: MIC (A)-3005, MIC (A)-3006

Semester-IV:

Theory courses: - MIC (A)-4001, MIC (A)-4002, MIC (A)-4003, MIC (A)-4004 (Elective – I)

Practical courses: MIC (A)-4005, MIC (A)-4006 (Project)

M.Sc.Part- I , Sem. I

MIC (A) – 1001 Anatomy, Cytology & Taxonomy of Microorganisms.

Unit- I **12**

Bacterial Classification - Introduction, Classification of prokaryotic organisms- an overview. Nucleic acids in bacterial classification. Genetic methods. Bacterial Nomenclature, Serology & Chemotaxonomy, 16S rRNA technique, Lipid profile technique for identification of bacteria.

Unit-II **12**

1) Archaebacteria- Approaches for exploring uncultivable bacteria. Culture independent molecular methods. Methods of extracting total bacterial DNA from habitat. General characteristics, morphology & classification of Archaebacteria,

2) Cyanobacteria - **C**lassification, morphology & general characteristics.

3) Mycoplasma- General Characteristics, Morphology & recent scheme of classification.

4) Myxobacteria- – Classification, morphology & general characteristics.

Unit-III **12**

1) Actinomycetes General characteristics, morphology & classification of Actinomycetes.

2) Yeasts -General characteristics, morphology & classification of Yeast.

3) Molds -General characteristics, morphology & recent scheme of classification of Molds

.4) Protozoa - General characteristics, morphology& Classification of Protozoa .

Unit-IV **12**

1) Algae- General Characteristics, Morphology & recent scheme of classification.

2) Rickettsia - General characteristics, Morphology & classification.

Reference Books:-

i) Bergey's Manual of Determinative bacteriology.

ii) Bergey's Manual of Systematic bacteriology.- Vol.I, II, III & IV
iii) Mycology – C.J. Alexopoulous.
iv) Introduction to Mycology - C.W.Mims.
v) Plant pathology - R.J.Mehrotra & K.R. Aneja.-
vi) Botany fundamentals - S.K. Singh.
vii) Fungi - John Webster & Roland Weber
Viii) Botany for degree student's series - Vashista
ix) The Yeast – A.H. Rose.

MIC (A) – 1002 Virology

Unit- I **12**

Evolution & Classification of Viruses.

1) Evolution of Viruses.-
a) The potential for a rapid evolution in RNA viruse- quasispecies & rapid evolution.
b) Rapid evolution- recombination.
c) Evolution of measles & influenza virus
2) Classification of Viruses –
a) on the basis of disease.
b) on the basis of host organism.
c) on the basis of viral particle morphology.
d) on the basis of Viral nucleic acids.
e) on the basis of Taxonomy.
3) Satellites, viriods & prions.
4) Slow viruses & DI particles.

Unit- II **12**

1) Reproduction of animal viruses.
a) DNA viruses.- Herpes viruses & pox viruses
b) RNA viruses- Reo viruses & Rabdo viruses.
2) Reproduction of Bacterial viruses - Lambda, phi X 174 – RNA phageses.
3) Reproduction of Plant viruses causing – bunchy top of banana, mosaic disease of sugarcane, potato spindle tuber disease.
4) Lysogeny of μ phages, comparative study of lysogeny of P1,P2, P22.

Unit-III **12**

Transmission of Viruses.

1) Horizontal, vertical, Zoonoses transmission.

2) Nature of virus reservoirs.

3) Virus epidemiology in small & large population.

4) Animal model to study viral pathogenesis – mouse model for study of pox infection & its spread.

5) Subtle & insidious virus- host interactions.

6) Emerging virus infections.

Unit-IV **12**

Vaccines & antiviral drugs.

1) Vaccines -

a) Principal requirement of vaccine.

b) Conventional vaccine- concept, application & examples.

c) Advantages, disadvantages & difficulties associated with live & killed vaccines.

d) Modern vaccines – peptide vaccines, genetically engineered vaccine – concept, applications, examples.

e) Clinical complications with vaccines & immunotherapy.

2) Antiviral drugs.

a) Discovery & screening of antiviral drug.

b) Antiviral chemotherapy – general approach, drugs –

i) Inhibiting viral entry.

ii) Inhibiting replication of viral nucleic acid.

iii) Inhibiting viral protein function.

3) Drug resistance.

4) Viruses as therapeutic agents.

References:-

1) Principles of virology – 3rd edition. Vol.I & II. – by S.J. Flint.

2) Basic virology- 3rd edition – Edward K. Wagner.

3) Fundamentals of Microbiology & Immunology. – Ajit K. Banaergee.

4) Evolution of RNA viruses – Straus J.H.

5) Microbiology – Davis.

6) Virology Vol. IV – Topny & Wilson.

7) Introduction to Plant Virology – Longman.

8) Introduction to Modern virology – 6th Edition, N.J. Dimmock, A.J. Easton & Leppard .

MIC (A) 1003: Biomolecules and Bioenergetics

UNIT -I **12**

1) Amino acids -

a) Structure and Classification of amino acids – Neutral, acidic, basic and aromatic.

b) Properties of amino acids- acid base nature, Titration curve of glycine,electric charge.

c) Peptide bond and its nature.

d) Peptide and polypeptides-Introduction, Ionization, Behavior, Size and composition

e) Polypeptide diversity.

2) Proteins -

a) Structural levels of proteins. i) Primary structure –(ex.Oxytocin) ii) Secondary structure – (ex.α – keratin)-alpha helix, beta pleated structure, B-turn, iii)Tertiary structure – (e.g. myoglobin) iv)Quaternary structure –(Hemoglobin

b) Protein stability –forces that stabilize protein structure

c) Reverse turns and Ramchandran plot

d) Denaturation and Renaturation of protein

e) Folding pathways for protein structure

f) Role of chaperon in protein folding

g) Diseases caused by misfolding-an overview

. **UNIT -II** **12**

1) Amino acid sequencing

a) Importance of amino acid sequencing.

b) Sanger method

c) Dansyl chloride & Dabsyl chloride method.

d) Edman degradation method & Autoanalyser.

2) Protein structure.

a) Enzymatic cleavage of protein to determine the structure.

b) Prediction of conformation of protein structure from amino acid sequence.

c) Study of surface properties of proteins by using potein ligand interaction, Monoclonal antibodies and fluorescence techniques.

3) Vitamins**:**

a) Introduction, definition and properties.

b) Structure and forms of Coenzymes.

c) Classification, mode of action, Sources and daily requirement and deficiency of Vitamins e.g. Thiamine, Pyridoxine, Niacin , Riboflavin and Vit C..

UNIT -III **12**

1) Carbohydrates**:**

a) Monosaccharides and related compounds. Classification, structure of aldoses and ketoses. Configuration and conformation of monosacchardes

b) Disaccharides –Lactose, Sucrose.

c) Polysaccharides –

i) Homopolysaccharide . Steric forces and hydrogen bonding in homopolysaccharide folding. Structure and role of starch, glycogen, cellulose, heparin, hyaluronate.

ii) Heteropolysaccharide in bacterial and algal cell wall. e.g.agar and agarose.

d) Glycoconjugates- Proteoglycan, Glycoprotein Glycolipids.

2) Lipids**:**

a) Definition functions and classification.

b) Fatty acids – general formula, nomenclature, Even-odd, Saturated- Unsaturated fatty acids PUFA and chemical properties,

c) Structure, function and properties of - i)simple lipids- Triacylglycerols ii) complex lipids- Phosphoglycerides eg. Lecithin, Sphingolipids eg - , Sphingomyelin iii) Derived lipids- Steroids eg. Cholesterol, Ketone bodies.

d) Terpenes- Characteristics, Classification with one example.

