

UNIVERSITY OF MUMBAI
No.UG/ 210 of 2007

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Master of Science (M.Sc.) degree examination vide Pamphlet No.175 and to this office Circular No.UG/473 of 2005 dated 25th November,2005 and the Director/Head of the recognized Institutions concerned and the Principals of the affiliated colleges in Science, are hereby informed that the recommendation made by the Board of Studies in Microbiology at its meeting held on 9th March,2007 has been accepted by the Academic Council at its meeting held on 13th April,2007 vide Item No.4.13 and that in accordance therewith the syllabus in the subject of Microbiology at the M.Sc. (Part-II) examination is revised as per Appendix and that the same will be brought into force with effect from the academic year 2007-2008.

MUMBAI-400 032
18th May, 2007

for I/c. REGISTRAR

To,

The Director/Head of the recognized Institutions concerned and the Principals of the affiliated colleges in Science,

A.C./4.13/13.04.2007

No.UG/ 210- A of 2007, MUMBAI-400 032

18th May,2007

Copy forwarded with compliments for information to :-

1. The Dean, Faculty of Science
2. The Chairperson, Board of Studies in Microbiology

for I/c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, , the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the P.A. to the Pro-Vice-Chancellor, and the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information

The Officer on Special Duty and Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Account Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) + Deputy Registrar (Special Cell), the Deputy Registrar, (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (1 copy), BUCT (1 copy), the Deputy Account. Unit V (1 copy), the In-charge Director, Centralized Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

UNIVERSITY OF MUMBAI



REVISED SYLLABUS

FOR

M.Sc. (PART II)

IN

MICROBIOLOGY

(with effect from the academic year 2007-2008)

PREAMBLE

The present syllabus of M.Sc II microbiology came into effect from the academic year 2002 – 2003. In keeping with the recent trends and developments in the Biological Sciences, the BOS in Microbiology felt the need to revise the syllabus of M.Sc. Part II which was implemented in 2006 – 2007. In continuation, the M.Sc. II syllabus required a revision. The activity was undertaken by the core committee comprising of members of BOS wherein the other board members contributed productively

The proposed M.Sc. II syllabus aims at providing an active learning environment to enable students to develop employable skills concurrently with an understanding of theoretical foundations and practical techniques.

The main features of the proposed revision syllabus are:

- Health sciences world over has always been in the forefront. In view of the same topics such as Epidemiology, infections of current global significance / concern, cancer & immune system, Clinical research, Vaccine development & Biotherapeutics have been included in one of the papers (**Paper V**)
- Biotechnology has always been an integral part of Microbial science. To expand the horizons beyond the undergraduate learning of Biotechnology, a paper on “Advances in Biotechnology” has been included in the proposed syllabus. The focus is on agricultural, Industrial, Environmental & Animal Biotechnology. The paper (**Paper VI**) also introduces the nanobiotechnology concepts, its applications and biosafety regulations to students.
- A paper (**Paper VII**) on “Quality Management Systems in Microbiological Practices” has been designed with inputs from the interaction with personnel from various industries.
- **Paper VIII**, entitled “Tools and Techniques in Microbiology” will introduce the students to some Molecular Biology techniques and Fundamentals of Research Designs. In addition, a unit in data analysis will acquaint the students with data management.

As an extension of the theoretical knowledge, the students will be conducting experiments in the laboratory on the basis of the theory papers. In addition, they will undertake a Research Project in relevant areas of Microbiology.

The proposed syllabus is an outcome of several deliberations and meetings of the core committee and BOS members.

M.Sc. Part –II – Microbiology

Proposed Revised Syllabus w.e.f. 2007-2008

	Paper V: Immunology and Microbiology in Health Science	No. of Lect.
Unit 1	The Immune System in Health and Disease	30
Unit 2	Epidemiology of Infectious Diseases	30
Unit 3	Developments in Biotherapeutics and Diagnostics	30
Unit 4	Clinical Research and Development of Vaccines	30
	Paper VI : Advances in Biotechnology	
Unit 1	Industrial Biotechnology	30
Unit 2	Agricultural Biotechnology	30
Unit 3	Environmental Biotechnology	30
Unit 4	Animal Biotechnology, Nanobiotechnology & Regulations	30
	Paper VII : Quality Management Systems in Microbiological Practices	
Unit 1	QC.GMP,GLP,QA : Nature & Interrelationship	30
Unit 2	Standard Methods of Analysis used in diverse industries	30
Unit 3	Control of organisms in diverse environments	30
Unit 4	Quality Management Systems & Emerging approaches	30
	Paper VIII : Tools & Techniques in Microbiology	
Unit 1	Tools & Techniques in Molecular Biology	30
Unit 2	Molecular tools in Microbial Community Analysis	30
Unit 3	Fundamentals of Experimental Design	30
Unit 4	Data Analysis	30

