SHIVAJI UNIVERSITY, KOLHAPUR.

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Revised Syllabus For

Bachelor of Science

Part - II

MICROBIOLOGY

Syllabus to be implemented from June, 2014 onwards.

Shivaji University, Kolhapur

Revised Syllabus For Bachelor of Science Part – II : Microbiology

1. **TITLE : Microbiology**
2. **YEAR OF IMPLEMENTATION**:- Revised Syllabus will be implemented from June, 2014 onwards.
3. **PREAMBLE :**

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at second year of three years of B.Sc. degree course.

Students learn Microbiology as a separate subject from B.Sc. II. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research.

The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time, precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. **GENERAL OBJECTIVES OF THE COURSE / PAPER :**
    1) To make the students knowledgeable with respect to the subject and its practicable applicability.
    2) To promote understanding of basic and advanced concepts in Microbiology.
    3) To expose the students to various emerging areas of Microbiology.
    4) To prepare students for further studies, helping in their bright career in the subject.
    5) To expose the students to different processes used in industries and in research field.
    6) To develop their ability to apply the knowledge of Microbiology in day to day life.
    7) To prepare the students to accept the challenges in life sciences.
    8) To develop skills required in various industries, research labs and in the field of human health.
5. **DURATION :**The course shall be a full time course.
6. **PATTERN :** Pattern of Examination will be Semester.
7. **MEDIUM OF INSTRUCTION :** The medium of instruction shall be English.

8. STRUCTURE OF COURSE :

1) B. Sc. II : Total Number of Papers - 04

Sr.No.	Subjects	Marks
	SEMISTER III	
1.	Paper - V	50 marks
2.	Paper - VI	50 marks
	SEMISTER IV	
3.	Paper – VII	50 marks
4.	Paper – VIII	50 marks
	PRACTICAL	
5.	Practical	100
Total		300

2) Structure and Titles of Papers of B.Sc. II Course

SEMESTER III

Paper V : Cytology, Physiology and Metabolism

Paper VI : Microbial genetics

SEMESTER IV

Paper VII : Fundamentals of Industrial Microbiology, Biostatistics & Bioinformatics

Paper VIII : Basics of Immunology and Medical Microbiology

3) Equivalence in accordance with titles and contents of papers – (for revised syllabus)

Pre Revised Syllabus (2011-12)		**Revised Syllabus**	
Paper No.	**Title of the Paper**	**Paper No.**	**Title of the Paper**
V	**Cytology Physiology & metabolism**	**V**	**Cytology, Physiology and Metabolism**
VI	**Microbial genetics**	**VI**	**Microbial genetics**
VII	**Fundamentals of Industrial Microbiology, Biostatistics & Bioinformatics**	**VII**	**Fundamentals of Industrial Microbiology, Biostatistics & Bioinformatics**
VIII	**Basics of Immunology and Medical Microbiology**	**VIII**	**Basics of Immunology and Medical Microbiology**

4) OTHER FEATURES :

(A) LIBRARY :

Reference Books – Latest Editions, Journals and Periodicals.

(B) SPECIFIC EQUIPMENTS NECESSARY TO RUN THE COURSE :

OHP, Computer, L.C.D. Projector.

(C) LABORATORY SAFETY EQUIPMENTS :

1) Fire extinguisher
2) First aid kit
3) Fumigation chamber
4) Stabilized power supply
5) Insulated wiring for electric supply.
6) Good valves & regulators for gas supply.
7) Operational manuals for instruments.
8) Emergency exits.

