Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AUTONOMOUS)

CBCS

Reaccredited by NAAC with 'A+' Grade

New Syllabus For

Master of Science

Part - I

APPLIED MICROBIOLOGY

Syllabus to be implemented from June, 2018 onwards

A. RULES AND REGULATIONS: M.Sc. I

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

1.3 The students with B. Sc. from other universities shall be eligible if they qualify through the entrance 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 should be given equal weightage (50:50).

1.5 The examination shall be split up into four semesters.

1.6 The commencement and conclusion of each semester shall be notified by the Institute from time to time.

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

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

1.9 The result shall be declared at the end of each semester examination as per Institute 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: June 2018 onwards

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 / 05 / 05 / 02**
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 all the semesters 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 Institute.

• **Course Fee** : as prescribed by Institute.

4. Eligibility For Admission:

• As per 1.2 for graduates of this Institute

• As per 1.3 for graduates from other Universities

• And Merit List of entrance examination result

5. Medium of instruction : English

6. Structure of the course:

Semester I

Theory Courses:

MAMiT – 101 Microbial Biodiversity

MAMiT – 102 Recent Trends In Virology

MAMiT – 103 Microbial Physiology And Biochemistry

MAMiT - 104 Essentials Of Genetics

Practical Courses:

MAMiP - 105 Practical Course I

MAMiP - 106 Practical Course II

Semester II

Theory Courses:

MAMiT – 201 Analytical Techniques

MAMiT – 202 Molecular Biology And Genetics

MAMiT – 203 Microbial Metabolism

MAMiT - 204 Essentials Of Immunology

MAMiT - 205 Biostatistics and Bioinformatics

Practical Courses

MAMiP - 206 Practical Course III

MAMiP - 207 Practical Course IV

M.Sc. Evaluation Structure Semester – I

	ESE	Internal Exam		Practical I			Submission		Total
		CCE - I	CCE- II (Online Test)		Exam	Journal	Project Part I	Day to day performance	
Paper I	80	10	10	Lab - I	70	10	30	10	
Paper II	80	10	10						
Paper III	80	10	10	Lab - II	70	10			
Paper IV	80	10	10						
Total	320	40	40		140	20	30	10	600

M.Sc. Evaluation Structure Semester – II

	ESE	Internal Exam		Practical I			Submission		Total
		CCE - I	CCE- II (Online Test)		Exam	Journal	Project Part I	Day to day performance	
Paper V	80	10	10	Lab - I	70	10	30	10	
Paper VI	80	10	10						
Paper VII	80	10	10	Lab - II	70	10			
Paper VIII	80	10	10						
Paper IX	80	10	10						
Total	400	50	50		140	20	30	10	700

CCE I : Seminar / Assignment / Open book test (Any one of these three)

10. System of Examination: applicable to Institute.

1. Scheme of examination:

• Semester exam (both theory and practical examination) should be conducted by the

Institute at the end of each term (semester).

• Theory paper of the external examination should be of 80 marks.

• The internal evaluation test for 20 marks should be conducted by the Department.

• There should be **two** tests for each course paper in the middle of the Semester

• They should be surprise tests during theory lectures.

• The two practical course examinations should be of 100 marks each.

• Question paper should be set in view of the entire syllabus and covering each unit of the syllabus.

2. Standard of passing:

As per the rules and regulations of the Institute for the M. Sc. Course.

3. Nature of question paper and scheme of marking:

a) Institute examination theory paper: Maximum marks – **80**

• Total number of questions – **07.**

• All questions should carry equal marks.

• Out of the seven questions, five are to be attempted of which Question 1 should be compulsory.

• Question No. **1** should 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 should be answered along with the other questions in the same answer book.

• Remaining six questions should 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 should be **20** each carrying **01** mark.

c) Practical Examination (External only) Maximum marks – 100

• Equal weightage shall be given to the two units of the practical course.

• Total number of questions – **06**

• All questions should be compulsory

• Questions 1 to 4 should have at least two **(02)** internal options

C. INTAKE CAPACITY:

1. 30 + 10% (drop out) every year on the basis of entrance examination.