- Each paper shall have four periods per week. Each period shall be of one hour duration.
- Each practical shall be of four hours per week. Each period shall be of one hour duration.
- Research Project will be allotted eight periods per week.
- Research Project must contain the following : Introduction, Review of Literature, Materials and Methods, Results , Discussion and Bibliography (50-60 total pages)
- The research project will be presented in the form of a poster, which will be adjudged by the examiners at the final University Practical Examination.

Paper V

Immunology and Microbiology in Health Science

Unit 1 : The Immune System In Health and Disease

30 lectures

1. Tolerance And Autoimmunity

6 lectures

- 1.1 Establishment and Maintenance of Tolerance, Organ- Specific Autoimmune Diseases
- 1.2 Systemic Autoimmune Diseases, Animal Models for Autoimmune Diseases
- 1.3 Evidence Implicating the CD4+ T Cell, MHC, and TCR in Autoimmunity
- 1.4 Proposed Mechanisms for Induction of Autoimmunity, Treatment of Autoimmune Diseases

2. Transplantation Immunology

6 lectures

- 2.1 Immunologic Basis of Graft Rejection, Clinical Manifestations of Graft Rejection
- 2.2 General Immunosuppressive Therapy, Specific Immunosuppressive Therapy
- 2.3 Immune Tolerance to Allografts, Clinical Transplantation

3. Immune Response to Infectious Diseases

6 lectures

- 3.1 Viral and Bacterial Infections, Parasitic and Fungal Diseases

4. AIDS and Other Immunodeficiencies

6 lectures

- 4.1 Primary Immunodeficiencies
- 4.2 AIDS and Other Acquired or Secondary Immunodeficiencies

5. Cancer and the Immune System

6 lectures

- 5.1 Cancer : Origin and Terminology
- 5.2 Malignant Transformation of Cells
- 5.3 Tumors of the Immune System
- 5.4 Tumor Antigens
- 5.5 Tumor Evasion of the Immune System
- 5.6 Cancer Immunotherapy

Unit 2: Epidemiology of Infectious Diseases

30 lectures

1. Principles of Epidemiology

5 lectures

- 1.1 Epidemics - A continuing Threat. Terminology
- 1.2 Etiologic agents and their reservoir
- 1.3 Mechanisms of transmission
- 1.4 The susceptible population
- 1.5 Methods of epidemiology
- 1.6 Epidemiological typing
- 1.7 Breaking the chain - Control measures

- 2. Surveillance and Statistics in Epidemiology** 6 lectures
- 2.1 Types and methods of public health and infectious disease surveillance establishing surveillance system
- 2.2 Confidence intervals and hypothesis testing for a single population proportion
Confidence intervals for the odds ratio and testing the odds ratio
- 3. Epidemiological Issues** 7 lectures
- 3.1 Indian scenario - eg. Polio, Global travel and health considerations
- 3.2 Nosocomial infections, Bioterrorism
- 3.3 Major factors Affecting Emergence and Re-emergence of infectious diseases.
- 4. Advances in the Study of Infections of Current Global Concern** 12 lectures
- 4.1 Viral infections: Influenza- Avian and Human, Hepatitis B & C, Dengue, Haemorrhagic fever, Chikungunya, HIV, SARS
- 4.2 Bacterial Infections : Leptospirosis, Mycobacterial infections-nontuberculosis infections, Helicobacter
- 4.3 Mycoplasma, fungal and protozoal infections

Unit 3 –Developments in Biotherapeutics and Diagnostics 30 lectures

- 1. Experimental Systems** 4 lectures
- 1.1 Experimental Animal Methods, Cell Culture Systems e.g. mammalian, insect, plant
- 2. Advances in Biotherapeutics** 16 lectures
- Gene Therapy, Stem cells, Monoclonal Antibodies, Therapeutic Proteins, RNA
Drug delivery systems
- 3. Diagnostic Methods** 9 lectures
- 3.1 Advances in Molecular and Immunological Techniques
- 3.2 Microarrays
- 3.3 Advances in Fluorescence Technology
- 4. Radio-Pharmaceuticals** 1 lecture