SHIVAJI UNIVERSITY, KOLHAPUR

Revised syllabus – Introduced from June, 2014

B.Sc. Part II (Semester Pattern)

Theory Syllabus

SEMESTER-III : Paper V - Cytology, Physiology and Metabolism

Unit – I

Cytology of a Bacterial Cell : 10

1. i. Cell wall – Composition, structures of Gram positive and Gram negative bacterial cell wall. Structures of components and structural variations.
   ii. Cell membrane – Structure, Chemical composition and functions. Transport across cell membrane
   iii. Flagella – Structure, Mechanism of movement, tactic behavior
   iv. Bacterial Endospore - Ultrastructure, Sporulation and Germination
2. Cytoplasmic inclusions -
   i. Special prokaryotic organelles–Chlorobium vesicles, Gas vesicles, Magnetosomes, Carboxysomes.
   ii. Reserve food materials – Nitrogenous and non nitrogenous

Unit – II

Growth 10

1. Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth
2. Effect of environmental factors on microbial growth.

i) Temperature - Mesophiles, psychrophiles, thermophiles and hyperthermophiles. Thermal destruction of bacteria – D, F and Z values, TDP and TDT

ii) pH - Neutrophiles, Acidophiles and Alkalophiles

iii) Osmotic pressure – Isotonic, hypotonic and hypertonic environments, xerophiles and halophiles.

iv) Heavy metals.

Unit - III

Microbial Metabolism 8

1. Fundamental principles of energetics, high energy compounds.
2. Catabolism of glucose – EMP, TCA cycle.
3. ATP generation by :
   i) Substrate level phosphorylation.
   ii) Oxidative phosphorylation - Respiration electron transport chain, aerobic and anaerobic respiration.
   iii) Bacterial Photophosporylation – Photosynthetic apparatus, Cyclic Photophosporylation in purple bacteria and Non-cyclic Photophosporylation in cyanobacteria.

Unit – IV

Enzymes **8**

1. Classification
2. Factors influencing enzyme activity (Substrate concentration, temperature, pH, metal ions)
3. Regulation of enzyme activity : Concept of allosteric enzymes and pattern of feed back inhibition.
4. Applications of enzymes : Amylases, proteases and lipases

SEMESTER-III: Paper VI - Microbial Genetics

Unit – I **8**

1. Forms of DNA.
2. Basic concepts – Gene, genome, genotype, phenotype, mutagen, recon, muton, cistron, split genes.
4. Lac operon - Structure
3. Genetic code – Definition and properties of genetic code.

Unit – II **10**

1. Basic Concepts of Mutation: Base pair substitutions, frame shift , missense, nonsense, neutral, silent , pleiotropic and suppressor mutations.
2. Spontaneous mutation – Definition and basic concepts.
3. Induced mutations – Definition , Mechanism of mutagenesis by –
   i. Base analogues : 5-Bromouracil and 2- aminopurines
   ii. Mutagens modifying nitrogen bases- a. Nitrous acid
   b. Hydroxylamine
   c. alkylating agents
   iii. Mutagens that distort DNA - a. acridine dyes
   b. UV light

Unit – III **10**

1. Genetic recombination in bacteria.
2. Fate of exogenote in recipient cell.
3. Modes of gene transfer – a. Transformation.
   b. Conjugation
   c. Transduction

Unit – IV **8**

1. Plasmids **–** a. Natural – Properties, types , structure and applications
b. Artificial – pBR 322- structure and applications

2. DNA repair : i) Photoreactivation ii) Dark repair mechanism (Excision repair)

Books Recommended for Semester III Theory papers :

1. Foundation in Microbiology – by Kathleen Park talaro, Arther Talaro.
2. Introduction to Microbiology – John I. Ingraham, Catherine A. Ingraham A. Ingraham A. Ingraham, Ronald M; Second edition.
3. Zinsser's Microbiology – by Wolfagang K. Joklik, (1995) Mc Graw-Hill Co.
4. Microbial Genetics – by Stanley R. Maloy, David Freifelder and John E. Cronan.
5. Molecular Genetics of Bacteria – by Larry Snyder, Wendy Champness.
6. Microbiology – Pelczar, Reid and Chan
7. Fundamentals of Microbiology – Frobisher et al.
8. General Microbiology – R. Y. Stainer
9. Chemical Microbiology – A. H. Rose.
10. General Microbiology – Vol. I and Vol. II – Pawar and Diganawala
11. Biochemistry – Lehninger.
12. Outlines of Biochemistry – Cohn and Stumph
13. A Text book of microbiology – R. Dubey, D. K. Maneshwari, S. Chand Co. Ltd. Ramnagar New Delhi 110055

SEMESTER IV : Paper VII - Fundamentals of Industrial Microbiology, Biostatistics & Bioinformatics

Unit – I **9**

Basic concepts of fermentation.