UNIT -IV **12**

1) Bioenergetics**:**

a) Thermodynamic principles- laws of thermodynamics, Oxidation, reduction reactions redox couples.

b) Oxidative phosphorylation - Archaetecture of mitochondria.Electron transport reactions in mitochondria.

c) Electron transport chain in prokaryotes.

d) Mechanism of ATP synthesis- Chemiosmotic model.

e) Uncouplers and Inhibitors of ETC.

2) Photosynthesis**:**

a) General features of photophosphorylation , Evolution of oxygenic Photosynthesis

b) General photochemical events-Light driven electron flow.

c) Photochemical reaction centers in bacteria-

Pheophytin- Quinone center and Fe-S center , photosystem II of Cyanobacteria.

d) Photosynthetic pigments in *Halobacterium.*

e) Photochemical reaction centers in plant-. Photosystem I & II.

f) Electron flow in I & II photosystem –Z scheme

g) ATP synthesis by photophosphorylation

ReferenceBooks :

1) Biochemistry by Zubey vol I, II, III.
2) Lehninger's Biochemistry by Nelson &Cox 5th Edition.
3) Biochemistry by Lubert Stryer-2010
4) Principles of Biochemistry – White & Smith
5) Lehninger's Principles of Biochemistry – Nelson & Cox
6) Biochemistry by Voet & Voet.
7) Practical Biochemistry – David Plummer
8) Elements of Biochemistry – Shrivastava.
9) Practical Biochemistry for Students – Malhotra.
10) Biochemical methods – Sadasivam
11) The Cell-Cooper
12) Biochemistry and Molecular Biology of Plants-B.Buchanan ,W.Cruissem R.Jones.
13) Biochemistry – Chemical reactions of living cell.Vol I and II by David Metzie

MIC (A) 1004: Genetics

Unit- I **12**

1) Mendelism :

a) Monohybrid crosses and Mendel's' Principle of segregation.

b) Dihybrid crosses and Mendelian principle of independent assortment

c) cell division & cell cycle, Mitosis & Meiosis & their regulation.

d) Epistasis

e) Statistical analysis of Genetic data. The Chi-square test.

f) Multiple alleles – ABO blood groups.

g) Essential genes and lethal genes.

h) The environment and gene expression- co-dominance, incomplete dominance, pleiotropy.

i) Sex linkage, Sex limited & influenced characters

2) Non Mendelian Inheritance**:**

a) Determining Non Mendelian Inheritance

b) Maternal effects.

c) Cytoplasmic inheritance (Mitochondria,chloroplast,infective particles)

Unit -II **12**

1) Structure of chromosomes:

a) Lampbrush chromosomes

b) Polytene chromosomes

c) Heterochromatin – defense against mobile DNA elements.

d) Mitotic chromosomes – their patterns

2) Chromosomal DNA and its packaging:

a) Procaryotic and eukaryotic chromosome unique & repetitive DNA sequences

b) Nucleosome core particle – Histone, non-histone

c) ATP driven chromatin remodeling machines.

d) Covalent modification of Histone tails

e) Split genes – Exon, Intron, detection of intervening sequences,β-chains of haemoglobin, ovalbumin.

f) Splicing mechanism i) Autocatalytic RNA ii) Spliceosome

Unit -III **12**

1) DNA Repair -

a) Error free mechanism –

i) Mismatch repair.

ii) Base excision repair.

iii) Nucleotide excision repair.

iv) Direct repair.

b) Error prone mechanism

2) DNA Recombination.

a) Homologous genetic recombination.

b) Site specific recombination.

c) Eukaryotic transposons.

Unit-IV **12**

Human Genetics.

a) Pedigree analysis,

b) Lod score for linkage testing,

c) karyotype

d) Genetic disorders- Haemophilia, Colour blindness, Hungstinson's disease

e) Quantitative genetics- polygenic inheritance, hetitability & its measurements & QTL mapping.

f) Stem cells

ReferenceBooks :

1) Principles of Genetics – Gardner

2) Genes by Lewin – V and IX

3) Microbial Genetics – Friefielder

4) Gene – Watson

5) Genetics – Klug & Commings.

6) Lehninger's Principles of Biochemistry – Nelson & Cox

7) Molecular Cell biology by Lodish -2010

8) An introduction of Genetic Analysis 10th Edition. Freeman 2010.Anthony & J.F.Griffithe. Susan R. wessler.

M.Sc.Part-I, Sem.I

MIC (A) 1005 **Practical Course – I**

Unit – I

1) Isolation, Identification & Characterization of Actinomycetes.
2) Isolation, Identification & Characterization of Yeasts.
3) Isolation, Identification & Characterization of Molds.
4) Isolation & Characterization of Microaerophilic Microorganisms.
5) Isolation, Identification & Characterization of Cynobacteria- *Nostoc, Oscillotoria*.
6) Morphological studies of Algae- *Chlorella*, *Spirullina,*
7) Iduction of ascospores in *S. cereviciae*.
8) Isolation, identification of spores of VAM fungi from soil.

Unit-II

1) Isolation of plaque morphology mutant of phages by using U.V. radiation.
2) Isolation of temperature sensitive mutants of phages by using U.V. radiation.
3) Demonstration of Egg inoculation technique.
4) Bacteriophage Enrichment from soil for *Bacillus* sp.
5) Isolation of Cyanophages from aquatic environment.
6) Enumeration of bacterophages using small drop plaque assay.
7) Mechanical transmission of plant viruses (TMV) local lesion method.
8) Determination of cross infectivity of *E. coli* with *Pseudomonas, Salmonella & Proteus vulgaris* phages
9) One step Growth curve of coliphage.

Practical Course - II

MIC (A) 1006

Unit-I

1) Estimation of bacterial protein by Folin cio-calteu method.
2) Quantitative estimation of amino acids by using ninhydrin method.
3) Estimation of DNA by Diphenylamine method.
4) Isolation of RNA from yeast.
5) Estimation of RNA by Bial's orcinol method.
6) Isolation & characterization of photosynthetic pigment chlorophyll a & b from plant.
7) Estimation of Vit.C from biological source.
8) Detection of changes in confirmation of Protein by viscosity measurement.
9) Estimation of extra cellular polysaccharide – sugar profile by TLC.
10) Titration curve of glycine

Unit-II

1) Isolation of bacterial plasmid.
2) Isolation of antibiotic resistant mutants by Chemical mutagenesis.
3) Isolation of thiamine requiring mutants.
4) Effect of U.V. radiations to study the survival pattern of *E.coli* / *yeast.*
5) Study of repair mechanisms in *E.coli*. (Photoreactivation & Dark repair)
6) Problems on Population Genetics.
7) Problems on Genetic code.
8) Study of optimum pH of bacterial Amylase.
9) Study of optimum temperature of bacterial Amylase

Credit System

M.Sc.Part- I , Sem. II

MIC(A) 2001 Bio-Instrumentation

Unit – I **12**

1) Microscopy- Types, principle, specimen preparation, staining ,applications of Phase contrast, Fluorescence ,Electron Microscope.

2) Electro chemical Techniques**.**

a) Basic principles of electro chemical techniques – electrodes ,electrochemical reactions, Danial cell , electrode potential , cell potential.

b) Measurement of EMF by standard hydrogen electrode.

c) Types of electrode & their applications- Calomel, Ag- AgCl, glass ,oxygen, PCO2, PH electrodes.

d) Determination of pH using pH Meter.

e) Potentiometric titration.