2. The above includes 10 % students from other Universities.

D.CREDIT SYSTEM:

1. Definition of CREDITS:

1. Lectures

2. Practicals

3. Seminars

4. Private study work in the Library/Home

5. Examinations

6.Online Examination

7. Project

8. Industrial training

9. 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
Practical Course	02 × 04 =	08

- As there are four (**04**) semesters to the M. Sc. course, the total credits form lectures and practicals should 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.

1) Theory courses : **16 × 04 = 64** credits
2) 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 should be conducted by the Institute.

Internal: 20 marks per theory paper

• This should be conducted by the Department.

Practical Examination:

• This should be conducted only by the Institute.

Project evaluation:

External: 50 marks by the external 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: - MAMiT – 101,MAMiT – 102 ,MAMiT – 103 ,MAMiT - 104.

Practical courses: MAMiP –105 ,MAMiP - 106

Semester-II:

Theory courses: - MAMiT – 201, MAMiT – 202 , MAMiT – 203 , MAMiT - 204, MAMiT - 205

Practical courses: MAMiP – 206 ,MAMiP - 207

Semester-III:

Theory courses: - MAMiT – 301,MAMiT – 302 ,MAMiT – 303 , MAMiT.E. - 304 – 1 / MAMiT.E. - 304 – 2, MAMiT – 305

Practical courses: MAMiP – 306 ,MAMiP – 307

Semester-IV:

Theory courses: - MAMiT – 401 ,MAMiT.E. - 402-1 / MAMiT.E. - 402-2

Practical courses: MAMiP – 403 ,MAMiP – 404

(E : Elective)

Names of the papers per semester :

Semester I

Paper Number	Name of the Paper
MAMiT. 101	MICROBIAL BIODIVERSITY
MAMiT. 102	RECENT TRENDS IN VIROLOGY
MAMiT. 103	MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY
MAMiT. 104	ESSENTIALS OF GENETICS

Semester II

Paper Number	Name of the Paper
MAMiT. 201	ANALYTICAL TECHNIQUES
MAMiT. 202	MOLECULAR BIOLOGY AND GENETICS
MAMiT. 203	MICROBIAL METABOLISM
MAMiT. 204	ESSENTIALS OF IMMUNOLOGY
MAMiT. 205	BIOSTATISTICS AND BIOINFORMATICS

Semester III

Paper Number	Name of the Paper
MAMiT. 301	MICROBIAL ECOLOGY AND EXTREMOPHILES
MAMiT. 302	GENE TECHNOLOGY
MAMiT. 303	INDUSTRIAL MICROBIOLOGY
MAMiT. 304 E-1	MEDICAL AND PHARMACEUTICAL MICROBIOLOGY
MAMiT. 304 E-2	MYCOLOGY
MAMiT. 305	FOOD AND DAIRY TECHNOLOGY

Semester IV

Paper Number	Name of the Paper
MAMiT. 401	MICROBIAL PRODUCTION
MAMiT. 402 E-1	IMMUNOTECHNOLOGY
MAMiT. 402 E-2	INDUSTRIAL QUALITY AND WASTE MANAGEMENT

M.Sc.Part- I , Sem. I

MAMiT. 101 : MICROBIAL BIODIVERSITY Lectures: 48

UNIT –I : Techniques for classification Lectures: 12

I. Need for classification – Introduction, Overview, Aims and objectives
II. Techniques – Cell wall composition analysis
Lipid and fatty acid profile
Protein profile and isozyme analysis
16s rRNA technique
Serology and chemotaxonomy
III. Approaches for exploring uncultivable bacteria. Culture independent molecular methods.
Methods of extracting total bacterial DNA from habitat.

UNIT –II : Classification of Fungi, Algae and Protozoa Lectures: 12

I. Classification of Molds: General characteristics , morphology & scheme of classification of
Molds.
II. Classification of Yeast: General characteristics , morphology & scheme of classification of
yeasts.
III. Classification of Algae: General characteristics , morphology & scheme of classification of
algae.
IV. Classification of Protozoa: General characteristics , morphology & scheme of classification
of protozoa.

