

CIRCULAR: -

A reference is invited to the Ordinances, Regulations and syllabi relating to the B.Sc. degree course under the revised pattern vide Pamphlet No.141 and to this office Circular No.UG/112 of 2004, dated 19th March, 2004 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 12th January, 2009 has been accepted by the Academic Council at its meeting held on 13th February, 2009 vide item No.4.18 and that, in accordance therewith, the syllabus and paper pattern (Theory and Practicals) of the S.Y.B.Sc. in the subject of Microbiology has been revised as per Appendix and that the same has been brought into force with effect from the academic year 2009-2010.

MUMBAI-400 032
5th May, 2009

PRIN. K. VENKATARAMANI
REGISTRAR

To,

The Principals of the affiliated colleges in Science.

A.C./4.18/13.02.2009


No. UG/137-A of 2009,

MUMBAI-400 032

5th May, 2009

Copy forwarded with compliments for information to :

- 1) The Dean, Faculty of Science.
- 2) The Chairperson, Board of Studies in Microbiology.
- 3) The Controller of Examinations.
- 4) The Co-ordinator, University Computerization Center.


(D. H. KATE)
DEPUTY REGISTRAR
(U.G./P.G.Section)

Copy to :

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative, Ratnagiri for information.

The controller of examinations (10 copies), the Finance and Accounts officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrollment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical, Affiliation Section (2 copies), the Director Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building) Vidyanagari, (2 copies) the 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 that no Separate Action Taken Report will be sent in this connection. The Assistant Registrar Constituent Colleges Unit (2 copies), BUCT (1 copy), the

13.2.2009

UNIVERSITY OF MUMBAI



Revised Syllabus and Paper Pattern
(Theory & Practicals)

for the

S.Y.B.Sc

In

Microbiology

(With effect from the academic year 2009-2010)

REVISED SYLLABUS FOR S.Y.B.Sc. MICROBIOLOGY
w.e.f. 2009-2010

PAPER I : CONCEPTS IN IMMUNOLOGY AND GENETICS

UNIT 1 : IMMUNOLOGY (15)

1) INNATE IMMUNITY (07)

- i) Overview of host resistance
- ii) Non-specific Host resistance
- iii) Natural host resistance- age, stress, diet etc.
- iv) Physical and Mechanical barriers – skin, mucous membrane
- v) Respiratory system, gastrointestinal tract, genito-urinary tract, eyes
- vi) Chemical barriers – basic proteins, bacteriocins, b-lysins and other polypeptides.

2) IMMUNE SYSTEM (08)

- i) Cells, Tissues and Organs of the immune system
- ii) Cells of Immune system- Lymphoid cells, mononuclear cells, granulocytes, mast cells, dendritic cells
- iii) Organs and tissues of the immune system- Primary and secondary lymphoid organs / tissues
- iv) Inflammation, fever, phagocytosis
- v) Natural killer cells
- vi) Molecular defense- Cytokines, integrated host defense, immuno-compromised host.

UNIT 2: IMMUNOLOGY : (15)

1) ANTIGENS (07)

- i) Immunogenicity versus antigenicity
- ii) Factors that influence immunogenicity – foreignness, molecular size, chemical composition, heterogenicity, ability to be processed and presented, contribution of the biological system to immunogenicity- genotype of the recipient, animal, immunogen dosage, route of administration and adjuvants
- iii) Epitopes / antigen determinants
- iv) Haptens and antigenicity
- v) Immunogenicity of some natural substances – native globular proteins, polysaccharides, lipids, nucleic acids
- vi) Types of antigens- heterophile antigens, isophile antigens, sequestered antigens, super antigens, bacterial and viral antigens.

2) IMMUNOGLOBULINS (08)

- i) Immunoglobulins – basic and fine structure
- ii) Immunoglobulin classes and biological activities
- iii) Antigen determinants on immunoglobulins- isotypes, allotypes, idiotypes
- iv) Immunoglobulin receptors

UNIT 3 : MEDICAL- VIRULENCE (15)

1) HOST- PARASITE INTERACTION (Attachment and Penetration) Koch's and River's postulates (01)

2) MICROBIAL VIRULENCE FACTORS (06)