Unit- II **12**

1) Chromatography **–** basic principles & applications

a) Ion Exchange chromatography.

b) Gel Filtration chromatography.

c) Affinity chromatography .

d Gas liquid chromatography.

e) High performance liquid chromatography.

2) Centrifugation

a) Principle & mathematical derivation about centrifugal force – sedimentation rate & sedimentation coefficient.

b) Components of centrifuge- types of rotors & centrifuge tubes.

c) Types & applications of different types of centrifuges.

d) Ultra Centrifuge – Preparative- Differential & Density gradient Centrifugation .analytical type

e) Care & maintenance of centrifuge.

Unit-III **12**

1) Electrophoresis

a) Basic principles of electrophoresis .

b) Types of electrophoresis.- Moving boundary, Zonal , paper, Gel – i) Agarose ii) PAGE iii) SDS – PAGE iv) Pulse Field Gel

c) Disc / tube electrophoresis -

i) isoelectric focusing

ii) 2 D PAGE

iii) Immuno electrophoresis

iv) Capillary electrophoresis

2) Radio Isotopic techniques.

a) Radio isotopes & radio activity

b)Types of radio active decay – Positron , Negatron Alpha ,Gama & X-Ray emissions .

c) Detection & measurement of radio activity.

d) Geiger Muller (GM) counter

i) Scintillation counter

ii) Cloud chamber

iii) Bubble chamber

e) Auto Radiography

i) Applications & Hazards of Radio activity, Safety aspect & disposal of radio active waste.

Unit- IV **12**

1) Spectroscopy –

a) Basic principles of spectroscopy – EMR, photons, types of spectrum, interaction of Light with matter.

b) Principles of photometry - Laws of photometry.

c) Types of spectroscopy – i) Atomic spectroscopy – Atomic emission & absorption spectroscopy.

d) Mass spectroscopy

e) Plasma emission spectroscopy.

2) Spectroscopy – II

a) Molecular spectroscopy

i) U.V./ visible spectroscopy.

ii) Infra red & Raman spectroscopy.

iii) NMR

iv ESR

v) Luminometry – Fluorimetry , Chemiluminometry , Bioluminometry

b) CD/ORD Spectroscopy .

c) Nephelometry & Turbidometry

d) X – ray spectroscopy – X- ray absorption , X- ray diffraction , x- ray fluoresces.

Reference Books -

i) Techniques in Biochemistry – T. Devasena & G. Rajgopal

ii) Enzymes – Biochemistry, Biotechnology, Clinical chemistry – Trevor & palmer

iii) Principles & techniques of Biochemistry & Molecular Biology – Wilson & Walker

iv) Bioinstrumentation – L.Veera Kumari , MIP Publishers , Chennai

v) Analytical Biochemistry – Dr. P. Ashokan- Chinna Publications.

vi) Tools in Biochemistry – David Cooper.

vii) Instrumental methods of chemical analysis, Goel Publication House by – B.K. Sharma.

MIC (A) 2002: Molecular Biology

UNIT -I **12**

1) DNA Replication.

a) DNA replication in *E.coli*, Origin of replication, Types of E. coli DNA polymerases, Details of Replication process, Regulation of replication, connection of replication to cell cycle.

b) Eukaryotic, DNA Replication, Multiple replicons, Eukaryotic DNA polymerases, ARS in yeast, ORC, Regulation of replication.

2) Transcription in Prokaryotes and Eukaryotes**:**

a) RNA Polymerase – Structure and function.

b) Transcription – Initiation, elongation, termination.

c) Post transcriptional modifications and structure of mRNA, rRNA.

UNIT -II **12**

Regulation of gene expression in bacteria & Viruses-

1) Concept of Negative & Positive regulation**.**

Lac operon – nature of repressor, structure of repressor, Allosteric change in conformation of repressor. Types of operators & interaction of repressor with RNA polymerase. Additional levels of regulation – regulatory RNA – alternative secondary structures that control alternation. Control of alternation by translation. Antisense RNA used to inactive gene expression. Regulator RNAs present in bacteria.

2)Bacteriophage life cycle – Regulatory events that control lytic cascade & lysogeny.

Functional clustering in genome. Nature of repressor & operators, Balance between lysogeny & lytic cycle.Role of cellular proteases and environmental conditions that regulate life cycle of phages

3) Alternative sigma factors to regulate large sets of genes.

UNIT –III

1) Translation Prokaryotes and Eukaryotes **12**

a) Genetic code- Deciphering genetic code and its importance

Altered code in mitochondria and induced variations in genetic code

b) Translation – Activation of amino acid , Initiation, Elongation and Termination process at molecular level

c) Translational frame shifting, RNA editing

2) Oncogenes

a) Oncogenes & their Proteins – Classification & Characteristics.

b) Genetic basis of cancer – Conversion of Protooncogenes to Oncogenes by – Mutation & viruses (HIV, RSV)

c) Oncogenic Mutations in growth promoting proteins – PDGF, Receptor tyrosin kinase, Erythroprotin receptor Ras pathway, c-Fos, c-Myc.

d) Mutations causing loss of growth inhibiting & cell control – TGFβ signaling, Rb & p53 protein.

e) Apoptotic gene as protooncogene or tumor suppressor genes.

f) Molecular markers of tumors.

UNIT-IV **12**

1) Sequencing Genes and Genomes.

a) Methodology for DNA sequencing, Chain termination DNA sequencing (sanger's Method)

b) Pyro sequencing.

c) Shot gun approach of genome sequencing.

d) Clone contig approach.

e) Use of maps to aid sequence assembly. Genetic maps, physical maps

f) Importance of maps in sequence assembly.

g) Mapping – Linkage maps, tetrad analysis, mapping with molecular markers, mapping using somatic cell hybrids, mapping by transformation and conjugation.

2) Human Genome Project.

a) Concept and meaning of Genome Project.

b) Applications of Genome Project.

c) Gene annotation.

ReferenceBooks.

1) An introduction of Genetic Analysis 10th Edition. Freeman 2010, Anatomy & J.F. Griffith.

2) Introduction to Genetic analysis – Lodish.

3) Lehninger – Biochemistry.

4) Gene Lewin- X

5) Molecular Cell biology by Lodish – 2010.

6) Molecular Biology F. Weaver- 2010

7) Molecular Biology of gene 4th Benjamin & Cumin 2010.

8) An Introduction of genetic analysis 5th edition Freeman 2010.

MIC (A) 2003 : Microbial Biochemistry

UNIT -I **12**

1) pH and buffers **:**

a) Ionization of water, weak acid and weak bases.

b) pH – pH scales, Bronsted Lowery concept of acids and bases.

c) Buffer – Buffer solutions, Henderson Hasselhalch equation.

d) Biological buffer system – Phosphate buffer system, bicarbonate buffer system, proteins, amino acids

2) Membrane biochemistry :

a) Componentsof membrane,

b) Membrane structural models,

c) Eukaryotic and prokaryotic protein transport systems,

d) Membrane protein

e) Ion channels K^+, Na^+, Cl^-

f) Na +/ k+ pump

UNIT -II **12**

1) Enzymes:

a) Structure ,function & reaction mechanism of - i) Pyruvate dehydrogenase ii) Fatty acid synthetase iii) ATPase

b) Allosteric enzymes - i) Concept of allosterism ii) Positive and negative cooperativity. iii) Structural aspects of allosteric enzymes and their significance in regulation.

c) Mechanism of action of enzymes- i) Single displace reaction. ii) Double displace reaction

2) Enzyme kinetics:

a) Historical aspects

b) Methods used for investigating the kinetics of enzyme catalysed reactions – initial velocity

c) Michaelis Menten equation, graph, progressive curve and its significance.

d) Alternative plots – Line weaver Burk Plot, Eadie Hofstee plot.

