

# **SHIVAJI UNIVERSITY, KOLHAPUR.**



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**Accredited By NAAC With 'B' Grade**

**Revised Syllabus For**

**Bachelor of Science**

**Part - I**

**MICROBIOLOGY**

**Syllabus to be implemented from June, 2013 onwards.**

# Shivaji University, Kolhapur

## Revised Syllabus For Bachelor of Science Part – I : Microbiology

### 1. TITLE : Microbiology

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June, 2013 onwards.

### 3. PREAMBLE:

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

Students learn Microbiology as a separate subject from B.Sc. I. 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 in English.

## 8. STRUCTURE OF COURSE-

(Note – The structure & title of papers of the degree as a whole should be submitted at the time of submission/revision of first year syllabus.

### 1) FIRST SEMESTER ----- (NO.OF PAPERS 2)

Sr.No.	Subjects	Marks
1.	Paper – I	50
2.	Paper – II	50

### SECOND SEMESTER----- (NO.OF PAPERS 2 )

Sr.No.	Subjects	Marks
1.	Paper – III	50
2.	Paper – IV	50
3.	Practical	50
	Total of Semester I and II	250

### 2) Structure and Titles of Papers of B.Sc. Course :

#### B.Sc. I Semester I

Paper I : Fundamentals of Microbiology

Paper II : Basic Microbial Techniques & Biochemistry

#### B.Sc. I Semester II

Paper III : Medical Microbiology, Microbial Techniques and Bioinstrumentation.

Paper IV : Applied Microbiology

### 3) EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

Sr.No.	Title of Old Paper	Title of New Paper
1.	Semester I: Paper I : Fundamentals of Microbiology Paper II : Basic Microbial Techniques and Biochemistry	Semester I: Paper I : Fundamentals of Microbiology Paper II : Basic Microbial Techniques and Biochemistry
2.	Semester II: Paper III : Medical Microbiology, Microbial Techniques and Bioinstrumentation. Paper IV : Applied Microbiology	Semester II: Paper III : Medical Microbiology, Microbial Techniques and Bioinstrumentation. Paper IV : Applied Microbiology
3.	Practical – Old	Practical – New

### 4) OTHER FEATURES :

(A) LIBRARY :

Reference and Text Books, Journals and Periodicals, Reference Books for Advanced Books for Advanced studies. – List Attached

(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, 2013

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## B.Sc. Part I : Microbiology

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### Theory : Paper I : Fundamentals of Microbiology

#### UNIT I

9

#### History and Scope of Microbiology :

- A. Introduction of Microbiology.
- B. Prokaryotic and Eukaryotic cell structure.
- C. Introduction to types of Microorganisms – Bacteria, Algae, Fungi, Protozoa and Viruses.
- D. Spontaneous generation theory and controversy over it.
- E. Contributions of 1) Antony van Leeuwenhoek 2) Louis Pasteur 3) Robert Koch 4) Joseph Lister 5) Edward Jenner.
- F. Beneficial and harmful activities of microorganisms.
- G. Introduction to applied branches of Microbiology : a) Air, b) Water, c) Sewage, d) Soil, e) Dairy, f) Food, g) Medical, h) Industrial, i) Biotechnology and j) Geomicrobiology.

#### UNIT II

11

#### 1. Morphology and cytology of Bacteria

- A. Morphology of Bacteria – i) Size, ii) Shape, iii) Arrangements
- B. Cytology of Bacteria –
  - a) Structure and functions of :
    - i) Cell wall
    - ii) Cell membrane
    - iii) Capsule and slime layer
    - iv) Flagella
    - v) Pili
    - vi) Nuclear material
    - vii) Mesosome
    - viii) Ribosome

#### 2. General Principles of bacterial nomenclature :

- i) Taxonomic ranks

- ii) Common or Vernacular name
- iii) Scientific or International name

### UNIT III

7

#### Microbial nutrition

##### A. Microbial Nutrition

- 1) Nutritional requirements of microorganisms :  
Water, Micronutrients, Macronutrients, Carbon, Energy source, Oxygen and Hydrogen, Nitrogen, Sulphur and Phosphorous and growth factors-auxotroph, prototroph and fastidious organisms.
- 2) Nutritional types of microorganism based on carbon and energy sources.
  - a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs
  - e. Photoautotrophs f. Chemoautorphs g. Photoheterotrophs
  - h. Chemoheterotrophs.