- a. Enzymes: hyaluronidase, collagenase, streptokinase, coagulase
- b. Exotoxins : cytolytic toxins, diphtheria, tetanus, botulinum toxin, enterotoxin
- c. Endotoxins : structure and function, Limulus assay for endotoxin
- d. Virulent organisms : salmonella spp, and its virulence factors
- e. Measuring virulence LD50

3) CLINICAL INFECTION IN THE HOST (04)

- a. Establishment, spread and pathological effects
- b. Pattern of infection
- c. Signs and symptoms
- d. Portal of exit, persistence of microorganisms and pathological conditions

4) EPIDEMIOLOGY OF INFECTIOUS DISEASES (04)

- a. Epidemiological terminology
- b. Measuring frequency – The epidemiologist's tools
- c. Infectious disease Epidemiology.
- d. Recognition of an infectious disease in a population in an epidemic
- e. Virulence and the mode of transmission
- f. Emerging and reemerging infectious diseases and pathogens
- g. Control of epidemics
- h. Nosocomial infections
- i. Global travel and health considerations

UNIT 4 : GENETICS (15)

1) MENDELIAN GENETICS : (02)

- i) Genetic terminology, Gametes, Cross, zygote, gene, locus, alleles, genotype, phenotype
- ii) Mendel's experimental design
- iii) Mendel's Principle of Segregation, Principles of Independent Assortment

2) GENETIC INFORMATION (13)

- i) Gene and its function Central Dogma of life
- ii) Prokaryotic, Structure of DNA, Double helix, different forms of DNA structure, important features of DNA structure, hybridization of nucleic acids, Circularity. Supercoiling, topoisomerases. Basic proteins in bacterial chromosome
- iii) Genetic elements: The chromosome, Non-chromosomal genetic elements, viruses and plasmids, transposable elements

UNIT 5 : GENETICS : (15)

1) CHROMOSOME STRUCTURE OF EUKARYOTIC CELL (10)

- i) Physical properties, concept of linkage groups, Linearity of the chromosome
- ii) Chromatin structure, euchromatin, heterochromatin
- iii) Role of histones and non-histone proteins
- iv) Structure of condensed chromatin
- v) Nucleosomes, centromere, kinetochores, telomeres
- vi) Differences in the chromosomal structure of prokaryotic, eukaryotic cells and viruses.

2) GENETIC CODE (05)

- i) Historical perspective
- ii) Features of the genetic code, Triplet nature, degeneracy, universality, non-overlapping, comma less, wobble hypothesis etc.
- iii) Exceptions to code – list different codes and variations

UNIT 6 : TAXONOMY (15)

- i) Species : The Units of Classification, Characterization of Species, The Naming of Species,
- ii) The Problems of Taxonomic Arrangement : The phylogenetic Approach to Taxonomy, Numerical taxonomy
- iii) New Approach to Bacterial Taxonomy : DNA composition, Nucleic acid hybridization, T_m, N.A Sequencing, RNA fingerprinting and sequencing, Ribotyping, Fatty Acid Analyses.
- iv) Bergey's Manual

PAPER II : MICROBIAL BIOCHEMISTRY

UNIT 1 : CHEMICAL BASIS OF LIFE (15)

- i) Cellular foundations – cells as the structural and functional units. Cellular dimensions are limited by oxygen diffusion. cytoplasm is highly dynamic, cells build supramolecular structures. Chemical foundations – Compounds of carbon and functional groups, macromolecules as major constituents of cells. Three dimensional structure – configuration and conformation. Dynamic Steady state of living cell, never at equilibrium with the surrounding, transformation of energy and matter from the surrounding.
- ii) Types bonds and their importance- electrovalence, covalent bond, ester, phosphodiester, thioester, peptide, glycosidic bonds. Water- structure and interaction with solute.
- iii) Carbohydrate- monosaccharides, oligosaccharides and polysaccharides- definition and biological role.
- iv) Lipids- definition and biological importance (special reference to cell membrane) and classification
- v) Amino acids, Peptides and proteins – Physical and chemical properties. Proteins – three dimensional structure. Complementary interactions between proteins and ligands.