1. Definition, concept of primary and secondary metabolites
2. Types of fermentations – Batch, continuous, dual and multiple
3. Typical Fermentor design – Parts and their functions.
4. Factors affecting fermentation process.

Unit – II **9**

Screening and Fermentation Media

1. Primary and secondary screening
2. Fermentation media -
   a. Water, carbon source, nitrogen source, precursors, growth factors, antifoam agents, chelating agents.
   b. Use of wastes as Fermentation media – Molasses, sulphite waste liquor & corn steep liqior

Unit – III **9**

1- Biostatistics

1. Introduction
2. Data presentation – Tables and Graphs (Line and Histogram)
3. Central tendency: Mean, Median and Mode
4. Applications.

2- Bioinformatics : Introduction and applications.

Unit – IV **9**

Bioinstrumentation :

1. Principle, process and applications of - Lyophilization,
2. Principle, construction, working & applications of – Fluorescence Microscope
3. Principle, working and applications of -
   i) Electrophoresis (Agarose gel, PAGE)
   ii) UV-visible spectrophotometer.

Paper VIII: Basics of Immunology and Medical Microbiology

Unit – I **9**

1. Immunity i) Defintion

ii) Innate Immunity- Types, factors influencing innate immunity

iii)Acquired Immunity – Active & passive

2. Non Specific defense mechanisms of the vertebrate body

i) First line of defense

ii) Second line of defense

Unit – II **9**

1. Organs and tissues of immune system - Types of Primary and secondary lymphoid organs.
2. Cells of the immune system- Monocytes & macrophages, granulocytes, mast cells, dendritic cells, NK cells, lymphocytes- B & T cells.

Unit – III **9**

1. Antigen : Chemical nature, types of antigens, factors affecting antigenicity.
2. Antibody : Types of antibodies – Structure, properties and functions.
3. Theories of antibody production.
4. Immune Response : Primary and secondary immune responses.
5. Mechanism of antigen – antibody reaction.
6. Serological tests

(a) Agglutination test - Widal test, Passive agglutination test - RPR

(b) Precipitation test - Gel diffusion test

(c) Complement fixation test

(d) Fluroscent antibody test

(e) ELISA (Direct test)

Unit – IV **9**

1. **Cellular microbiology** – Quorum sensing & bacterial pheromones,

2. Microbial diseases :

Causative agent, spread, pathogenesis, symptoms, microbiological diagnosis, prevention and control of the following diseases :

(i) Enteric fever

(ii) Staphylococcal wound infections

(iii) Infections caused by Proteus species

(iv) Tuberculosis

(V) Dengue fever

Books Recommended for Semester IV Theory papers :

1. Basic and Practical Microbiology – Atlas.
2. Biostatistics : a foundation for analysis in the Health sciences by – Wayne W. Daniel John Wiley & Sons. Inc.
3. Biostatistics in Theory and Practice – T. K. Saha, Emkay Publi. New Delhi.
4. Statistics for biologists – R. C. Campbell.
5. Fundamental principles of Bacteriology – A. G. Salle.
6. Industrial microbiology – Prescott and Dunn.s
7. Industrial microbiology – Casida, E.
8. Industrial microbiology – Miller and Litsky
9. Text book of Microbiology – Ananthnarayan
10. Principles and Applications of statistics in Biosciences – By Kamat D. V. Maxam Prakashan – Mumbai – 400 059
11. Bioinformatics : A primer, Narayan P.
12. Text Book of Bioinformatics, Subramanian C.
13. Bioinformatics methods and applications by Rastogi, Mediratta N. I.
14. Clinical Microbiology – Ramnik Sood.
15. Medical Lab Technology – Mukharji Vol. II
16. Medical Lab Technology – Godkar