### UNIT IV

9

#### Culture media :

- A. Common components of media and their functions  
Peptone, Yeast extract, NaCl, Agar and Sugar
- B. Culture media
  - a) Living Media (Lab. animals, plants, bacteria, embryonated eggs, tissue cultures)
  - b) Non living media – i) Natural, ii) Synthetic, iii) Semi synthetic, iv) Differential, v) Enriched, vi) Enrichment, vii) Selective.

### Paper II: Basic Microbial Techniques and Biochemistry

#### UNIT I

12

#### 1. Microscopy :

- A. General Principles of Microscopy – Image formation, Magnification, Numerical aperture (uses of oil immersion objective), Resolving power and Working distance.
- B. Ray diagram, special features, applications and comparative study of –
  - i) Compound Microscope
  - ii) Electron Microscope

#### 2. Stains and staining procedures

- A. Definition of dye and stain
- B. Classification of stains – Acidic, Basic and Neutral

- C. Principles, Procedure, Mechanism and application of staining procedures
  - i) Simple staining
  - ii) Negative staining
  - iii) Differential staining : Gram staining and Acid fast staining
- D. Special staining methods
  - i) Cell wall (Chance's method)
  - ii) Capsule (Maneval's method)
  - iii) Volutin granules (Albert's method)

## UNIT II

10

### Control of Microorganisms

- A. Definitions of - Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis, Sanitization.
- B. Physical agent : i) Temperature – a) Dry heat, b) Moist heat, ii) Desiccation, iii) Osmotic pressure, iv) Radiations – U.V. Ray, Gamma rays, v) Filtration – Asbestos and Membrane filter
- C. Chemical Agents : Mode of action, application and advantages
  - i) Phenol and Phenolic compounds
  - ii) Alcohols (Ethyl alcohol)
  - iii) Halogen compounds (chlorine and iodine)
  - iv) Heavy metals (Cu and Hg)
- v) Gaseous Agents – Ethylene oxide, Beta-propiolactone and formal

## UNIT III

08

### Proteins, Enzymes and Nucleic acids :

- A. Proteins :
  - i) General structure of amino acids , peptide bond.
  - ii) Types of amino acids based on R group –
    - a) Nonpolar, aliphatic amino acids.
    - b) Aromatic amino acids.
    - c) Polar, Uncharged amino acids.
    - d) Positively charged (basic) amino acids
    - e) Negatively charged (acidic) amino acids.
  - iii) Peptides - properties
  - iii) Structural levels of proteins: primary, secondary, tertiary and quaternary.
- B. Enzymes: i) Definition,

- ii) Structure- Concept of apoenzyme, coenzyme, cofactor and active site.
- iii)Types- Extracellular , Intracellular, Constitutive and Inducible.

C. Nucleic Acids :

- i) DNA – structure and composition (Waston and Crick Model)
- ii) RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.

**UNIT IV**

**06**

**Carbohydrates and lipids :**

1. Carbohydrates : Definition, classification and brief account of
  - A) Monosaccharides :  
Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose.
  - B) Disaccharides : Glycosidic bond, structure of lactose and sucrose.
  - C) Polysaccharides : Structure and biological role of starch, glycogen and cellulose.
2. Lipids :
  - A. Simple lipids – Fats and oils, waxes.
  - B. Compound lipids – Phospholipid, Glycolipids
  - C. Derived lipids – Cholesterol

**Paper III : Medical Microbiology, Microbial Techniques and Bioinstrumentation.**

**UNIT I**

**9**

**Approaches to the isolation and identification of bacteria.**

- A. Methods for isolation of pure culture.
  - i) Streak plate    ii) Pour plate    iii) Spread plate
- B. Maintenance of stock cultures - Agar slants and Agar stabs
- C. Systematic study of pure cultures :
  - i. Morphological characteristics.
  - ii. Cultural characteristics - Colony characteristics on solid media, growth in liquid media , growth on agar slants.
  - iii. Biochemical Characteristics -
    - a. Sugar fermentation
    - b. Production of metabolites - H<sub>2</sub>S gas
    - c. Production of enzymes - Amylase, Caseinase & Catalase.
  - iv. Serological and genetic characteristics

## UNIT II

10

### Medical Microbiology

- a) Definitions – Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, epidemiology, etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity.
  - b) Virulence factors (production of endotoxins, exotoxins, enzymes, escaping of phagocytosis)
  - c) Types of diseases – i) Epidemic, ii) Endemic, iii) Pandemic, iv) Sporadic.
  - d) Types of infections – Chronic, acute, primary, secondary, reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial.
  - e) Modes of transmission of diseases
    - 1. Air-borne transmission, 2. Vehicle transmission 3. Contact transmission
    - 4. Vector borne transmission
- General principles of prevention and control of microbial diseases.