Unit 4 - Clinical Research and Development of Vaccines 30 lectures

- 1. Clinical Research** 14 lectures
- 1.1 Introduction to Clinical Research
- 1.2 Good Clinical Practice Guidelines
- 1.3 Ethical Aspects of Clinical Research
- 1.4 Regulatory Requirements in Clinical Research
- 1.5 Clinical Research Methodologies and Management
- 1.6 Clinical Data Management and Statistics in Clinical Research
- 2. Development of Vaccines** 8 lectures
- 2.1 Designing Vaccines for Active Immunization
- 2.2 Live, Attenuated Vaccines, Inactivated or Killed Vaccines, Subunit Vaccines, Conjugate Vaccines, DNA Vaccines, Recombinant Vector Vaccines
- 2.3 Different delivery systems, Vectors and Adjuvants
- 3. Vaccines – Specific Examples** 8 lectures
- Avian Influenza, Tuberculosis, Polio, Malaria, HIV

PRACTICALS

1. Electrophoresis of Proteins – Human Serum
2. Assay of Antibody levels :
 - a) Gel Precipitation : Ouchterlony's Method, Audin's Method.
 - b) Immunoelectrophoresis.
 - c) Passive Haemagglutination.
 - d) ELISA, RIA, CIEP (Demonstration)
3. Collection of Human Blood and Separation of Mononuclear Cells. counting viable cells.
4. Phagocytosis – Assay. Bacteria and Yeast cells.
5. Complement Fixation test – Demonstration.
6. Isolation and Identification of Pathogens From :
 - Faeces- Using Hicombi TM XLD MacConkey's Agar Plate
 - Urine - Using Hicombi TM CLED MacConkey's Agar Plate
 - Hicrome UTI Agar Plate
7. Study of Pathogens using Rapid Identification Kits – any two
 - Use of Octo discs to check for MDR of isolated pathogens
 - Recommended: Rapid UTI ABST Kit HIMEDIA
8. **Assignment** on the current status of vaccines for an infectious disease of global/Indian concern with various factors involved and epidemiology.
9. **Work experience** in a clinical pathology lab as an observer for the tenure of one week with a certificate to that effect duly signed by the concerned authority/pathologist.

References

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Janeway - Travers
2. Immunology - An Introduction - Tizard - 4th edition.
3. Immunology - 6th edition - Roitt, Brastoff Male.
4. Biotechnology in India Volumes 1 & 2 Editors: T.K.Ghose, P.Ghosh
Springer
5. Medical Immunology - Lange 10th edition.
6. Immunology and Immunotechnology - Ashim Chakravarty.
7. Medical Microbiology - 3rd edition - Cedrics Mims
8. Microbiology - 6th edition - Prescott Harley Klein
9. Textbook of Clinical Trials - Editors David Machim, Simon Day &
Sylvan Green - John Wiley & Sons
10. Management of Data in Clinical Trials - Eleanor McFadden M.A. - John Wiley
& Sons, Inc.
11. Vaccines from Concept to Clinic - Edited by Lawrence C Paoletti and
Pamela M McInnes - CRC Press 1999
12. Clinical Trials - Issues & Approaches - Edited by Stanley H Shapiro/
Thomas A. Louis - Marcel Dekker Inc. New York
13. Clinics in Laboratory Medicine. Emerging Infections and their causative
agents. September 2004 Vol. 24 No. 3
14. Handbook of Epidemiology - W. Ahrens I. Pigeot Springer -
Verlag Berlin Herdelberg 2005
15. Diagnostic Microbiology - 6th Edition- Koneman
16. Epidemiology for Public Health Practice - Robert H Friis & Thomas A. Sellers
3rd Ed. - Jones & Bartlett Publishers.
17. Immunology- 6th Edition - Kuby
18. Recombinant DNA - Watson, Gilman, Witkowski & Zoller
2nd Ed. Scientific American Books
19. Molecular Biotechnology : Principles and Applications of Recombinant DNA . Glick
and Pasternak (3rd) ASM Press

<http://www.cdc.gov/> and related cdc sites

Paper VI

Advances in Biotechnology

Unit-1:-Industrial Biotechnology

30 lectures

1. Synthesis of commercial products by recombinant microorganisms 12 lectures

- 1.1 Restriction endonucleases
- 1.2 Small biological molecules-synthesis of L-Ascorbic acid
- 1.3 Microbial synthesis-Indigo, amino acids, removal of lipids
- 1.4 Antibiotics-cloning antibiotic biosynthetic genes, synthesis of novel antibiotics
- 1.5 Engineering of polyketide antibiotics. Improving antibiotic production, peptide antibiotic.
- 1.6 Biopolymers-Engineering of microorganism for xanthum gum production
- 1.7 Isolation of melanine biosynthesis genes
- 1.8 Synthesis of an animal adhesive biopolymer in microbial cells
- 1.9 Microbial synthesis of rubber
- 1.10 Microbial production of polyhydroxyalkanoates.