UNIT –III: Classification of Archaebacteria, Eubacteria & Rickettsia Lectures: 12

I. Classification of Domain Archaebacteria: General characteristics , morphology & scheme of
classification of Archaebacteria
II. Classification of Domain Eubacteria: General characteristics , morphology & scheme of

classification of Eubacteria - Cyanobacteria ,Mycoplasma , Myxobacteria, Actinomycetes
III. Classification of Ricketssia: General characteristics, Morphology & classification of
Rickettsia.

UNIT –IV: Space Biodiversity **Lectures: 12**

I. Aims and Objectives of space research
II. Life detection methods: a) Evidence of metabolism (Gulliver)
b) Evidence of photosynthesis
c) ATP production
d) Phosphate uptake
e) Sulfur uptake
III. Martian environment : Atmosphere, Climate, and other details
IV. Antarctica as a model for Mars : Search for life on Mars, Viking mission, Viking landers and
Biology box experiment. Gas exchange, label release and pyrolytic release experiment
V. Monitoring of Astronauts microbial flora: Alteration in load of medically important microbes,
changes in mycological and bacteriological autoflora.

REFERENCES:

i) **UNIT - I & III:** Bergey's Manual of Determinative bacteriology.
ii)**UNIT – I & III:** Bergey's Manual of Systematic bacteriology.- Vol.I II,III & IV
iii) **UNIT – II:** Mycology – C.J. Alexopoulous.
iv) **UNIT – III:** Brock's Biology of microorganisms by Micheal T. Madigan
v) **UNIT – IV:** The evolution of life from space : Astrobiology, viruses, Microbiology and Genetics by Chandra,
Wickramasinghe and R. Gabriel Joseph
vi) **UNIT – IV:** Astrobiology: A very short introduction by David C. Catling

LEARNING OUTCOME :

- Students should get detailed information related to need and significance of classification & required techniques.
- Students should understand concept of biodiversity microbes other than bacteria
- Students should learn how to classify Eubacteria and Archaebacteria
- Student should be updated with present research in Space biodiversity

MAMiT. 102 : RECENT TRENDS IN VIROLOGY Lectures: 48

UNIT –I : Evolution and classification of viruses Lectures: 12

I. Evolution of viruses: The potential for rapid evolution in RNA viruses, rapid evolution- Recombinantion, Evolution of measles & influenza virus
II. Nomenclature and classification of viruses: Classification & nomenclature of animal viruses, Classification & nomenclature of plant viruses, Classification & nomenclature of bacteriophages.
III. Inihibition and inacrtivation of bacteriophages, animal viruses, plant viruses: Photodynamic inhibition, inactivation by heat and radiation, inactivation by chemicals
IV. Transmission of viruses: horizontal, vertical and zoonoses. Animal models to study transmission.

UNIT –II : Life cycles of viruses Lectures: 12

I. Reproductive cycles of Animal viruses: DNA viruses- Herpes and pox
RNA viruses- Reo and Rhabdo
II. Reproductive cycles of bacterial viruses: Lambda, phi X 174
III. Reproductive cycles of plants viruses: bunchy top of banana, mosaic disease of sugarcane,
potato spindle tuber disease
IV. Genetic regulation of bacteriophage life cycle: a) Regulatory events that control lytic cascade & lysogeny b) Functional clustering in genome c) Nature of repressor & operators d) balance between lysogeny and lytic cycle d) Role of cellular proteases and environmental conditions that regulate life cycle of phages e) Alternative sigma factors to
regulate large sets of genes.

UNIT –III : Oncogenic viruses Lectures: 12

1) Oncogenic viruses : HIV, RSV, SV 40
a) Oncogenes & their Proteins – Classification & Characteristics.
b) Genetic basis of cancer – Conversion of Protooncogenes to Oncogenes by – Mutation & viruses
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 : Vaccines and Antiviral drugs **Lectures: 12**

I. 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.
II. Antiviral drugs: a) Discovery & screening of antiviral drug. b) Antiviral chemotherapy –
general approach, drugs - Inhibiting viral entry, Inhibiting replication of viral nucleic acid,
Inhibiting viral protein function, Drug resistance,
III. Viruses as therapeutic agents.