## UNIT III

### Bioinstrumentation:

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- 1. Principle, working and applications of Colorimeter.
- 2. Principle, working and applications of Laminar air flow cabinet.
- 3. Centrifugation and ultracentrifugation: Principle, types and applications.

## UNIT IV

9

### Biotechniques:

- 1) Chromatography : Principles, methods and applications of -
  - i) Paper Chromatography – principle, method, application
  - ii) Thin layer chromatography – principles, method, application.
- 2) Isolation and cultivation of yeasts and molds.
- 3) Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O<sub>2</sub>

## Paper IV : Applied Microbiology

### UNIT I

10

#### Food Microbiology:

- a) Principles of microbial spoilage of food
- b) Spoilage of fruits, bread and meat.
- c) General principles and methods of food preservation.
  - i) Asepsis
  - ii) Removal of microorganisms - trimming, filtration, centrifugation.
  - iii) Dehydration methods.
  - iv) Use of heat – low temperature and high temperature.
  - v) Irradiation
  - vi) Anaerobiosis
- d) Use of Chemical preservatives – Na-benzoate, NaCl, Vinegar and Sugar.

### UNIT II

10

#### Milk Microbiology

- a) General composition of Milk.
- b) Sources of contamination in milk.
- c) Microbiological examination of Milk – SPC and dye reduction tests :
  - i) MBRT test, ii) Resazurin test
- d) Spoilage of milk – Change in Colour and flavor, curdling and ropiness
- e) Pasteurization (definition, types of methods used ) –
  - vii) LTH (Low Temperature Holding)
  - viii) HTST (High Temperature Short Time)
  - ix) UHT (Ultra High Temperature)

Efficiency of Pasteurisation – Phosphatase test (Qualitative)

### UNIT III

10

#### Water Microbiology:

- a) Sources of microorganisms in water.
- b) Fecal pollution of water.
- c) Indicators of fecal pollution – *E. coli*
- d) Routine Bacteriological analysis of water.

- 1) SPC
- 2) Tests for Coliforms
  - i) Qualitative a. **Detection of coliforms** - Presumptive test, Confirmed Test, Completed test.  
b. **Differentiation between coliforms** - IMViC test, Eijkman test.
  - ii) Quantitative – MPN, Membrane filter technique
- e) Municipal water purification process and it's significance.

#### UNIT IV

06

##### **Air Microbiology:**

- a) Sources of microorganisms in air.
- b) Definitions of - i) Infectious dust, ii) Droplets, iii) Droplet nuclei
- c) Sampling methods for microbial examination of air
  - i) Solid impaction - Sieve device
  - ii) Liquid Impingement – Bead-bubbler device
- d) Germ free and Gnotobiotic Life – Rearing germ free animals, germ free animals verses normal animals, uses of germ free animals.

#### Practical Course

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##### **1) Use, care and study of compound Microscope.**

##### **2) Demonstration of Laboratory equipments**

- i) Incubator
- ii) Autoclave
- iii) Hot air oven
- iv) Centrifuge
- v) Colorimeter
- vi) Seitz's filter
- vii) pH meter
- viii) Colony Counter
- ix) Water bath
- x) Distilled water plant
- xi) U. V. Chamber
- xii) Laminar air flow cabinet

**3) Microscopic examination of Bacteria**

- i) Monochrome staining      ii) Negative staining
- iii) Gram staining              iv) Hanging drop technique of motility

**4) Staining of –**

- i) Cell wall (Chance's method)
- ii) Capsule (Meneval's method)
- iii) Volutin granules (Albert's method)

**5) Mounting and identification of molds –**

- i) *Aspergillus*                      ii) *Penicillium*

**6) Preparation of culture media –**

- i) Peptone water                  ii) Nutrient broth
- iii) Nutrient agar                iv) MacConkey's agar
- v) Sabouraud's agar              vi) Starch agar
- vii) Milk agar

**7) Isolation, Colony characteristics, Gram staining and motility of –**

- i) *Escherichia coli*
- ii) *Bacillus species*
- iii) *Staphylococcus aureus*

8) Isolation of bacteria from air by solid impaction technique.

**9) Biochemical tests -**

- i) IMViC test
- ii) Sugar fermentation – glucose and lactose
- iii) H<sub>2</sub>S production

**10) Detection of enzyme activity -**

- i) Amylase                          ii) Catalase
- iii) Caseinase

**11) Determination of bacteriological quality of milk by MBRT test.**

**12) Enumeration of bacteria from water and milk by SPC method.**

**13) Paper Chromatography (separation of amino acids from a mixture – determination of number of amino acids)**

**Books recommended for Theory**

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- 1) Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieq, N.R. 5<sup>th</sup> edition, 1986 (McGraw Hills Publication).