2. Enzyme technology:

10 lectures

- 2.1 Introduction, Extremozymes, Nontraditional enzymes, Immobilized enzyme
- 2.2 Uses of enzymes in solution and immobilized enzymes
- 2.3 Enzyme reactors, Biosensors, synzymes, Bi & Polyfunctional enzymes
- 2.4 Safety and regulating aspects, Allergy, activated related toxicity and residual microbial activity

3. Protein engineering:

3 lectures

Adding disulphide bonds, changing asparagine to other amino acids, reducing the number of free sulphhydryl residues, Increasing enzymatic activity, Modifying metal cofactor requirements, Decreasing protease sensitivity, Modifying protein specificity, Increasing enzyme stability & specificity, Altering multiple properties

4. Flux control Analysis:-Basic principles & Industrial Applications.

5 lectures

- 4.1 Introduction traditional versus modern concepts
- 4.2 Flux control analysis:-basic principles-The flux control coefficient, The summation theorem
- 4.3 Elasticities, the connectivity theorem response coefficient
- 4.4 Effect of isocitrate dehydrogenase (ICDH) & isocitrate lyase (ICL) on the partition of carbon flux at the junction of isocitrate during growth of E.coli on acetate :a case study. The model.

Unit-2 Agricultural Biotechnology

30 lectures

1. Genetic engineering of plant

8 lectures

- 1.1 Use of reporter gene in transformed plant cells, Manipulation of gene expression in plants-Isolation & use of different promoters, targeted alteration in plant DNA & RNA, targeted foreign DNA to the chloroplast genome.
- 1.2 Production of marker free transgenic plant-removing marker genes from nuclear DNA & chloroplast DNA
- 1.3 Plant gene cloning by transposons
- 1.4 Arabidopsis as a model organism for molecular genetics of plants

2. Genetic engineering of plants-Applications

14 lectures

- 2.1 Development of insect, pathogen and herbicide resistant plant, Development of stress & senescence tolerant plants-Oxidative stress, salt stress, fruit ripening & flower wilting.
- 2.2 Genetic manipulation of flower pigmentation, Modification of plant nutritional content-amino acids, lipids, iron & vitamins
- 2.3 Modification of food plant taste & Appearance, Preventing discolouration, Sweetness and starch, Modification of oil & seed protein (Golden rice)
- 2.4 Plants as Bioreactors-Antibodies, polymers, foreign protein in plants.
- 2.5 Edible vaccines, Plant yield-increasing iron content, altering lignin content & Increasing oxygen content.

3. Plant growth promotion bacteria

8 lectures

- 3.1 Nitrogen fixation-nitrogenase, composition of nitrogenase, genetic engineering of the nitrogenase gene cluster
- 3.2 Glycogen synthase mutants, engineering oxygen levels
- 3.3 Hydrogenase-Hydrogen metabolism & genetic engineering of hydrogenase genes.
- 3.4 Nodulation-Competition among nodulating organisms, genetic engineering of nodulation genes
- 3.5 Growth promotion by free living bacteria- decreasing plant stress.
- 3.6 Biocontrol of pathogens-Siderophores, antibiotics, Enzymes, Ice nucleation & antifreeze proteins, Ethylene & root colonization.

Unit:-3 Environmental Biotechnology

30 lectures

1. Environmental monitoring

8 lectures

- 1.1 Introduction, sampling, physical, chemical and biological analysis, recombinant DNA technology
- 1.2 Determination of biodegradable organic material
- 1.3 Monitoring pollution, Bioindicators, Biomarkers, Toxicity testing using biological material, Biosensors.

2. Microbial Insecticides

4 lectures

- 2.1 Insecticide toxin-B.thuringiensis, action isolation, use & engineering.
- 2.2 Genetic engineering of improved biocontrol, baculovirus as bio-control agents.

3. Bioremediation

3.1 Introduction, synthetic & petrochemical compounds, Inorganic wastes 10 lectures
 3.2 Bioremediation strategies, Bioremediation techniques in situ & ex situ
 3.3 Phytoremediation, Bioremediation of hydrocarbon of hydrocarbon, metals, gas, dye in paper and pulp industries, heavy metals and xenobiotics.

