

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AUTONOMOUS)

Reaccredited by NAAC with 'A+' Grade

New Syllabus For

Bachelor of Science

Part - I

MICROBIOLOGY

Syllabus to be implemented from June, 2018 onwards

Yashvantrao Chavan Institute of Science, Satara (Autonomous)

Revised Syllabus For Bachelor of Science Part – I : Microbiology

1. TITLE : Microbiology

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June, 2018 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.

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 :**1) Semester I :**

Sr. No.	SUBJECT TITLE	Theory				Practical	
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of Hours Per week	Credits
1	Introduction to Microbiology & Microbial Diversity	Paper-I: MBT-101	5	4	Practical Paper – I : MBP-103	4	2
	Bacteriology	Paper –II MBT-102					

1) Semester II :

Sr. No.	SUBJECT TITLE	Theory				Practical	
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of Hours Per week	Credits
1	Microbial Physiology & Ecology	Paper-III: MBT-201	5	4	Practical Paper – II : MBP-203	4	2
	Biochemistry	Paper –IV MBT-202					

Note :- MB : Microbiology, T: Theory, P : Practical

SEMESTER –I								
Sr. No.	SUBJECT TITLE	PAPER NO	TEACHING SCHEME					
			THEORY (TH)			PRACTICAL (PR)		
			No. of lectures	Hours	Credits	No. of lectures	Hours	Credits
1	DSC -1A	I & II	5	4	4	4	3.2	2
2	DSC -2A	I & II	5	4	4	4	3.2	2
3	DSC -3A	I & II	5	4	4	4	3.2	2
4	DSC -4A	I & II	5	4	4	4	3.2	2
5	AECC -1A	I	4	3.2	2	---	---	---
	TOTAL OF SEM –I		24	19.2	18	16	12.8	8

- **Theory & Practical lectures of 48 minutes each.**
- **Total marks for B. Sc part - I including English =1100**

SEMESTER –II								
Sr. No.	SUBJECT TITLE	PAPER NO	TEACHING SCHEME					
			THEORY (TH)			PRACTICAL (PR)		
			No. of lectures	Hours	Credits	No. of lectures	Hours	Credits
1	DSC -1B	III & IV	5	4	4	4	3.2	2
2	DSC -2B	III & IV	5	4	4	4	3.2	2
3	DSC -3B	III & IV	5	4	4	4	3.2	2
4	DSC -4B	III & IV	5	4	4	4	3.2	2
5	AECC -1B	II	4	3.2	2	---	---	---
	TOTAL OF SEM –II		24	19.2	18	16	12.8	8
	TOTAL OF SEM –I & II		48	38.4	36	32	25.6	16

- **Total Credit for B. Sc part –I Semester I & II = 52**
- **AECC –Ability Enhancement Compulsory Course (1A & 1B) –English**

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.

B.Sc. Part- I, Semester- I Microbiology

BMiT -101

Total Hours :- 36

Credit :- 04

Paper – I :- Introduction and Scope of Microbiology .

Unit – I - History and development of Microbiology.

09

- Theory of abiogenesis and biogenesis
- Contributions of Antony Van Leeuwenhoek , Louis Pasteur, Robert Koch, Alexander Fleming ,Joseph Lister.
- Establishment of fields of Medical Microbiology and Immunology through the work of Paul Ehrlich, Edward Jenner.

Unit – II – Bacterial systematics.

09

- Aim and principles of classification, systematic and taxonomy.
- Introduction to Bergey's manual of systematic Bacteriology.
- Concept of species, taxa, strain, conventional, molecular and recent approaches to phylogenetic bacterial taxonomy, rRNA oligonucleotide sequencing, signature sequences.

Unit- III – Introduction to types of microorganisms.

09

- Difference between prokaryotic and eukaryotic microorganisms
- General characteristics of different groups – acellular microorganisms. (Viruses, Viroids, Prions) and cellular microorganisms. (Bacteria, Archaeobacteria , Rickettsia, Algae, Fungi and Protozoa) with emphasis on distribution , occurrence and economic importance.

Unit – IV – Scope of Microbiology.

09

- Definitions and microorganisms used as biopesticides, biofertilizers, in biodegradation, biodeterioration and bioremediation
- Definition of fermentation, and microbes producing important industrial products through fermentation.
- Microorganisms in food fermentations (dairy and nondairy based fermented food products) and probiotics.

Learning Outcomes :-

Students should be able to

1. Learn the fundamental aspects of prokaryotic and eukaryotic cell structures and the differences between them.
2. Learn about different taxonomic groups of micro organisms.
3. Comprehend the mega diversity among micro organisms.
4. Describe the scope of Microbiology in various fields.

5. Understand the significance of different taxonomic classification systems especially the Bergey's Manual of Determinative Bacteriology in the field of Microbiology.
6. Study the contributions of eminent scientists in the overall development of modern Microbiology.
7. Examine and understand the importance of the theory of abiogenesis.