- 2) Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.
- 3) Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7<sup>th</sup> edition.
- 4) Medical Microbiology Vol. I and II by Cruick Shank R., Duguid J.P., Marmion B.P., Swain R.H.A., XII<sup>th</sup> edition, Churchill Livingstone, New York.
- 5) A textbook of Microbiology by Ananthnarayan – Orient Longman, Bombay
- 6) General Microbiology by Stanier R. Y. V<sup>th</sup> edition, McMillan, London.
- 7) General Microbiology Vol I and II by Powar and Dagainawala, Himalaya Publications.
- 8) Medical Bacteriology by Dey and Dey – Allied Agency, Calcutta.
- 9) Food Microbiology by W. C. Frazier.
- 10) Basic Experimental Microbiology by Ronal M. Atlas, Alfred E. Brown, Kenneth W. Dobra, Wonas Miller (1986) Pren-tice Hall.
- 11) General Microbiology by Robert F. Boyd (1984), Times, Mirror/Mosby College.
- 12) A Biologics guide to principles, techniques of Practical Biochemistry by K. Wilson and K. H. Goulding, Edward Arnold Publication.
- 13) Introduction to Practical Biochemistry by D. Plummer, J. Willey and Sons.
- 14) Microbiology by Prescott, Herley and Klein, II<sup>nd</sup> edition.
- 15) Bacteriological Techniques by F. K. Baker
- 16) Introduction to Microbial Techniques by Gunasekaran.
- 17) Biochemical methods by Sadasivam & Manickam
- 18) Elementary Microbiology Vol. I by Dr. H.A.Modi , Akta Prakashan, Nadiad, Gujrat.
- 19) Principles of Biochemistry by Nelson and Cox (Lehninger) – Fifth edition.

#### **Books recommended for Practical**

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- 1) Medical Microbiology by Cruickshank Vol. II.
- 2) Stains and Staining procedures by Desai and Desai.
- 3) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
- 4) Bacteriological techniques by F. J. Baker.
- 5) Introduction to Microbial techniques by Gunasekaran.
- 6) Biochemical methods by Sadasivam and D. Manickam.
- 7) Laboratory methods in Biochemistry by J. Jayaraman.
- 8) Experimental Microbiology by Patel & Patel

#### **List of minimum equipments**

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- |                 |   |   |
|-----------------|---|---|
| 1) Hot air oven | - | 1 |
| 2) Incubator    | - | 1 |

- |                              |   |                       |
|------------------------------|---|-----------------------|
| 3) Autoclave                 | - | 1                     |
| 4) Refrigerator              | - | 1                     |
| 5) Medical microscopes       | - | 10 nos. for one batch |
| 6) Chemical balance          | - | 2                     |
| 7) pH meter                  | - | 1                     |
| 8) Seitz filter              | - | 1                     |
| 9) Centrifuge                | - | 1                     |
| 10) Colorimeter              | - | 1                     |
| 11) Distilled Water Plant    | - | 1                     |
| 12) Laminar air flow cabinet | - | 1                     |
- 13) Arrangements for gas supply and fitting of two burners per table.
  - 14) One working table of 6' x 2½' for two students.
  - 15) One separate sterilization room attach to the laboratory (10' x 15')
  - 16) At least one wash basin for a group of five students
  - 17) Colony counter
  - 18) Water bath
  - 19) One separate instrument room attached to lab (10' x 15')
  - 20) One laboratory for one batch including working tables (6' x 2½') per two students for one batch
  - 21) Store room (10' x 15')

### **Practical Examination**

- (A) The practical examination will be conducted on two consecutive days for three 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.

### **Nature of question paper and distribution of marks for Practical Examination**

	Marks
Q.1 Special Staining	10
Q.2 Isolation and study of colony characters, gram nature and motility	

of bacteria / Enumeration of bacteria from water / milk by SPC.	15
Q.3 Biochemical tests / Fungal Mounting / MBRT test	05
Q.4 Detection of enzyme activity / Paper chromatography	05
Q.5 Spotting	10
Q.6 Journal	05

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Total marks – 50

**Nature of question paper and distribution of marks for  
Theory Examination**

Q.1 Objective type (The multiple choice – 10 questions)	10
Q.2 Attempt Any Two (A) Descriptive question (B) Descriptive question (C) Descriptive question	20
Q.3 Attempt Any 4 out of 6 (Short Notes / Answers)	20

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50

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