4. Bioenergy from wastes

Biomass for energy production, ethanol methanol & hydrogen production. 4 lectures

5. Vermicomposting

Biofertilizers, bioplastics- Biopol & Biolac 4 lectures

Unit-4: Animal Biotechnology, Nanobiotechnology & Regulations

30 lectures

1. Animal biotechnology

12 lectures

1.1 Transgenic mice-Methodology-Retroviral vector method, DNA microinjection method, Engineered embryonic stem cell method, Genetic modification with cre-10*⁺ recombinant systems, transgenesis with high capacity vectors.

1.2 Transgenic mice- Applications

Transgenic models for Alzheimer disease, using transgene mice as test system, conditional control of cell death.

1.3 Cloning live stock:-cloning by nuclear transfer transgenic cattle, sheep, goats, pigs, rabbits, birds & fish.

1.4 Generation of agriculturally important animals-Animal recombinant bovine growth hormone, production of pharmaceutical products in transgenic animals, Protection of farm animals by transgene expression of viral coat proteins.

2. Nanobiotechnology

7 lectures

2.1 Introduction, synthesis of nanomaterials-Biological methods-introduction, synthesizing microorganism and plant extracts, use of proteins & templates like DNA.

2.2 Properties of Nanomaterials & analysis techniques, Mechanical, structural, melting of nanoparticles, Electrical conductivity, optical properties, magnetic properties.

2.3 Application-Medical field & environment

2.4 Synthetic biology-Introduction

3. Biosafety

11 lectures

3.1 Introduction –Definition, History, Objectives

3.2 Risk assessment-Risk regulation, containment, Biosafety during industrial production, national & international guidelines & regulations

3.3 Intellectual property right (IPR) & protection (IPP)

- 3.4 Regulating the use of biotechnology-Recombinant DNA techniques regulation
Regulation of food And food ingredients-chymosin, Trptophan & bovine
somatotropin. Deliberate release of GMOS-Ice minus p.syringe, open field tests of other
GMOS, controversy about GMOS,
- 3.5 Human Gene therapy-Development of a policy for somatic cell gene
therapy, Accumulation of defective genes in future generation. Human Germ line gene
therapy, Human cloning
- 3.6 Patenting biotechnology inventions:-Patenting, patenting in different countries,
patenting DNA sequenses, Patenting multicelluler organism & fundamental research.

Practicals

1. Extraction and purification of bacterial enzyme active at high temperature.
2. Study of specific activity of thermostable, alkali-stable protease/amylase/lipase.
3. Immobilization of the above enzyme and study of their activity.
4. Addition or reduction of disulfide bonds of an enzyme and study of its activity.
5. Demonstration: Automation in fermentation.
6. Isolation of nitrogen fixing non-symbiotic organisms and studying nitrogenase activity.
7. Bioremediation of effluent from textile industries (Isolation of organisms, reduction in
BOD, COD, pH, TSS, MLSS etc.)
8. Biosorption of metal ions ($Hg/P^6/Ni/CR^{-6}$) by microorganisms.
9. Curing of plasmid and isolation of plasmid from organisms in 8.
10. Assignment on regulation acts, IPR related to GMO, Recombinant DNA and human
cloning.
11. Group experiment: Vermicomposting (Group of 1- 5)
12. Visit to research institute or industry – Report of the visit.

References :

- 1) Fermentation Microbiology and Biotechnology
E.H.T. El Mansi and C.F.A. Bryce (2005).
Tailor and Francis Group.
- 2) Molecular Biotechnology: Principles and Applications of Recombinant DNA –
Glick and Pasternak 3rd Edition.
ASM Press.
- 3) Recombinant DNA – Watson, Gilman, and Witkowski and Zoller (2nd Edition).
Scientific American Books.
- 4) Biotechnology: Expanding Horizons.
B.D.Singh(2005).
Kalyani Publishers.
- 5) Environmental Biotechnology – Alan Seragg (2nd Edition).
Oxford University Press.
- 6) Nanotechnology – Basic Sciences and Emerging Technologies
Wilson, Kannangava, Smith, Simmons, Raguse. (2005).
Overseas Press.
- 7) A Textbook of Biotechnology – R.C.Dubey. (2005)
S.Chand & Co.
- 8) Nanotechnology: Principles and Practices.
S.K.Kulkarni.
Capital Publishing Co.
- 9) Environmental Biotechnology – S.N.Jogdand
Himalaya Publishing Co.