PRACTICAL SYLLABUS

1. **Micrometry.**
2. **Stains and staining procedures :**

   i) Spore staining (Dorners method) ii) Flagella staining (Bailey's method)

   iii) Nucleus staining (Giemsa's method) using yeast cells.
3. **Preparation of media :**

   Triple sugar iron agar, Tributyrin agar, Blood agar, Gelatin agar, Amino acid decarboxylation medium, Amino acid deamination medium, Arginine broth, Christensen's medium, Peptone nitrate broth, Hugh and Leifson's medium, Egg-Yolk agar, Mannitol salt agar.
4. **Biochemical tests :**

   (i) Gelatin hydrolysis test. (ii) Amino acid decarboxylation test

   (iii) Amino acid deamination test (iv) Arginine hydrolysis test

   (v) Urea hydrolysis test (vi) Nitrate reduction test

   (vii) Huge and Leifson's test (viii) Oxidase test

   (ix) Lipase detection test. (x) Coagulase test

   (xi) Lecithinase test

5. **Effect of environmental factors on microorganisms :**

   (i) Temperature (ii) pH

   (iii) Heavy metal – Copper (iv) Antibiotics – Penicillin, Streptomycin

   (v) Salt (NaCl)

6. **Primary Screening of -**

   (i) Antibiotic procedures – Crowded plate technique

   (ii) Amylase producers

7. **Isolation and identification of pathogenic microorganisms from clinical sample.**

   (a) *Salmonella species* (b) *S. aureus* (c) *Proteus species*

8. **Determination of Blood groups – ABO and Rh.**

9. **Determination of growth phases of *E. coli* by Optical density.**

10. **Study of Diauxic growth**

11. **Isolation of Lac negative mutants of *E.coli***

12. **Serological tests - Widal test – qualitative slide test, RPR test, Dot ELISA - Demonstration**

12. **Biostatistics –** Measures of central tendency : Mean, Median and Mode

Books recommended for Practicals :

1. Medical Microbiology – Cruickshank et al. Vol. II.
2. Manual of Diagnostic Microbiology – Wadher and Boosreddy.
3. Diagnostic Microbiology – Fingold.
4. Introduction to Microbial technique – Gunasekaran.
5. Biochemical methods – Sadashivam and Manickam.
6. Bacteriological techniques F. J. Baker.
7. Laboratory Fundamentals of Microbiology – Alcamo, I. E.

PRACTICAL EXAMINATION

(A) The practical examination will be conducted on two consecutive days for six hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

(C) Candidates have to visit at least one place of microbiological interest (pharmaceutical/ industry/dairy/research institute etc.) and submit the report of their visit at the time of examination. The Head of the Department should duly certify the report.

Nature of the Practical question paper and distribution marks for B.Sc.II Microbiology.

(D)	**Marks**
Q.1 Determination of lag phase / diauxic growth / staining	15
Q.2 Isolation and identification of pathogen from clinical sample	20
Q.3 Serology / blood groups / biostatistics / micrometry	05
Q.4 Primary screening technique / isolation of lac negative mutant	10
Q.5 Biochemical tests	10
Q.6 Effect of environmental factors	10
Q.7 Spot tests (on culture media)	10
Q.9 Journal	10
Q.10 Tour report	10

Total marks –	100

Nature of question paper and distribution of marks for B.Sc. Part II Microbiology Theory Examination

Common Nature of Question paper as per Faculty of Science

List of the minimum equipments for B.Sc. II Microbiology course :

All the equipments that are required for B.Sc. Part I Microbiology course and in addition, the following equipments.

1. Serological Waterbath - One
2. U. V. Chamber - One
3. Micrometer slides - Four per batch
4. Internet facility

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