3) Enzyme inhibition: Significance, One example, Michaelis Menten equation,M.M graph, L.B.equation & graph for-

a) Competitive inhibition

b) Noncompetitive inhibition

c) Un- Competitive inhibition.

UNIT -III 12

1) Pathways in Utilization of different substrates in *E. coli.*

a) Overview of glucose metabolism

b) Substrate other than glucose –

i) Fructose

ii) Lactose -Transport and breakdown of lactose, utilization of galactose.

iii)) Acetate

iv) Pyruvate

v) Malate

c) Relation with TCA and glyoxylate bypass.

d)Gluconeogenesis.

2) Lipid Metabolism.

a) Beta oxidation – pathway and regulation.

b) Role of acyl carnitine in fatty acyl transport.

c) Synthesis of fatty acid

d) Structure and composition of fatty acid synthetase complex-reaction and regulation.

e) Synthesis of triacyl glycerides.

f) Ketone bodies – formation and utilization.

UNIT -IV 12

1) Microbial response to stress :

a) Microbial stress response,

b) Stress proteins, and their roles,

c) Cold and heat shocks

d) Oxidative and starvation stress

2) Signaling and Behaviour in Procaryotes :

a) Adaptive responses by facultative anaerobes to anaerobiosis

b) Regulatory system.

c) Chemotaxis

d) Nitrogen assimilation.

e) Two components signaling system.

f) Porin structure

g) Tumbling.

h) Common signaling systems of plants , microbes & mammals .

Reference Books

1) Lehninger's Principles of Biochemistry rth edition – Nelson & Cox
2) Biochemistry – 2nd edition D. Voet, J. Voet.
3) Biochemistry – 4th edition Lubert Stryer.
4) Fundamental of Biochemistry by Jain.
5) The Nature of enzymology by Foster.
6) Enzymes by Palmer
7) Bacterial metabolism by G. Gottschalk.
8) Biochemistry by Zubay.
9) The Physiology and Biochemstry of Procaryotes by White (Oxford Uni. Press)
10) Introduction to bacterial metabolism – Doelle H. W. (1975) (Academic Press)
11) The microbial world – Stanies
12) Biochemical calculations – Segal
13) General Microbiology – Schlege.

2004 MIC (A) Immunology

Unit I **6**

1) Organs of immune System –

a) Structure and Immune function of – Primary lymphoid organ,

Secondary lymphoid organ,

Lymphatic system.

b) Evolutionary comparison of lymphoid cells organs.

c) Programmed Cell Death.

i) Pathways of target cell apoptosis.

ii) Fas pathway.

iii) Perforin / granzyme pathway.

2) Organisation and Expression of Ig genes

a) Multigene organization of Ig genes-

i) Lambda chain multigene family.

ii) Kappa chain multigene family.

iii) Heavy chain multigene family.

iv) Variable region gene rearrengments.

v) Heavy chain gene rearrengments.

vi) Mechanism of variable region gene rearrengment

b) Generation of Antibody diversity.

c) Class switching.

d) Expression of Ig genes.

Unit II **6**

1) Major Histocompatibility Complex

a**)**General Organization and Inheritance of the MHC

b) MHC molecules and genes.

c) Detailed genetic map of MHC genes.

d) Cellular distribution of MHC molecule

e) Regulation of MHC expression.

f) MHC and immune responsiveness.

2) Experimental System-

a) Experimental animal models & cell culture system .

b) Microarray technique , application and Advantages and Disadvantages of DNA microarray, oligonucleotide microarray

c) Knock out and Knock in technique.

Unit III **6**

1) Immune response to infectious diseases

a) General features

b) Immunity to Bacteria, Viruses, Protozoa

c) Evasion of immune mechanisms by extracellular and intracellular Bacteria, Viruses, Protozoa.

d) Host response to plasmodium infection

2) Immunity to tumors

a) Tumor of immune system

b) Tumor antigen

c) Immune responses to tumor- T cell , antibodies ,NK cell, Macrophages Evasion of immune response by tumors .cancer immunotherapy.

Unit IV

1)Primary immunodeficiencies

a)Lymphoid immunodeficiencies.

b)Defects in lymphocyte activation and function

c)Immunodeficies of the myloid lineage

d)Complement defects

e)Treatment

2)Secondary immunodeficiencies

3)Immunotechniques and their application-

a)Flow cytometry- Principle, Procedure, Application , Advantages and Disadvantages.

b)Immunoelectron microscopy/ two photon microscopy

c)Fluroscence in situ hybridization (FISH)

d)Immune PCR

e) Mixed lymphocyte reaction.

Refrence Books –

1) Cellular and Molecular Immunology – Abul K. Abbas. (5th Edition)

2) Kuby Immunology – Kindt Goldsby & Osborne.

3) Immunology – Tizard.

4) Immunology – C. Vaman Rao.

5) Essential Immunology – Roitt I.M.

6) Basic and clinical Immunology – Danie P. Stites, John Stobo, H. Fudenberg.

Credit Course

MIC(A) 2005 **Practical Course- III**

Unit-I

1) Separation and identification of amino acid mixture by 2D paper chromatography.

2) Study of U.V. absorption spectra of macromolecules. (Protein, nucleic acid, bacterial pigments)

3) Separation and identification of amino acid mixture by TLC..

4) Separation of proteins by using molecular sieve chromatography.

5) Preparation of immobilized cells of Yeast cells and determination of invertase activity.

6) Study of effect of gel concentration on immobilized enzyme activity.

7) Determination of capacity of ion exchange resin [Dowex – 50].

8) Cell lysis – homogenization / sonication.

9) Quantitative estimation of hydrocarbons , pesticides ,organic solvents ,Methane by gas chromatography.

Unit-II

1) Determination of mutation rate in bacteria.

2) Fluctuation test.

3) Testing of chemical for mutagencity using Ames test.

4) Demonstration of PCR , DNA sequencer and Fermentor.

5) Separation of serum protein by horizontal submerged Gel Electrophoresis .

6) Separation of DNA by agarose gel electrophoresis

7) Purification of plasmid DNA by phenol / chloroform extraction.

8) Isolation of plasmid DNA from bacterial cells by alkaline lysis method (Birnborm & Doly 1979)

9) Use of rotary shaker to study the rate of oxygen absorption.

MIC(A) 2006 **Practical Course- IV**

Unit-I

1) Preparation of buffers.e,g.Phosphate , Acetate & Carbonate..

2) Isolation of cellulase producers from soil.

3) Determination of effect of activator on amylase activity.

4) Determination of effect of inhibitor on amylase activity.

5) Determination of substrate concentration effect (K_M) for enzyme amylase.

6) Determination of Molar extinction coefficient.

7) Study of organisms subjected to nutritional stress (Carbon)

8) Detection of Siderophore produced by *Pseudomonas* spp.

9) Estimation of cellulose activity by Viscometry method.

10) Estimation of soil enzymes- Urease & Phosphatase.

Unit-II

1) Diagnostic immunology method – immunodiffusion.

2) Separation of serum- protein by **submerged** agarose gel electrophoresis.

3) Determiantion of antibody titer by Ouchterlony double diffusion test.

4) Purification of H & O antigen from *S. typhi*.

5) Purification of Antibodies using ammonium sulphate precipitation & Column chromatography.

6) ELISA.- Detection of antigen/ antibody by Sandwitch ELISA.