REFERENCES:-

1) **UNIT – I:** Principles of virology – 3rd edition. Vol.I & II. – by S.J. Flint.
2) **UNIT – I:** Basic virology- 3rd edition – Edward K. Wagner.
3) **UNIT – IV:** Fundamentals of Micro. & Immunology. Ajit K. Banaergee.
4) **UNIT – II:** Evolution of RNA viruses – Straus J.H.
5) **UNIT – II:** Microbiology – Davis.
6) **UNIT – II & III:** Virology Vol. IV – Topny & Wilson.
7) **UNIT – III:** Introduction to Plant Virology – Longman.
8) **UNIT – II:** Intro to Modern virology – 6th Edi., N.J. Dimmock, A.J. Easton
9) **UNIT II:** Virology by Luria

LEARNING OUTCOME :

- Students should understand significance, morphology and classification of various viruses.
- Students should know concept and techniques of cultivation of viruses
- Students should learn about replication of various viruses.
- Student should be updated with present research in vaccines and antiviral drugs useful to combat viral diseases.

M.AMiT. 103 : MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY

Lectures: 48

UNIT –I : Amino acid and proteins — Lectures: 12

I. 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.
II. 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 : Carbohydrates and lipids — Lectures: 12

I. 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.
d) Glycoconjugates- Proteoglycan, Glycoprotein Glycolipids.

II. 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 e.g. Cholesterol, Ketone bodies.
IV. 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
Thiamine , Riboflavin and Vit C..

UNIT –III : Bioenergetics **Lectures: 12**

I. 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.
II. 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

UNIT –IV: Bacterial Chemolithotrophy **Lectures: 12**

I. Physiological groups of chemolithotrophs
II. Ammonia oxidation by members of genus *Nitroso* group
III. Nitrite oxidation by Nitro group
IV. Oxidation of molecular hydrogen by *Hydrogenomonas* spp.
V. Ferrous and sulfur/sulphide oxidation by *Thiobacillus* spp.

REFERENCEBOOKS :

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

LEARNING OUTCOME :

- Students should understand the molecular details of bio-organic molecules and their physiological significance..
- Students should know structure and role of various bimolecules.
- Students should learn about energy generation mechanisms of cell.
- Student should be updated with present research in chemolithotrophy.

M.AMiT. 104 : ESSENTIALS OF GENETICS **Lectures: 48**

UNIT –I :Mendelian and Non-Mendelian Genetics **Lectures: 12**

I. Mendelism :
a) Monohybrid crosses and Mendel's' Principle of segregation.
b) Dihybrid crosses and Mendelian principle of independent assortment
c) Epistasis
d) Statistical analysis of Genetic data. The Chi-square test.
e) Multiple alleles – ABO blood groups.
f) Essential genes and lethal genes.
g) The environment and gene expression- co-dominance, incomplete dominance, pleiotropy.
h) Sex linkage, Sex limited & influenced characters
II. Non Mendelian Inheritance**:**
a) Determining Non Mendelian Inheritance
b) Maternal effects.
c) Cytoplasmic inheritance (Mitochondria,chloroplast,infective particles)

UNIT –II : Chromosomes and their packaging **Lectures: 12**

I. Structure of chromosomes:
a) Lampbrush chromosomes
b) Polytene chromosomes
c) Heterochromatin – defense against mobile DNA elements.
d) Mitotic chromosomes – their patterns
e) Mitotic chromosomes – their patterns
II. 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,
f) Splicing mechanism i) Autocatalytic RNA ii) Spliceosome

UNIT –III : DNA damage and repair **Lectures: 12**

I. DNA Repair
a) Error free mechanism –
i) Mismatch repair.

ii) Base excision repair.
iii) Nucleotide excision repair.
iv) Direct repair.
b) Error prone mechanism-
II. DNA Recombination.
a) Homologous genetic recombination.
b) Site specific recombination.
c) Eukaryotic transposons.