UNIT 2 : TRANSCRIPTION, TRANSLATION (15)

1. RNA SYNTHESIS (07)

- i) RNA Metabolism – DNA dependent synthesis of RNA- RNA polymerase, Promoters, Regulation of transcription at various levels,
- ii) Specific sequences signal termination of RNA synthesis
- iii) RNA polymerases in eucaryotic cells.
- iv) Protein factors required for RNA polymerase II
- v) Inhibition of DNA dependent RNA polymerase
- vi) RNA dependent synthesis of RNA

2. PROTEIN SYNTHESIS (08)

- I) Stages of Protein synthesis
 - i) Activation of amino acids
 - ii) Initiation
 - iii) Elongation
 - iv) Termination and Release
 - v) Folding and posttranslational processing

UNIT 3 : ESTIMATION OF BIOMOLECULES & BIOSTATISTICS (15)

1. ESTIMATION OF BIOMOLECULES (10)

- A) Macromolecular composition of a Microbial Cell
- B) Methods of Elemental Analysis :
 - Carbon by Slyke's method
 - Nitrogen by Microkjeldahl Method
 - Phosphorous by Fiske- Subbarow Method
- C) Estimation of Carbohydrates by Phenol and Anthrone Method
- Estimation of Reducing Sugars by DNSA Method
- Detection of Sugars by Aniline-phthalate method
- D) Estimation of Proteins by Biuret Method
- Estimation of Amino acids by Ninhydrin Method
- E) Extraction of Lipids by Soxhlet Method
- F) Extraction of Nucleic acids
- G) Estimation of Nucleic acids by DPA and Orcinol Method

2. BIOSTATISTICS (05)

- i) Introduction to Biostatistics
- ii) Sample and Population
- iii) Data presentation- Dot diagram, Bar Diagram, Histogram, frequency curve.
- iv) Central Tendency – Mean, Median, Mode Summation notations
- v) Standard Deviation, Variance, Q-Test, t-test and F test

UNIT 4 : THERMODYNAMICS (15)

- i) Scope of Thermodynamics
 - a. Concept of Free energy, Enthalpy, Delta G, Standard Free Energy change of reaction, entropy
 - b. First and Second Law of Thermodynamics
 - c. Open and Closed System
 - d. Structure and Properties of ATP, Standard free energy change of hydrolysis of ATP, and other high energy compounds.
 - e. Energy yielding Mechanisms: Fermentation, Respiration and Photosynthesis
 - f. Biological oxidation – reduction reactions

UNIT 5 : INTRODUCTION TO METABOLISM (15)

- i) Metabolism : Catabolism, Anabolism and link between the two.
- ii) Concept of biochemical pathways -precursor, intermediate and end product
- iii) Constitutive & Inducible pathways
- iv) Types of Biochemical Pathways : Linear, Branched and Cyclic.(EMP, TCA as examples)
- v) Amphibolic and Anaplerotic reactions. Glyoxylate bypass.
- vi) Pool of Basic building blocks ATP and reducing power.

UNIT 6 : ENZYMOLOGY (15)

- i) Basic Concepts- apoenzyme, holoenzyme, prosthetic group and cofactors. Allosteric enzymes.
- ii) Classification of enzymes.
- iii) Michaelis – Menton Equation – Derivation, LB equation and plot.
- iv) Effect of Enzyme concentration, Substrate concentration, pH, Temperature on Enzyme activity
- v) Multi-substrate Reactions – Ordered, Random and Pingpong reaction.
- vi) Inhibitors of Enzyme : Reversible and Irreversible. Competitive, Non-competitive and Un-competitive inhibition
- vii) Koshland –Nemethy and Filmer Model, Monod, Wyman and Changux Model.
- viii) Principles of enzyme purification.

PAPER III : APPLIED MICROBIOLOGY

UNIT 1 : INSTRUMENTATION : pH METER, ELECTROPHORESIS, COLORIMETER (15)

A) pH METER : (04)

A) The standard hydrogen electrode. Reference electrode, glass electrode, Measurement of pH

B) COLORIMETER : (04)

Principle: Working of Colorimeter, Beer's law, Beer and Lambert's Law. Applications of colorimetry in Biological Science

C) ELECTROPHORESIS (07)

- i) Principle, Types and Instrumentation
- ii) Applications in Separation of Protein, Nucleic acid, fingerprinting, and sequencing.

UNIT 2 : FERMENTATION TECHNOLOGY (15)

- i) Screening- Primary and secondary
- ii) Fermentation Media
- iii) Preparation of Inoculum
- iv) Types of Fermentations – Aerobic, Anaerobic. Surface, Submerged, Batch, Continuous and Solid State.
- v) Fermenter Design.