7) Immunoelectrophoresis.

8) Detection of C- reactive protein.

9) Purification of IgG from human serum.

10) Assay of Antibody levels by passive hemaglutination with tanned Erythrocytes.

11) Coomb's test – Direct & indirect.

(Old Corse)
M. Sc. Part II ,Semester III

MIC (A) 301 : Microbial Eology and Extremophiles

Unit- I **6**

Origin of cells and unicellular evolution.

a) Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers.

b) Concept of Oparin and Haldane.

c) Experiment of Miller and Very.

d) Origin & evolution of prokaryotes.

e) Origin and evolution of eucaryotes.

f) Anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit- II **6**

The nature of ecosystems.

a) Basic features of – Producer ,consumer & decomposer .

b) Biotic components

c) Abiotic components- i) physical factors ii) inorganic substances iii) organic substances

Unit-III **6**

Ecology of microorganisms.

a) Introduction.

b) The ecosystem.

c) Habitat.

d) The ecological niche.

e) Number and diversity of microorganisms in an ecosystem.

f) Nutrient limitation in the normal state in the natural ecosystem.

g) Aquatic ecosystems.

Unit- IV **6**

Microbial Biofilm

a) Physiology , Morphology, Biochemistry of Microbial Biofilm formed in the natural environment.

b) Mechanism of microbial adherence .

c) Laboratory methods used to obtain Biofilm.(with respect to physiology, growth, special arrangement, depth, surface physio chemistry)

d) Benifecial & harmful role of biofilm , biofouling .

Unit-V **6**

Community ecology .

a) Defination.

b) Types –major and minor.

c) Characteristics of a community- i) Community diversity. ii) Structure. iii) Community dominant. iv) Stratification.v) Community periodicity.vi) Community interdependence.vii) Ectone and Edge effect. viii) Ecological niche. ix) Concepts of community. x) Ecological succession.

Unit-VI **6**

Quantitative Ecology.

Number ,Biomass & Activities.

a) Sample collection – soil, water , air, sediment , biological samples.b) Sample processing.

c) Detection of microbial populations – phenotypic detection – liquid profile analysis, molecular detection

d) Determination of microbial Biomass. – Biochemical assay, Physiological approaches to Biomass determination.

Unit-VII **6**

Applications of ecology.

a) Introduction.

b) Agriculture.

c) Farm ponds and food fish.

d) Biological control.

e) Range lands management.

Unit-VIII **6**

Extremophiles.

a) Adaptation to environmental conditions.

i) Abiotic limitations to microbial growth.

ii) Microbial response to adverse conditions- Temp., starvation, radiation, pressure, salinity, hydrogen ion conc. redox potential, magnetic force, antagonism siderophores.

iii) Survival strategies of microorganisms.

Reference Books :-

i) Concepts of ecology- Edward J.Kormonday 25799

ii) Ecology and the quality of our envt. 2nd edition- Charles H. Southwick – 9375

iii) Ecology- N.S.Subrahmanyam, A.V.S.S. Sambamurthy 23046

iv) Fundamentals of Ecology- Odum. 382

v) Ecology and environmental biology – Dr.K.A.Siddique 23047

vi) Concepts of ecology- N. Arumugam. 26001

vii) Microbial ecology- Fundamentals & applications 4th edition- Atlas and Bartha published by Pearson education ,Singapore.

viii) Extremophiles by B.N.Zonri, Springer verlag,New York.

ix) Microbial diversity by (1999) Colwd, Academic Press.

x) Microbial life in extreme environment (1978) by D.S.Kushner, Academic Press, Inc New York.

xi)Biology of microorganisms , 6th edition, Thomas D.Brock,Michael T.Madigan.

MIC (A) 302 : BIOSTATISTICS, BIOINFORMATICS AND SCIENTIFIC WRITING

UNIT I **5**

Biostatistics

Basic terms, measures of central tendency and dispersion :

Population, sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean, median mode, quartiles and percentiles, measures of diversions : range, variance, standard derivation, coefficient of variation, symmetry : measures of skewness and kurtosis.

UNIT II **6**

Probability and distribution

Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addiction and multiplication rules, conditional probability, examples, Bernoulli, Binomial, poisson and normal distribution. Mean and variance of these distribution (without proof). Sketching of p.m.f. and p.d.f. Use of these distribution to describe in biological models. Model sampling and stimulation study.

UNIT III **6**

Measures of dispersion

a) Correlation- Meaning, types of correlation, measurement of correlation, rank correlation, test of significance of correlation coefficient

b) Regression- Meaning, Regression equations, Regression coefficients, problems.

UNIT IV **6**

Hypothesis testing

Hypothesis, critical region and error probabilities. Tests for proportion, equality of proportions, equality of means of normal population when variance known and when variances are unknown. Chi-square of test for independence. P-value of the statistic. Confidence limits, introduction to way and two way analysis of variance.

UNIT V **7**

Scientific writing

1) General aspects :

2) Reporting practical and project work :

Structure of reports – Title, authors and their institution, abstract summary, list of contents, abbreviations. Introduction, materials and methods, results discussion, conclusions, acknowledgement, literature cited (Bibliography) choosing a journal, writing, submitting, responding to refrees comments, checking proofs and waiting for publication.

3) Writing literature surveys :

Selection of topic, scanning the literature and organizing references, deciding structure and content, introduction, main books of the text, conclusion, references, style of literature surveys.

4) Review writing :

Writing review paper, purpose of review, organization of the review, types of reviews.

UNIT VI **7**

A] Bioinformatics : An introduction.

- **a)** Basic introduction, History & definitation
- **b)** Scope & goals of bioinformatics
- **c)** Basic terminologies- alignment, accession number, gene annotation, databases.
- **d)** Application of bioinformatics- human genome project, pharmaceutical industry, drug discovery.

B] Databases

a) Definition & database management concept
b) Major databases in bioinformatics
c) Classification of biological databases- nucleotide, protein

UNIT VII **6**

A] Sequence alignment

a) Concept of local & global alignment
b) Pairwise sequence alignment & its methods
c) Multiple sequence alignments & its applications
d) Tools for sequence similarity search & alignments- BLAST & FASTA.
e) Phylogenetic analysis : An overview.

UNIT VIII **5**

A] Structural databases- visualization of structural data, pattern matching, molecular modeling,

B] mapping databases- Genomic mapping, types of maps.

C] Introduction to genomics, proteomics, metabolimics, pharmacogenomics & pharmacogenetics.

References

1) Bioinformatics – A Primer by (P. Narayan) (25043)
2) Essential Bioinformatics by (Jin Xiong) (25772) Genomics and protomics (with practical exercises)
3) Computational Biochemistry, by C. Stan tsai, A John Wiley & Sons, Inc., Publication
4) Bioinformatics – Databases & Algorithms by N. Gautam (25447) blue book for basis.
5) Bioinformatics – David Mount
6) Basedra S. K. (1998) computers today, Galgotia Publications.
7) Bergeron B. (2003). Bioinformatics computing. Prentice Hall Inc. Eastern Economy Edition.
8) Warollaw A. C. (1925), Practical Statistics for Experimental Biologists John Wiley and Sons Ltd.
9) Dixit J. V. (1996) Principles and Practice of Biostatistics 1t Edn. M/s Banarasidas Bharot (Publisher)
10) T. Bhaskarrao (2002) Methods of Biostatistics, Paras Publishing.
11) Bailey N. T. J. (1995), Statistical methods in biology 3rd Edition Cambridge law price edition Cambridge University Press.

Students are supposed to refer to current contents and periodicals for recent and additional information.