UNIT –IV : Human Genetics **Lectures: 12**

I. Pedigree analysis,
II. Lod score for linkage testing,
III. Karyotype
IV. Genetic disorders- Haemophilia, Colour blindness, Hungstinson's disease
V. Quantitative genetics- polygenic inheritance, hetitability & its measurements & QTL
mapping.

REFERENCE BOOKS :

1) **UNIT – I:** Principles of Genetics – Gardner
2) **UNIT – II:** Genes by Lewin – V and IX
3) **UNIT – III:** Microbial Genetics – Friefielder
4) **UNIT – I:** Gene – Watson
5) **UNIT – II:** Genetics – Klug & Commings.
6) **UNIT – III:** Lehninger's Principles of Biochemistry – Nelson & Cox
7) **UNIT – IV:** Molecular Cell biology by Lodish -2010
8) **UNIT – IV:** An introduction of Genetic Analysis 10th Edition. Freeman 2010.Anthony & J.F.Griffith, Susan R. Wessler.

LEARNING OUTCOME :

- Students should understand essentials of bacterial and human genetics.
- Students should know structural levels of chromosomes.
- Students should learn about DNA repair and gene recombination mechanisms.
- Student should be updated with present research in human genetics.

M.Sc.Part-I, Sem.I

M.AMi P. 105 Practical Course – I (LAB-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) Induction 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) Determination of cross infectivity of *E. coli* with *Pseudomonas, Salmonella & Proteus vulgaris*
phages
7) Preparation of high titre of E.coli phages.
8) Phage typing of E.coli.

REFERENCE BOOKS:

1) An introduction to practical biochemistry – 3rd edition, David T. Plummer
2) Practical handbook of microbiology – Shouldiam M. O'Leary
3) Practical microbiology – S. Chand
4) A textbook of practical biochemistry – Joshi A. Rashmi

M.AMi P. 106 Practical Course – I (LAB-II)

Unit-I

1) Estimation of bacterial protein by Lowry 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 pigments chlorophyll a & b from plant.
7) Estimation of vitamin C from biological source.
8) Detection of changes in conformation of protein by viscosity measurement.

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.

REFERENCE BOOKS:

1) An introduction to practical biochemistry – 3rd edition, David T. Plummer
2) Practical handbook of microbiology – Shouldiam M. O'Leary
3) Practical microbiology – S. Chand
4) A textbook of practical biochemistry – Joshi A. Rashmi

LEARNING OUTCOMES:

- Students should understand various biochemical methods to study biomolecules.
- Students should know various concepts of mutation.
- Students should learn about population genetics.
- Student should be updated with techniques used to study enzymes.

M.Sc. Part- I , Sem. II

M.AMiT. 201 : ANALYTICAL TECHNIQUES **Lectures: 48**

UNIT –I : Microscopy and Electrochemical Techniques **Lectures: 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,
Daniel 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 : Chromatography and Centrifugation **Lectures: 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 : Sequencing and Purification Techniques **Lectures: 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.
3) Amino acid sequencing
a) Importance of amino acid sequencing.
b) Sanger method
c) Dansyl chloride & Dabsyl chloride method.
d) Edman degradation method & Autoanalyser.

UNIT –IV : Spectroscopy **Lectures: 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
b) CD/ORD Spectroscopy .
d) X – ray spectroscopy – X- ray diffraction

REFERENCE BOOKS –

i) **UNIT – I & II:** Techniques in Biochemistry – T. Devasena & G. Rajgopal
ii) **UNIT – II:** Principles & techniques of Biochemistry & Molecular Biology – Wilson & Walker
iii) **UNIT – III & IV:** Bioinstrumentation – L.Veera Kumari , MIP Publishers , Chennai
v) **UNIT – IV:** Analytical Biochemistry – Dr. P. Ashokan- Chinna Publications.
vi) **UNIT – I, II & III:** Tools in Biochemistry – David Cooper.
vii) Instrumental methods of chemical analysis, Goel Publication House by – B.K.