UNIT 3 : FOOD MICROBIOLOGY (15)

- i) Scope of Food Microbiology and role of Microbiologist in Food Industry
- ii) General Principles of Spoilage and Contamination of Food
- iii) General principles of Preservation of Food.

UNIT 4: INSTRUMENTATION: CHROMATOGRAPHY, CENTRIFUGATION (15)

A) CHROMATOGRAPHY– (10)

- i) General Principles
- ii) Paper Chromatography, Thin Layer Chromatography
- iii) GLC and HPLC
- iv) Absorption Chromatography
- v) Ion Exchange Chromatography
- vi) Gel Filtration Chromatography
- vii) Affinity Chromatography

E) CENTRIFUGATION: (05)

- i) Preparative Centrifuge and its Applications
- ii) Analytical Centrifuge and its Applications

UNIT 5 : DAIRY MICROBIOLOGY (15)

- i) Microbial Flora of Milk, Normal and abnormal flora. Their sources and changes induced by them.
- ii) Milk Borne Pathogens
- i) Processing and analysis of Milk, Grading of Milk, Platform test, Dye reduction test, DMC, SPC, LPC Thermoturic count, Psychrophilic count, Pasteurization HTLT, LTHT and Phosphatase Test
- ii) Shelf Life, packaging, Storage and Distribution
- iii) Milk Products : Preparation of Powder and Sweetened condensed Milk, Butter Cheese (Types and Production of Cheddar and Cottage), Yogurt (Types and production). Other milk products and names of organisms associated with them

UNIT 6 : MICROBIAL BIOTECHNOLOGY (15)

- i) Introduction – Biotechnology as an Interdisciplinary science, Biosafety.
- ii) Energy and biotechnology – Biofuel, source of biomass, ethanol and methane from biomass, hydrogen production.
- iii) Biotechnology and Health care – Use of probes in disease diagnosis and use of monoclonal antibodies in disease diagnosis and treatment.
- iv) Biofertilizer, Biopesticide and vermicomposting.
- v) Bioleaching, Biosensors and Biochips

PRACTICAL I

1. Preparation of H and O antigens
2. Mitosis and Meiosis
3. Extraction of DNA from onion and *E.coli* (plasmid DNA, Mini prep)
4. Isolation and Identification of microorganism from soil
5. Virulence factors – Enzymes – Streptokinase, Coagulase, hemolysin, lecithinase, phagocytosis
6. Use of selective and differential solid media : SIBA, XLD, MacConkey's, SMA, CLED, TCBS Hoyle's tellurite agar
7. Use of Biochemical media for identification of pathogens- Oxidase, PPA, TSI, Bile solubility, Optochin, Bacitracin,
8. Pyocin typing.
9. Assignments – Epidemiology- Tuberculosis, AIDS, Malaria, Campylobacter, Legionella infections. Listeria.
10. Problems on Mendelian Genetics.

PRACTICAL II

1. Qualitative tests for Carbohydrates – Benedicts, Molisch
2. Qualitative test for proteins _ Biuret
3. Qualitative test for Amino acids _ Ninhydrin
4. Qualitative test for RNA and DNA – Orcinol and DPA
5. Production of Biomass – Fungal, Bacterial, Yeast
6. Determination of Dry and wet weight
7. Estimation of Proteins by Biuret method
8. Estimation of DNA – DPA method
9. Estimation of RNA – Orcinol method
10. Estimation of Reducing sugar – DNSA method
11. Estimation of Amino acids – Ninhydrin method
12. Effect of variables on enzyme activity (invertase from yeast), Temperature, pH, Substrate concentration, Enzyme concentration, Determination of KM of invertase (Lineweaver-Burke plot, Michaelis-Menton graph)
13. Purification of enzyme – Ammonium sulfate precipitation and dialysis. Measurement of enzyme activity before and after purification (DNSA method)
14. Problems based on bioenergetics.
15. Problems based on biostatistics
 - a) Linear regression (LB)),
 - b) Nonlinear regression (MM)
 - c) Use of EXCEL / similar packages