M.Sc.Part-II, Sem.III

MIC(A) 303 : Genetic Engineering

Unit-I **6**

Introduction to biotechnology.

A brief history of biotechnology.

Ethics & biotechnology.

Tools of gene cloning.

Enzymes – Alkaline phosphatase, polynucleotide kinase, exonuclease III, DNase I, S1 nuclease, Reverse transcriptase, DNA polymerase.

Vectors – Essential features of vectors, Types of vectors, Special vectors- shuttle vectors, expression vectors amplifiable vectors, integrating vectors, single stranded plasmid vectors, artificial minichromosomes , YAC, BAC.

Host cells for cloning.

Unit-II **6**

1) Techniques in genetic engineering, splicing of foreign DNA to vector.

Methods of introduction of r DNA in living cell.- animal, plant , bacteria & fungi.

2) Construction of CDNA & genetic libraries.

Unit- III **6**

Plant and Animal tissue culture.

a) Methods – Micropropagation.

From callus to plant.

Smatic embryogenesis.

Somaclonal variation, valuable germ plasma

Applications –

b) Animal tissue culture – media, serum free media, primary culture, organo typic culture Applications.

Unit- IV **6**

Manipulation of gene expression in host. Gene expression from strong & regulatable promoters-

Regulatable promoters.

Increasing protein production.

Large scale system.

Expression in other microorganisms.

Native fusion proteins.

Overcoming oxygen limitations, DNA integration into host chromosome.

Increasing secretion.

Unit-V **6**

Nanobiotechnology.

1) Introduction, synthesis of nanomaterials –Biological methods- Introduction, synthesizing microorganisms and plant extracts, use of proteins & template like DNA.

2) Properties of nanomaterials & analysis of techniques. Mechanical, structural, melting of nanoparticles, electrical conductivity, optical & magnetic properties

Unit-VI **6**

Biotechnology in food fermentation.

a) Introduction
b) Nutritional contribution of fermented foods in human health.
c) General composition, process and starter organisms for – idli, dhokala, pickles, curd, butter mil preparation.
d) Starter cultures – Types, nature

Unit-VII **6**

Biopreservation.

a) Concept of biopreservation
b) Bacteriocins – Types, nature, mode of action and spectrum.
c) Antimicribial activity of spices.
d) Naturally occurring antimicrobial enzymes.

Unit-VIII **6**

Stem cells – details – Types, characters, Applicaion.
Pharmacogenetics .

References :

1) Introduction to genetic engineering – Desmonds T. Nicholl.
2) T A Brown – Gene cloning – An introduction
3) Molecular biotechnology – B. R. Glick and Jack Pasteurnak
4) Molecular biotechnology – Das
5) Genetic engineering – S. Mitra
6) Kuby Immunolgy – Sixth edition
7) Food microbiology – K. Vijaya Ramesh, MJP Publisher, Chennai, 2007.
8) A comprehensive dairy microbiology – Yadav J. S., Sunita Grover, Y. K. Batish 1993.
9) Biotechnology – Food fermentation, Vol. I and II, Eds. V K. Joshi, Ashok Pandey.
10) Modern Food Microbiology Vol. 41, March 2001.
11) Bacteriocins – Konisky
12) Indian food industry – September – October 2001.
13) Introduction to biotechnology – William J. Thieman, Michael A. Palladino.
14) Introduction to biotechnology – K. S. Bilgrami, A. K. Pandey
15) Biotechnology – Prakash S. Lohar
16) Biotechnology – B. D. Singh
17) Genetic Engineering – Shukla.
18) Nanobiotechnology

MIC(A) 304 Immunology

Unit -I **6**

1) Hematopoiesis

a)Meaning, Pathway of formation of common lymphoid progenitor cells and common myeloid progenitor cells.

b)Type of growth factors and cytokines required

c)Regulation at genetic level-

Programmed Cell Death, Pathways of target cell apoptosis, Fas pathway, Perforin/ granzyme pathway

2) Organs of immune System –

a) Structure and Immune function of-

Primary lymphoid organ , Secondary lymphoid organ, Lymphatic system

b) Evolutionary comparison of lymphoid cells organs.

Unit- II **6**

Organisation and Expression of Ig genes

1) Multigene organization of Ig genes-

lambda chain multigene family .

Kappa chain multigene family .

Heavy chain multigene family.

Variable region gene rearrengments.

Heavy chain gene rearrengments.

Mechanism of variable region gene rearrengment

2)Generation of Antibody diversity-

Class switching.

Expression of Ig genes.

Unit -III **6**

Major Histocompatibility Complex

General Organization and Inheritance of the MHC

MHC molecules and genes.

Detailed genetic map of MHC genes.

Cellular distribution of MHC molecule

Regulation of MHC expression.

MHC and immune responsiveness.

Unit -IV **6**

Immune response to infectious diseases

a) General features

b)Immunity to Bacteria, Viruses, Protozoa

c)Evasion of immune mechanisms by extracellular and intracellular Bacteria, Viruses, Protozoa.

d)Host response to plasmodium infection

Unit -V **6**

1) Primary immunodeficiencies

1) Lymphoid immunodeficiencies.

a) Defects in lymphocyte activation and function

b) Immunodeficies of the myloid lineage

c) Complement defects

d) Treatment

2) Secondary immunodeficiencies

Unit- VI **6**

Immunity to tumors

a) Tumor of immune system

b)Tumor antigen

c)Immune responses to tumor- T cell , antibodies ,NK cell, Macrophages

d) Evasion of immune response by tumors.

e) Cancer immunotherapy.

Unit -VII **6**

Immunotechniques and their application-

a) Flow cytometry- Principle, Procedure, Application , Advantages and Disadvantages.

b) Immunoelectron microscopy/ two photon microscopy

c) Fluroscence in situ hybridization (FISH)

d) Immune PCR

Unit-VIII **6**

Exprimental System-

a) Experimental animal model- cell culture system Microarray technique , application and advantages and disadvantages of DNA microarray ,oligonucleotide microarray

b) Knock- out and Knock in technique.

References :-

1) Cellular and Molecular Immunology – Abul K. Abbas. (5th Edition)

2) Kuby Immunology – Kindt Goldsby & Osborne.

3) Immunology – Tizard.

4) Immunology – C. Vaman Rao.

5) Essential Immunology – Roitt I.M.

6) Basic and clinical Immunology – Danie P. Stites, John Stobo, H. Fudenberg.

M.Sc.Part-II, Sem. III

Practical Course- V

(Ecology & Extremophiles & Biostat, Scientific writing)

1) Isolation of thermophiles from hot water spring.
2) Isolation of microorganisms from saline soil.
3) Isolation of alkalophilic bacteria from soil/ water.
4) Enrichment & isolation of psychrophilic bacteria & halophilic and halotolerent bacteria.
5) Enrichment & isolation pesticide resistant bacteria.
6) Isolation of Glucanoacetobacter from soil.
7) Isolation of petroleum degraders & study the rate of degration.
8) Determination of measures of dispersion- Mean deviation, Standard deviation, Coefficient of verification.
9) Determination of measures of central tendency- Mean, Mode, Median.
10) Estimation of confidence interval for a normal distribution.
11) T Test & chi- square + test on sample data.
12) Representation of statistical data by - i) histograms ii) Pie diagram.
13) Writing a conference report –
14) Writing review paper & project.
15) Searching sequence databases.