Paper VII

Quality Management Systems In Microbiological Practices

Unit 1- QC, GMP, GLP, QA

1. Nature & Interrelationship

- | | |
|---|------------|
| 1.1 Quality Control: Basic concept (Process Industry & Testing Labs) | 2 lectures |
| 1.2 GMP: Basic Principles- Personnel, Premises, Equipment, Production, Vendor Management Documentation, (Raw material to product) | 5 lectures |
| 1.3 QA: Basic Principles- QA in sterile products, non sterile products, vaccines, food | 5 lectures |
| 1.4 Standard Operating Procedures (Raw Material to product) & Procedures for testing labs(05) | 5 lectures |
| 1.5 Validation of processes, equipments, personnel | 5 lectures |
| 1.6 Statistical Process Control - Problem solving techniques: (Pareto , Control chart, Cause effect, Scatter diagram) | 5 lectures |
| 1.7 GLP | 3 lectures |

Unit 2 –Standard Methods of Analysis used in diverse industries 30 lectures

- | | |
|---|------------|
| 1.1 Principles of sterilization and disinfection with evaluation of efficacy of the method, Methods of Sterilization & disinfection, Evaluating efficacy of sterilization and disinfection Testing of antibacterials, antifungal agents | 5 lectures |
| 1.2 Evaluation of Environmental parameters: | 5 lectures |
| i) Air quality, | |
| ii) Water quality- APHA method, (For washing & cleaning, process waters and as effluents) Tests for enumeration of indicator organisms coliforms, Clostridia, Faecal streptococci MPN, Membrane filtration; Pathogens in water | |
| iii) Clean Room assessment | |
| 1.3 Sampling & Identification of methods/ techniques for microbiological analysis of Raw material, intermediates and Finished products in diverse industries | |
| Standardized Methods of identification and enumeration of organisms | 5 lectures |
| 2.1 Dairy Industry (European Commission, US standards) | 4 lectures |
| Microbiological analysis of Milk and related products (Cream, milk powder, condensed milk, cheese, Butter and other fermented milk products) | |
| Microbial content determination from raw, pasteurized milk, sterile milk, determination of coliforms, Phosphatase test, MBRT., Monitoring microbial load from dairy equipment | |

- 2.2 Food Industry (Fresh and processed)
Vegetables, fruits, Animal products (Meat & Poultry), Bakery, beverages 4 lectures
Detection & characterization of organisms using chemical, biological and physical methods
- 2.3 Pharma & Cosmetic Industry
Sterility testing for products, Vitamin assays, antibiotic assays 4 lectures
- 2.4 Textile Industry
Testing of bioburden of textiles 3 lectures

Unit 3- Control of Organisms in diverse environments 30 lectures

- 1.1 Survival strategies of Microorganisms 5 lectures
- 1.2 Microbial response to adverse conditions (aw, pH, temp, O₂,) antagonism, adhesion, biosurfactants, chemotaxis, LPS, stress proteins, siderophores, pigments, radiation resistance 9 lectures
- 1.3 Problem organisms in diverse environments: Vibrio, Yersinia, Campylobacter, Listeria, Salmonella, Shigella, Staphylococcus 7 lectures
- 1.4 Emerging technologies of food preservation: chemicals, irradiation, modified atmospheres, biocontrol agents, 9 lectures

Unit 4- Quality Management Systems & emerging approaches 30 Lectures

- 1.1 Definition of Quality and various concepts 2 lectures
- 1.2 Quality Management Systems & ISO Series of standards 4 lectures
- 1.3 Regulatory bodies and Industry 3 lectures
- 1.4 FDA and Pharmacopias 3 lectures
- 1.5 HACCP 5 lectures
- 1.6 Documentation 3 lectures
- 1.7 Assessment and Quality Audits 4 lectures
- 1.8 Introduction to Quality Circles, Kaizen, JIT, Six Sigma 6 lectures

Practicals

The practical findings to be connected to theoretical concepts, compliances and assessments

The practical findings to be used to monitor QC, validate equipments and processes

- i) Standardization of the standard Plate count technique and check its reliability
- ii) Monitoring Air Quality of your lab and reporting on its suitability for aseptic work with identification of the source of contamination and remedial measures to prevent contamination.
- iii) Validation studies for laboratory equipments e.g. functioning of the autoclave, Oven, thermometer, Incubator, Balance
- iv) Water analysis (used for cleaning or rinsing, as an ingredient, as an effluent) using APHA Method
- v) Evaluation of effectiveness of antimicrobial preservatives