PRACTICAL III

1. Use of pH meter
2. Determination of λ max of a coloured solution
3. Verification of Beer – Lambert's Law Linear range, extinction coefficient and Molar extinction coefficient
4. Density gradient centrifugation (Yeast and bacteria)
5. Paper chromatography of amino acids
6. TLC of sugars
7. Column chromatography DEAE-Cellulose
8. Electrophoresis of proteins : SDS-PAGE
9. Electrophoresis of DNA
10. TDP and TDT
11. Food preservative – sugar and salt (MIC)
12. Selective isolation of food spoilage organisms
13. Microbial analysis of milk- DMC, SPC, Coliform count, spore bearers, RRT, MBRT
14. Isolation of Azotobacter and Rhizobia and preparation of biofertilizer.
15. Isolation of antibiotic producer and determination of antibacterial spectrum (Wilkin's agar overlay, Agar streak and Agar Strip)
16. Auxanography
17. Visit to Biogas plant
18. Demonstration of Vermicomposting.

REFERENCES :

PAPER I

1. Immunology, A Text Book. C.V.Rao, Narosa Publishing House, Mumbai. 2005
2. Text Book of Microbiology. 5th Edition. R. Ananthnarayan and C.K. Jayaram Paniker. Orient Longman. Hyderabad. 1997.
3. Immunology. Pathak and Palan
4. Genetics. 5th Edition. Peter Russell. Addison Weseley Longman Inc. New York. 1998.
5. Microbiology. 5th Edition. Prescott, Harley and Klein. McGraw Hill. New York. 2002.
6. General Microbiology, 5th Edition. R.Y. Stanier, J. Ingraham, M. Wheelis and P.R. Painter. Prentice Hall. New Jersey. 2007
7. The Elements of Immunology – Fahim H. Khan, Pearson Education

PAPER II

1. Methods in Microbiology. Vol. 5B. Norris and Ribbon. Academic Press.
2. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Addison Weseley Longman Inc. 1998.
3. Lehninger Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York. 2005.
4. Outlines of Biochemistry 5/E. E. Conn, P. Stumpf, G. Bruening and R. Doi. John Wiley & Sons. New York. 1999.
5. Enzymes, Biochemistry, Biotechnology and Clinical Chemistry. T. Palmer. East West Press Ltd. New Delhi. 2004.
6. Bacterial Metabolism. 2nd Edition. G. Gottschalk. Springer. 2004.
7. Basic Biotechnology. 2nd Edition. C. Ratledge and B. Kristinsen. Cambridge Univ, Press. 2006.

PAPER III

1. Food Microbiology. 2nd Edition. M. Adams and M. Moss. Panima Publishing House New Delhi. 2004.
2. Biotechnology Fundamentals and Applications. 3rd Edition. S. Purohit Agrobios, India. 2001.
3. Milk and Milk Products. 4th edition. C. Eckles, W. Combs and H. Macy TMH New Delhi. 1986.
4. Industrial Microbiology. L. Casida. New Age International Publishers. New Delhi.
5. Industrial Microbiology. A.H. Patel. MacMillan New Delhi. 1984.
6. Practical Biochemistry. Wilson and Walker.
7. Instrumentation in Biochemistry. William and Wilson.
8. A text Book of Biotechnology. R. C. Dubey
9. Biotechnology. B.D. Singh.
10. Food Microbiology, James Jay.

EXAMINATION PATTERN (As per University circular UG/302 of 2008 dt. 14.7.2008)

FIRST TERM : Three theory papers
Duration 2 hours each
Max. Marks 60 marks each

- Q.1 Based on units I, II, and III
- Q.2. Based on unit I
- Q.3 Based on Unit II
- Q.4 Based on Unit III

Each question will be set for 22 to 23 marks with internal options

SECOND TERM : Three theory papers
Duration 2 hours each
Max. Marks 60 marks each

- Q.1 Based on units IV, V, and VI
- Q.2. Based on unit IV
- Q.3 Based on Unit V
- Q.4 Based on Unit VI

Each question will be set for 22 to 23 marks with internal options

PRACTICAL EXAMINATION : Practical examination will be conducted at the end of the year. Duration of 9 periods conducted over three consecutive days. Practical examination will be of 120 marks

Practical - I (40 marks)

Practical - II (40 marks)

Practical -III (40marks)

Journal	05
Viva	05
Technique	10
(Identification Test)	
Isolation	05
Spots & Quiz	05
Assignment	10

Journal	05
Viva	05
Chemical assay	25
Spots & Quiz	05

Journal	05
Viva	05
Technique	25
Spots & Quiz	05

Students are required to bring a certified journal and assignment at the time of practical examination.

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