Practical course- VI

(Immunology & Genetic Engineering)

1) Estimation of alkaline phosphatase from patient's serum.
2) Determination of isozymes of Lactate dehydrogenase by PAGE.
3) Radial immunodiffusion (Qualitattive & Quantitative)
4) Separation of serum protein by submerged agarose gel electrophoresis.
5) Purification of H & O antigen from *S. typhi*.
6) Immunoelectrophoresis.
7) Agarose gel electrophoresis of genomic DNA, visualization of DNA & recording of Gel using Gel Doc system.

M.Sc.Part- II , Sem. IV (Revised Syllabus From June ,2013)

MIC (A) – 401 Industrial Microbiology

Unit - I **06**

Design of Fermentor –

a) Introduction , scale of operation- Lab scale , Bench scale , Pilot scale , production level .

b) Basic functions of Fermentor for microbial cell culture. Body construction material .

c) Types of Fermentor –

i) Mechanical – Waldhof fermenter. Rotating disc fermenter , trickling generator

ii) Hydrodanamic – deep – jet fermenter.

iii) Pneumatic – air lift fermenter, bubble – cap fermenter, cylindro conical vessels, acetator, cavitator

iv) Photo –bioreacter, tower and packed tower fermenters, cyclone column .

Unit – II **06**

Fermentation operation –

a) Aseptic operation & containment

b) Sterilization & maintenance of aseptic conditions – vessels , medium, additives , air.

Aseptic transfer of inoculum.

c) Common measurement & control system of Fermentor – Speed, Temp. ,Gas supply, pH,

Dissolved oxygen, antifoam control.

Unit-III **06**

Cell immobilization and its applications :

a) Introduction

b) Immobilized cell system –

   i) Surface attachment of cells.

   ii) Entrapment within porous matrices

   iii) Containment behind a barrier

   iv) Self aggregation of cells

c) Design of immobilized cell reactors

   i) Mass transport phenomena in immobilized cell system.

   ii) Reaction and diffusion in immobilized cell system

   iii) Bioreactor design

d) Physiology of immobilized microbial cells.

e) Beer production using immobilized cell technology – Case study.

Unit-IV **06**

Probiotics

a) Probiotic microorganisms associated with therapeutic properties
b) Criteria associated with probiotic microorganisms.
c) Safety of issues associated with the use of probiotic cultures for humans.
d) Beneficial health effects of probiotic cultures
e) Effective daily intake of probiotic.
f) Probiotic dairy products – case study.
g) Factors affecting probiotic survival in food system

UNIT V **6**

Solid state fermentation (SSF)

a) Introduction, comparison of SSF and submerged fermentation,
b) Advantages, disadvantages, problems, types,
c) Factors affecting, fermentor design for SSF, Koji manufacturing process, industrial application of SSF
d) Amylase production -case study.

UNIT VI **6**

Fermentation economics

a) Introduction, Philosophy of fermentation, manufacture of chemicals by fermentation
b) Economic objectives.
c) various aspects influencing fermentation economics – Strain improvement, High yielding strain, Market potential, fermentation media and raw material, fermentation equipments, recovery cost, water uses and recycling, effluent treatment -

UNIT VII **6**

Intellectual property

a**)** Introduction -

i)Genesis of Intellectual Property Rights (IPR)

ii) Territorial Nature of Patents

iii)Ownership and Royalties

iv)An overview of Patent System

v)Requirements for Patentability

vi)Patent Categories

UNIT VIII **6**

Patenting –

1) Information necessary for preparing and filing a patent application
2) Patenting procedure and form
3) Recent trends in biotechnology and microbiology patents.
4) The Indian Patent Act.
5) Indian Biodiversity Act.

Reference Books –

i) Industrial Microbiology – L.E.Casida 2012 Reprint

ii) Principles of Fermentation Technology –Second Edition P.F.Stanburg, A.Whitaker,S.J.Hall

iii) Biotechnology – Wulf Crueger & Anneliese Crueger

iv) Fermentation Technology & Biotechnology – 2nd edition – E.M.T.EL-Mansi,C.F.A.Bryce & A.L.Demain

v) Fermentation Technology- Vol. I & II - H.A. Modi

vi) Microbial technology – Vol.I & II - Peppler H.J. & D. Perlman

vii) Industrial Microbiology – Prescott & Dunn's

viii) Biotechnology – U.Satyanarayana

ix) Modern industrial Microbiology – Okafor Nkuda -2007, NH,USA

M.Sc.Part- II , Sem. IV (Revised Syllabus From June ,2013)

MIC (A) – 402 Bioprocesses .

Unit- I **6**

Concept of fermentation technology.

a) Range of fermentation processes & products.

b) Design of fermentation media – Criteria, Carbon & Nitrogen sources,

c) Buffers, precursors, steering agents, Inducers, inhibitors, antifoam agents, trace elements.

Unit-II **6**

Strain improvement –

a)Introduction,- Improvement of industrial microorganisms – Isolation & selection of induced mutants, Isolation of autotrophic mutants, isolation of resistant mutants.

b) One example of each method of strain improvement for primary & secondary metabolites.

c) Stock culture maintenance – techniques & significance.

Unit-III **6**

a) Scale up of fermentation process.

b) Inoculum development.

c) Sterilization of fermentation medium – batch, continuous & filter .

Unit-IV **6**

Fermentative production of-

a) Organic solvents – Acetone, butanol

b) Organic acids- Lactic acid, Acetic acid, Citric acid.

c) Enzymes –Protease, Glucose oxidase

Unit- V **6**

Fermentative production of-

a) Antibiotics – Streptomycin, Rifamycin, Bacitracin

b) Vitamins – Vit.C

c) Yeast – Bakers yeast & Brewers yeast .

Unit- VI **6**

Production of -

a) Microbial insecticides.

b) Mushroom production.

c) rDNA products- Insulin.

Unit-VII **6**

Production of -

a) Vaccines – General manufacturing aspects & quality control.

b) Microbial polysaccharides – Xanthan production.

Unit-VIII **6**

Down stream processing –

a) Introduction **,** Fermentation product Recovery.Criteria for choice of recovery process.

Biomass separation from fermentation media.

b) Filtration – filter aids, plate frame & rotary vaccum filter.

c) Centrifugation – Cell aggregation & flocculation, types of centrifuges .

d) Cell Disruption for intracellular products.

e) Solvent extraction & recovery.

f) Drying, Crystallization, whole broth processing.

Reference Books -

i) Industrial Microbiology – L.E.Casida 2012 Reprint

ii) Principles of Fermentation Technology –Second Edition P.F.Stanburg, A.Whitaker,S.J.Hall

iii) Biotechnology – Wulf Crueger & Anneliese Crueger

iv)Fermentation Technology & Biotechnology – 2nd edition – E.M.T.EL-Mansi,C.F.A.Bryce & A.L.Demain

v) Fermentation Technology- Vol. I & II - H.A. Modi

vi) Microbial technology – Vol.I & II - Peppler H.J. & D. Perlman

vii) Industrial Microbiology – Prescott & Dunn's

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ix) Modern industrial Microbiology – Okafor Nkuda -2007, NH,USA

MIC (A) 403 : INDUSTRIAL WASTE MANAGEMENT AND MICROBIAL BIOREMEDIATION

UNIT I **6**

Distillery industry :

Introduction, scenario of distillery industry, waste sources in distillery industry, characteristics of waste and effluents, environmental impact, treatment of distillery effluent.

UNIT II **6**

Petroleum industry :

Introduction, scenario of petroleum industry, , waste sources in petroleum industry impact of wastes in the environment. Treatment of petroleum waste, biodegradation and bioremediation of petroleum products.