Books recommended :-

1. Microbiology by Pelczar , M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
2. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
3. Fundamentals of Microbiology by Frobisher , Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition **(UNIT I to IV)**
4. Medical Microbiology Vol.I and II by Cruick Shank R., Duguid J. P., Marmion B.P., Swain R.H.A., XIIth edition , Churchill Livingstone , New York. **(UNIT I)**
5. A textbook of Microbiology by Ananthnarayan- Orient Logman , Bombay **(UNIT I)**
6. General Microbiology by Stanier R.Y.Vth edition, McMillan, London **(UNIT I to IV)**
7. General Microbiology Vol. I by Powar and Dagainawala, Himalaya Publications **(UNIT I to IV)**
8. Microbiology by Prescott, Herley and Klein, IInd edition **(UNIT I to IV)**
9. Elementary Microbiology Vol. I by Dr. H.A. Modi, Akta Prakashan Nadiad, Gujarat **(UNIT I to IV)**
10. Microbiology by C. P. Baveja **(UNIT I to IV)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I to IV)**

Paper – II :- Bacteriology**Unit – I - Bacterial cell organization. 09**

- Morphology – Size ,shape, arrangement.
- Cytology- i) Structure , chemical composition and functions of –
 - a) Cell wall- Gram positive & Gram negative Bacteria
 - b) Cell membrane, mesosomes.
 - c) Capsule , slime layer.
 - d) Surface appendages – flagella, pili.

Unit – II – Microscopy. 09

- a) Principle of microscopy.
- b) Types of Microscopes – Light , phase contrast, dark field, interference, fluorescent microscope.
- c) Compound Microscope – Parts, image formation, magnification, numerical aperture (uses of oil immersion objective) resolving power and working distance. Ray diagram , types and applications.
- d) Electron Microscope –Parts, principle of image formation, Ray diagram and applications.
- e) Comparative study of compound and electron microscope.

Unit- III – Stains and staining procedure. 09

- a) Definition of dye and stain.
- b) Classification of stain – acidic, basic and neutral.
- c) Study of bacteria – unstained (wet) preparation and stained preparations.
- d) Common staining techniques- Principle, procedure, mechanism and application of simple staining, negative staining, differential staining- Gram and acid fast staining, impregnation method.
- e) Special staining methods- Cell wall (Chance’s method), Capsule (Maneval’s method) and Volutin granule (Albert’s method)

Unit – IV – Control of microorganisms. 09

- a) Definitions of sterilization, disinfection.
- b) Physical agents of control of microorganisms- temperature (dry heat and moist heat). Filtration (asbestos and membrane filter)
- c) Chemical agents for control of microorganisms- mode of action, applications and advantages of –
 - i) Phenolic and phenolic compound.
 - ii) Alcohol (Ethyl alcohol)
 - iii) Halogen compounds (Chlorine and Iodine)

iv) Heavy metal (Cu and Hg)

Learning outcomes-

1. Study the morphological and cytological characters of the bacterial cell with emphasis on their functionality.
2. Imbibe the basics of stains and staining techniques for comprehensive study of bacteria and other microbes.
3. Understand the importance of Gram's staining in the bacterial taxonomical classification systems.
4. Comprehend the biological concepts of sterilization and disinfection.
5. Learn the mode of action of different chemicals and substances employed as disinfectants for the control of micro organisms.
6. Study the basic principles of autoclave and hot air oven.

Books recommended for Theory

01. Microbiology by Pelczar , M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
02. Fundamental Principles of Bacteriology by A.J. Salle, Tata McGraw Hill. **(UNIT I to IV)**
03. Fundamentals of Microbiology by Frobisher , Hindsdill, Crabtree, Good Heart, W.B. Saunders Company, 7th edition **(UNIT II & III)**
04. Medical Microbiology Vol.I and II by Cruick Shank R., Duguid J. P., Marmion B.P., Swain R.H.A., XIIth edition , Churchill Livingstone , New York. **(UNIT IV)**
05. A textbook of Microbiology by Ananthnarayan- Orient Logman , Bombay **(UNIT IV)**
06. General Microbiology by Stanier R.Y.Vth edition, McMillan, London **(UNIT I)**
07. General Microbiology Vol. II by Powar and Dagainawala, Himalaya Publications **(UNIT I)**
08. Microbiology by Prescott, Herley and Klein, IInd edition **(UNIT I to IV)**
09. Elementary Microbiology Vol. I by Dr. H.A. Modi, Akta Prakashan Nadiad, Gujarat **(UNIT III)**
10. Microbiology by C. P. Baveja **(UNIT II)**
11. Foundations in Microbiology, K.P. Tolaro 7th International edition 2009 McGraw Hill **(UNIT I to IV)**
12. Brock's Biology of Microorganisms M.T. Madigan 12th edition **(UNIT I)**

BMiP 103 - Practicals

1. Preparation of cotton plugs for test tubes and flasks.
2. Wrapping of plates and pipettes.
3. Use, care and study of compound microscope.
4. Demonstration of laboratory equipments- Incubator, Autoclave, Hot air oven, Seitz filter , Distilled water plant, anaerobic jar.
5. Microscopic Examination of Bacteria by
 - i) Monochrome staining method
 - ii) Negative staining method
 - iii) Gram staining.
 - iv) Hanging drop technique.
 - v) Acid fast staining- Permanent slide only.
6. Staining of organelles of bacterial cell
 - i) Capsule staining by Maneval's method
 - ii) Cell wall staining by Chance's method
 - iii) Volutin granule staining by Albert's method
7. Wet mount of Aspergillus and Penicillium .
8. Effect of copper as sterilizing agent.
9. To study efficacy of alcohol and hand sanitizer.