LEARNING OUTCOME:

- Students should understand bio-analytical techniques useful in research and industries.
- Students should know practical significance of separation techniques of biomolecules.
- Students should learn about techniques related to molecular level analysis.
- Student should be updated with techniques used in present research.

M.AMiT.202 : MICROBIAL METABOLISM **Lectures: 48**

UNIT –I : Bacterial Permeation **Lectures: 12**

1) Concept of pH and buffers :
a) Ionization of water, weak acid and weak bases.
b) pH – pH scales, Bronsted Lowry 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) Components of membrane,
b) Membrane structural models,
c) Methods to study diffusion of solutes.
d) Eukaryotic and prokaryotic protein transport systems,
e) Membrane protein.
f) Ion channels K+, Na+, Cl -
g) Na +/ K+ pump

UNIT –II : Essentials of Enzymology **Lectures: 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 : Carbohydrate and Lipid Metabolism **Lectures: 12**

1) Pathways in Utilization of different substrates in *E. coli*.
a) Overview of glucose metabolism
b) Substrates 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 triacylglycerides.
f) Ketone bodies – formation and utilization.

UNIT –IV : Signaling and Stress Response in Microbes **Lectures: 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.
e) Two components signaling system.
f) Porin structure
h) Common signaling systems of plants , microbes & mammals .

REFERENCE BOOKS:

1) **UNIT – I, II &III:** Lehninger's Principles of Biochemistry 5th edi – Nelson & Cox
2) **UNIT – I, II &III:** Biochemistry – 2nd edition D. Voet, J. Voet.
3) **UNIT – I, II &III:** Biochemistry – 4th edition Lubert Stryer.
4) **UNIT – I, II &III:** Fundamental of Biochemistry by Jain.
5) **UNIT – II:** The Nature of Enzymology by Foster.
6) **UNIT – II:** Enzymes by Palmer
7) **UNIT – II:** Bacterial Metabolism by G. Gottschalk.
8) **UNIT – I, II &III:** Biochemistry by Zubay.
9) **UNIT – II:** The Physiology and Biochemstry of Procaryotes by White (Oxford Uni. Press)
10) **UNIT – III:** Introduction to bacterial metabolism – Doelle H. W. (1975) (Academic Press)
11) **UNIT – IV:** The Microbial world – Stanier.
12) **UNIT – IV:** Biochemical Calculations – Segal.
13) **UNIT – IV:** General Microbiology – Schlege.

LEARNING OUTCOME:

- Students should understand various biochemical processes and communication in bacteria.
- Students should know structure, function and reaction mechanisms in cell.
- Students should learn about various metabolic pathways in bacteria.
- Student should be updated with stress responses in bacteria.

M.T.203 : MOLECULAR BIOLOGY AND GENETICS **Lectures: 48**

UNIT –I : DNA Replication **Lectures: 12**

1) DNA Replication.
a) DNA replication in prokaryotes - Origin of replication, types of *E.coli* DNA polymerases, details
of replication process, regulation of replication, connection of replication to cell cycle.
b) DNA replication in eukaryotes - Multiple replicons, eukaryotic DNA polymerases, ARS in yeast,
ORC,regulation of replication.
c) Regulation of S phase of cell cycle – Introduction of cell cycle, phases : G1, G2, S and M.
Regulation of S phase : Replication and regulation, cdk kinases.

UNIT –II : Transcription & Regulation of Gene Expression **Lectures: 12**

1) 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.
2) Regulation of gene expression in bacteria
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.

UNIT –III : Translation **Lectures: 12**

1) Translation Prokaryotes and Eukaryotes
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

UNIT –IV: Sequencing Genes and Genomes **Lectures: 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.

REFERENCE BOOKS:

1) **UNIT – IV:** An introduction of Genetic Analysis 10th Edition. Freeman 2010, Anatomy & J.F. Griffith.
2) **UNIT – IV**: Introduction to Genetic analysis – Lodish.
3) **UNIT – II & III:** Lehninger – Biochemistry.
4) **UNIT – I:** Gene : Lewin- X
5) **UNIT – I, II, III:** Molecular Cell Biology by Lodish – 2010.
6) **UNIT – I, II, III:** Molecular Biology F. Weaver- 2010
7) **UNIT – I:** Molecular Biology of gene 5th edition Benjamin & Cumin 2010.
8) **UNIT – IV:** An Introduction of Genetic Analysis 5th edition Freeman 2010.