UNIT III **6**

Food and beverage industry :

Introduction, scenario of food & beverage industry in India ,process and production, characteristic and impact of food processing on wasters, treatment of food and beverage waste, industry specific bioremediation. e.g. Edible oil industry, fermentation industry, dairy industry, meat and poultry industry.

UNIT IV **6**

Dye industry :

Introduction, scenario of the industry in India the source origin and characteristics of waste effluent, environmental impact, treatment technologies of dyes, mechanism of colour removal.

UNIT V **6**

1) Pharmaceutical industry :

Introduction, existing scenario, industrial process, waste generation, impact on environment, waste reduction and treatment, environmental standards.

2) Pesticide industry :

Introduction, existing scenario of industry, classification of pesticides, process and production, characteristics of waste / effluents, fate and effect of pesticides, pollution, prevention and control, treatment technologies, prospects of photodegradation, bioremediation, environmental standards.

UNIT VI **6**

Microbial bioremediation : I

a)Introduction : Current environmental scenario, environmental issue and the public, five R policies for waste mineralization, choice of technology.

b) Environmental contaminants : Nature of contaminants, general classification, effect of contaminants of environment, strategies for contaminant management.

UNIT VII **6**

Microbial Bioremediation: **II**

General perspective, microbes for bioremediation, bioremediational techniques, bioremediation monitoring and case studies.

UNIT VIII **6**

1) Genetics of microbial bioremediation : Microbial genetic, plasticity, role of plasmid in bioremediation, evolution barriers, enhancement, genetic, metagenomics in bioremediations.

2) Bioconversion of specific pollutants : Heavy metal, dioxins, radioactive wastes.

Reference:

1) Industrial pollution Vol. I E. Joe middle brooks.
2) Waste water treatment M. N. Rao & A. K. Datta.
3) Water and water pollution handbook Vol. I, Leonard, L. Ciaccio.
4) Industrial pollution, N. Iruving sax, Van Mostrand Rein hold company.
5) Encyclopedia of environmental science & tech. Vol. II Ram Kumav.

MIC (A) 404 : QUALITY MANAGEMENT SYSTEM IN INDUSTRY

UNIT I **6**

Healthy microbial practices

a)Scope and aims.

b)The advisory committee on Dangerous pathogens.

c) Laboratory facilities design -Work flow, Size and shape of rooms, Benches ,Floors, walls and ceilings, Heating, lighting and ventilation

d) Microbiological safety cabinets. Sitting and maintenance ,Other laboratory equipment

e)Sterilization, disinfection and decontamination

f)Personnel and training

g)Documentation - Standard operating procedures, Quality systems

UNIT II **6**

Biosafety

a)Introduction

b)Biosafety considerations in fermentation technology.

c)Containment – Physical containment, Biological containment.

d)Biosafety during industrial production.

e)Biosafety guidelines in India.

f)Guidelines and regulations

UNIT III **6**

Endotoxin testing

a) Introduction -Endotoxins and pyrogens, Regulatory development, Introduction to LAL test.

b)The gel clot method – Test principle and procedure, Gel clot lysate, sensitivity, Product interference.

c)The chromogenic end point method- Test principle and procedure, Performance characteristics.

d)The kinetic turbidimetric assay- Reagent preparation ,Test procedures, Performance characteristics

e) Method selection -Water samples, Samples other than water

f)Depyrogenation

UNIT IV **6**

Disinfection and cleansing :

a)General consideration and terminology.

b)Implementation of a cleaning and contamination control programme.

c)Protective clothing and equipment.

d)Selection of cleaning agents and disinfectants.

e)Cleaning practices and application methods.

f)Cleaning, disinfection and sterilization of isolators.

UNIT V **6**

a)Standard operating procedures.

b)Clean in place (CIP) and sterilization in place (SIP) facilities.

c)Validation -Data and document collection,Analytical methods,Sampling methods,Acceptance criteria

d)Disinfection monographs –Alcohol, Aldehydes, Amphoterics ,Chlorine dioxide, Hypochlorites, Peracetic acid, Phenolics, Quaternary ammonium compounds.

UNIT VI **6**

Antimicrobial preservative efficacy testing

a)Introduction

b)The requirement for a biological assessment of preservative activity.

c)Limitations of preservative efficacy tests.

d)Test procedures and factors influencing reproducibility, Selection of viable counting method and demonstration of operator competence., Selection and maintenance of test organisms., Growth, standardization and storage of test inocula.,Test container, product inoculation, mixing and storage. Product sampling and preservative neutralization. Incubation conditions for organisms recovered from inoculated product. Validation. Interpretation of test results.

e)Adaptations and alternatives to pharmacopoeial tests : The use of additional test organisms and more precisely defined cultural conditions. Mixed cultures, repeated challenges and variable inoculum concentrations. Rapid methods.

UNIT VII **6**

Microbiological analysis of

a)Air – Microbial load and identification of air flora.

b)Food – Vegetables, fruits, meat, poultry.

c)Bakery – Detection and characterization of organisms.

d)Pharma and cosmetics – Sterility testing for products, Vitamins assays, antibiotic assay.

UNIT VIII **6**

Quality assurance of food and pharmaceutical products

a)International standards as per WHO, FPO, ISI

b)Industrial rules and regulations as per Indian pharmacopea.

c)Detection of compounds using Indian pharmacopea.

d)Detection of ascorbic acid (tablet)

e)Detection of Vit. B2 (Riboflavin)

f) Detection of antibiotics.

Reference Book :

1) Handbook of Microbiology quality control – Norman A Hodges and Stephen P. Denyer.
2) Fermentation Technology – Dr. H. A. Modi, Vol. 2.
3) Pharmaceutical Microbiology – 6^{th} edition, W. B. Hugo and A. D. Russell.
4) Introduction to Sterilization and disinfection. J. F. Gardner. M. Peel.
5) Laboratory methods in Food and Dairy Microbiology. W. Harngan, M. McCance.
6) Indian Pharmacopia
7) Booklets of ISI standards.
8) Booklets of IPO.
9) Rules and regulations of food and drug administration.

M.Sc.Part-II, Sem. IV

Practical Course- VII

(Industrial Microbiology & Bioprocesses)

1) Isolation of industrially important microorgs for microbial processes – citric acid & lactic acid.
2) Determination of Thermal death point & thermal death time of microogs for design of a sterilizer.
3) Lab scale production of biofertilizer – (nitrogen fixer / PSB)
4) Isolation of urea hydrolyzing bacteria in soil.
5) Alkaline protease production by *B. licheniformes* in solid state fermentation.
6) Checking the efficiency of protease enzyme produced by SSF using standard curve of Tyrosine .
7) of sulphate reductig bacteria.
8) Quantitative estimation of nitrifiers from soil.
9) Determination of D value, Z value for heat sterilization in pharmaceuticals.
10) Bioassay of chlorophenicol by plate assay method or terbidometric assay method.
11) Sterility tesing by *B. stereothermophilus*.
12) Sampling of pharmaceuticals for microbial contamination & load (Symps. Suspensions, creams, & ointments, ophthalmic preparation)
13) Treatment of bacterial cells with cetrimide, phenol & detection of leaky substances such as Potassium ions, amino acids, purines.
14) Determination of MIC of Beta- lactum / amino glycoside.
15) Preservative efficacy testing.
16) Water analysis. –
17) Detection yeast & mold count of food sample.
18) Total plate count of baby food / bakery food.
19) Evaluation & validation of sanitary status of an eatery Examination of Microflora from table surface, utensils, drinking water.
20) Air sampling method.
21) Techniques used in Textile industry - Determination of bio-burden on textile material using AATCC – 100 – 2004 method.

Practical Course- VIII

(project / Industrial training)