Techniques used in diverse Industries

vi) Dairy Industry

Milk platform tests, Phosphatase test, Total count Viable count and interpretation v.t. prescribed ISI standards

vii) Food Industry

Determination of the microbial load of a vegetable preparation /Milk preparation/ egg curry/ Ice-cream of a flight kitchen and present a report on the safety of the preparation under the HACCP plan

viii) Pharma & cosmetic Industry

Sterility testing of pharmaceutical products (Pharmacopia)

ix) Textile Industry

Determination of bio-burden of textiles

Assessment of Antibacterial finishes on textile materials using AATCC-100-2004 method

References

1. ISO 9000 A manual for Total Quality management , S.Dalela, Saurabh , Ist ed. 1997,
2. Guide to ISO 9001:2000 A.K.Chakraborty,Basu, S.C.Chakraborty 1st ed.2005.
3. Quality in the Manufacture of Medicines and other health care Products, John Sharp, 2000
4. Modern Food Microbiology, James Jay, M.Loessner, D.Golden ,7th ed.2005,
5. Essentials of food Microbiology, J.Garbutt,
6. Quality Assurance and Quality Management in Pharmaceutical Industry, Y.Anjaneyulu ,R.Marayya, 2005,
7. Quality Control in Microbiology, J.Prier, J.Bartola, H.Friedman, 1973.
8. Good Laboratory Practices and Regulatory Issues, P.V.Mohanani. 2006
9. Introduction to sterilization and disinfection , J.F. Gardner, M.Peel 1986
10. Pharmaceutical Microbiology, W.Hugo, A.D Russell,6th ed.1977.
11. Microbiological Methods Collins, Lyne &Grange 7th ed.1995
12. Food Microbiology: A laboratory Manual A.Yousef, C.Carlstrom, 2003,
13. Laboratory Methods in Food and Dairy Microbiology, W.Harrigan, M.McCance. 1976
14. Isolation Methods for microbiologists : Shapton & Gould, 1969
15. The Microbiological safety of processed foods, J.Crowther, Balkumar Marthi. 1998
16. Just in time, D.Hutchins, 2001
17. Kaizen , Masaaki Imai, 2000

Paper VIII

Tools and Techniques in Microbiology

Unit I- Tools and Techniques in Molecular Microbiology 30 lectures

- 1.1 Cloning Vectors : Basic Biology of Plasmid and Phage vectors, lambda and M13 and other high capacity vectors 3 lectures
- 1.2 Enzymes used in Molecular cloning : Restriction and DNA methylation enzymes, DNA and RNA polymerases, ligases, reverse transcriptase, kinases, phosphatases, nucleases. 3 lectures
- 1.3 Construction and screening of Genomic library: Isolation of genomic DNA, Restriction digestion in PFGE, Cloning in high capacity vectors, Screening by southern hybridization, Preparation of probes by end labeling, nick translation and random selection, Chromosome walking and arraying of library clone 6 lectures
- 1.4 SAGE: A microassay for serial analysis of gene expression : Introduction, Tissue sampling and mRNA isolation, First and second strand synthesis, Linkers design, Preparation and ligation, Ditags formation, PCR amplification, Ditag isolation, Concatenation and cloning of concatemers, Data analysis 6 lectures
- 1.5 Analysis of gene expression by two dimensional gel electrophoresis : Introduction, Basic methods for running 2D gels, Special techniques for detection of differential gene expression, Pattern analysis and spot assignment, Some basic troubleshooting 6 lectures
- 1.6 Proteome Research : Methods for protein characterization- Introduction, Cleanliness, Western blotting, Edman protein microsequencing, amino acid composition, Proteinase cleavage, sample concentration, clean-up and preparation for mass spectrometry, Mass spectrometry 6 lectures

Unit 2: Molecular tools in Microbial Community Analysis

- 30 lectures
- 1.1 Denaturing Gradient Gel Electrophoresis (DGGE): Theory and concept, Advantages and disadvantages 4 lectures
- 1.2 RFLP analysis : Theory and concept, Whole genomes, PCR sequences, Pulse field Gel Electrophoresis, Advantages and disadvantages of RFLP analysis 10 lectures
- 1.3 Genetic stains : Polygenic stains using FISH, Chromosome painting and in situ reverse transcription 4 lectures
- 1.4 PCR: Basic steps, PCR detection of specific genes, RT-PCR, ICC-PCR, Multiplex and semi-nested PCR, PCR fingerprinting, Advantages and disadvantages 12 lectures