LEARNING OUTCOME:

- Students should understand gene expression and its regulation in prokaryotes and eukaryotes.
- Students should know mechanism of protein synthesis.
- Students should learn about universal hierarchy.
- Student should be updated with techniques used in present research in genetics.

M.T. 204 : ESSENTIALS OF IMMUNOLOGY **Lectures: 48**

UNIT –I: Immune system and organization and expression of Ig genes
Lectures: 12

1) Organisation and Expression of Ig genes
a) Multigene organization of Ig genesi)
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 :- MHC complex and experimental systems **Lectures: 12**

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 expressioon
f) MHC and immune responsiveness.
2) Experimental Systems-
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 :- Tumor immunology and Apoptosis **Lectures: 12**

1) 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.
2) Programmed Cell Death.
i) Pathways of target cell apoptosis.
ii) Fas pathway.
iii) Perforin / granzyme pathway**:**

Unit IV:- Immunodeficiencies and Immunotechniques **Lectures: 12**

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 applicationa)
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.

REFERENCE BOOKS:

1) **UNIT – I, II, III**: Cellular and Molecular Immunology – Abul K. Abbas. (5th Edition)
2) **UNIT – I, II, III**: Kuby Immunology – Kindt Goldsby & Osborne.
3) **UNIT – IV**: Immunology – Tizard.
4) **UNIT – IV**: Immunology – C. Vaman Rao.
5) **UNIT – I, II, III & IV**: Essential Immunology – Roitt I.M.

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

LEARNING OUTCOME:

- Students should understand immune system and its relation with various microbes.
- Students should know advances in the field of immunodeficiencies.
- Students should learn about immune response to diseases and tumors.
- Student should be updated with techniques and experimental systems required in immunological research.

M.Sc.Part-I, Semester -II

M.AMiL. 205 Practical Course – II (LAB-I)

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) Purification of plasmid by phenol/chloroform method.
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) Determination of molar extinction coefficient.

Unit – II

1) Determination of mutation rate in bacteria.
2) Fluctuation test.
3) Testing of chemical for mutagenicity 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) Quantitative estimation of hydrocarbons , pesticides ,organic solvents ,methane by gas chromatography.

REFERENCE BOOKS:

5) An introduction to practical biochemistry – 3rd edition, David T. Plummer
6) Practical handbook of microbiology – Shouldiam M. O'Leary
7) Practical microbiology – S. Chand

8) A textbook of practical biochemistry – Joshi A. Rashmi

M.AMiL. 206 Practical Course – II (LAB-II)

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 (KM) for enzyme amylase.
6) Titration curve of glycine
7) Study of organisms subjected to nutritional stress (Carbon)
8) Detection of Siderophore produced by *Pseudomonas* spp.
9) Assay of Protease and Lipase enzymes

Unit-II

1) Determination of antibody titer by Ouchterlony double diffusion test.
2) Demonstration of SDS-PAGE technique
3) ELISA- Detection of antigen/ antibody by Sandwitch ELISA.
4) Rocket immunoelectrophoresis
5) Radial Immunodiffusion test
6) Purification of H antigen from *S. typhi*
7) Estimation of alkaline phosphatase from patients serum
8) Purification of Antibodies using ammonium sulphate precipitation & column chromatography.

REFERENCE BOOKS:

1) An introduction to practical biochemistry – 3rd edition, David T. Plummer
2) Practical handbook of microbiology – Shouldiam M. O'Leary
3) Practical microbiology – S. Chand
4) A textbook of practical biochemistry – Joshi A. Rashmi

LEARNING OUTCOMES:

- Students should understand various methods to purify biomolecules.
- Students should know various techniques used to study mutation.
- Students should learn about enzymes activity.
- Student should be updated with techniques used in immunology