Unit 3 : Fundamentals of Experimental Design 30 lectures

- 1.1 Types of investigations : Observational and experimental, Manipulative and correlational study 5 lectures
- 1.2 Aim, Objective and Hypothesis 3 lectures
- 1.3 Sampling : Need for sampling, Types of sampling, Making inferences from samples 8 lectures
- 1.4 Variables : Nominal, ordinal, discontinuous, continuous, derived 5 lectures
- 1.5 Population : Ecological and statistical, statistical population in the laboratory 3 lectures
- 2.1 Experimental Design : Strengths and weaknesses in Experimental Design. Dealing with bias and other design issues, Different Experimental Designs 8 lectures
- 2.2 Importance of pilot study and preliminary data, Recording data 3 lectures
- 3. Research and law 2 lectures

Unit 4 : Data Analysis 30 lectures

- 1.1 Experimental data processing and presentation 2 lectures
- 1.1.1 Processing operations. Problems in processing, Elements of analysis in data processing. Softwares for data processing 4 lectures
- 1.1.2 Data presentation : Principles, uses and techniques 2 lectures
- 2.1 Data mining: Introduction, Major nucleotides, protein and gene expression databases, DNA and protein data analysis 8 lectures
- 3. Protein structure hierarchy 8 lectures
- 4. Biomolecular structure and modelling : Computational challenge, Protein folding, Practical applications 6 lectures

Practicals:

- Demonstration of :
 1. Preparation of Genomic DNA from E.coli/ yeast
 2. Construction of primers of gene of interest
 3. Amplification of the gene by PCR
 4. Cloning of the gene with suitable vectors and check over expression of the protein
- Use of Internet for data mining

References

1. Molecular Cloning : A Laboratory Manual (2nd Ed.)- J. Sambrook, E.F. Fritsch, T. Maniatis. Cold Spring Harbor Laboratory Press (1989)
2. Functional Genomics : A Practical Approach- S.P. Hund, Rick Livesey, Oxford University Press (2004)
3. Principles of Gene Manipulation and Genomics (7th Ed.) S.B. Primrose, R.M. Twyman. Blackwell Publishing (2006)
4. Brock Biology of Microorganisms (10th Ed.)
5. Environmental Microbiology: R.M. Maier, I.L. Pepper, L.P. Gerba Academic Press
6. Research Methods for the Biosciences : D.Holmes, P. Moody, Diana Dine. Oxford Univ. Press (2006)
7. An Introduction to Experimental Design and Statistics for Biology- David Heath, CRC Press(1995)
8. Experimental Design for the Lifesciences (2nd Ed.) G.D. Ruxton, Nick Colegrave, Oxford Univ. Press (2006)
9. Molecular Modelling and Simulation – An Interdisciplinary Guide : Tamar Schlick. Springer (2002)
10. Bioinformatics Technologies : Yi Ping Phoebe Chen, Springer International Edition
11. Research Methodology (2nd Ed.) Dipak Kumar Bhattacharyya, Excel Books (2006)
12. Research Methodology for Biological Sciences (2006) : N.Gurumani, MJP Publisher, Chennai 600 005
13. Molecular Biotechnology : Principles and Applications of Recombinant DNA . Glick and Pasternak (3rd) ASM Press

M.Sc. PART – II MICROBIOLOGY

ANNUAL PRACTICAL EXAMINATION ASSESSMENT PATTERN

PARTICULARS	PRACTICAL 1	PRACTICAL 2	RESEARCH PROJECT
<i>Major problem</i>	35 marks (Paper V and VI)	35 marks (Paper VII and VIII)	
<i>Internal Assessment</i>	*Published paper presentation (15marks)	*Published paper presentation (15marks)	
<i>Total marks</i>	50 MARKS	50 MARKS	100 MARKS
GRAND TOTAL	200 MARKS		

- The Published Research paper presentations should be on recent topics (last 5 years) from any two of the theory Papers V to VII. The presentations will be assessed by recognized postgraduate teachers of the respective college and the marks for the same will be submitted to the external examiners at the time of the University Practical Examination. In subsequent attempts , the marks of the candidate must be re-submitted by the H.O.D. of the respective college to the examiner at the corresponding exam centre.
- The candidate is required to submit a duly certified journal at the time of the practical examination. The candidate will not be permitted to appear for the practical examination without a duly certified journal.

ANNUAL THEORY EXAMINATION ASSESSMENT PATTERN

1. Every Paper will have five questions of 15 marks each.
2. Duration of each paper will be three hours.
3. Four questions will be based on each of the four units in the paper. There shall be internal choice as per UGC guidelines.
4. Fifth question will comprise of questions based on all four units.

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