Learning outcomes-

1. Students should know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
2. Students should be able to prepare cotton plugs, wrapping of plates and pipettes
3. Students should be able to prepare smear and examine bacteria using various staining procedures/techniques.
4. Students should be able to learn to critically observe and record the observations of all experiments.
5. Students should be able to determine efficacy of sanitizers.
6. Students should understand use of copper metal as bactericidal agent in day to day life.

Table activity-

1. **Small exhibition on fermented foods and dairy products.**
2. **Poster display of merits of biofertilizers and biopesticides.**

Books recommended for Practical

1. Stains and Staining procedures by Desai and Desai
2. Experimental Microbiology by Patel and Patel
3. Medical Microbiology by Cruickshank Vol.II
4. Bacteriological techniques by F.J. Baker

5. Experimental Microbiology by Rakesh Patel Vol. I and Vol. II
6. Handbook of Media for Clinical and Public Health Microbiology by Ronald Atlas
7. Practical Handbook of Microbiology by Emanuel Goldman and Lorrence Green

Semester II

BMiT -201

Total Hours :- 36

Credit :- 04

Paper – III :- Microbial Physiology

Unit :-I Microbial Nutrition 09

- a) Nutrition requirement of micro organisms– water & macronutrients
- b) Micronutrients , carbon , energy , hydrogen , nitrogen , sulphur , phosphorus , growth factor auxotrophs , prototrophs , fastidious organisms.
- c) Nutritional types of microorganisms depending on carbon and energy source.

Unit :-II Culture Media 09

- a) Common components of culture media and their functions.
- b) Types of culture media – Natural and Synthetic , Semi synthetic , Differential, Enriched , Enrichment , Selective , Transport, Indicator media.

Unit :- III Bacteriological techniques 09

- a) Pure culture techniques – History , Serial dilution technique , Streak plate technique , Spread plate technique , Pour Plate technique.
- b) Maintenance of stock cultures agar slants and agar stabs.
- c) Preservation of microbial culture – sub culturing , overlaying with mineral oils , Lyophilization.
- d) Cultivation of anaerobic bacteria by using media components and by exclusion of air or oxygen.

Unit IV Microbial growth 09

- a) Definitions of growth, Measurement of microbial growth-
 - 1) Direct microscopic count- Petroff-Hausser counting chamber ,2) Viable count – Membrane filtration 3) Electronic counting
- 4) Measurement of cell mass 5) Turbidity measurement- colorimetric technique. Phases of bacterial growth .Batch culture, Continuous culture, synchronous growth

Learning outcomes-

- 1. Learn the basic concepts of microbial nutrition and the various groups of micro organisms grouped as per their nutritional requirements.
- 2. Study the concept of culture medium, its types and the components used in it.

3. Understand the techniques employed for isolation of pure culture.
4. Learn the various techniques used for cultivation of anaerobes.
5. Study the ecological distribution of micro organisms in different ecospheres.
6. Comprehend the varied types of microbial interactions and their significance.
7. Study the significance of the commensals of the human body.

Books recommended for Theory

01. Microbiology by Pelczar , M.J.Jr., Chan E.C.S., Krieger, N.R. 5th edition, 1986 (McGraw Hills Publication). **(UNIT I to IV)**
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Paper – IV:- Biochemistry**Unit –I
Carbohydrates**

- a) Families of monosaccharide's – aldoses, Ketoses, Triose, Tetroses , Pentoses , Hexoses .
- b) Definitions , classifications and brief account of
 - i) Monosaccharides – classification based on aldehyde & ketone, groups, structure of ribose , deoxyribose , glucose , galactose and Fructose .
 - ii) Disaccharides – Concept of reducing and non reducing sugar, Glycoside bonds, Structure of lactose and sucrose.
 - iii) Polysaccharides structure and biological role of starch, glycogen and cellulose.

**Unit II
Proteins**

- a) Amino acids the building blocks of proteins, General formula of amino acids and concept of zwitterion, Classification of amino acids.
- b) Primary structure of proteins
- c) Oligopeptides – Structure and function of naturally occurring glutathione, insulin and Synthetic aspartame.
- d) Secondary structure of proteins , peptide unit and its salient feature . The alpha helix, β pleated sheet and their occurrence in proteins.
- e) Tertiary and quaternary structure of proteins, Forces holding the polypeptide together.
- f) Functions of proteins.

**Unit III
Enzymes**

- a) Definitions.
- b) Structure – Concept of apoenzyme, Coenzyme, Cofactor prosthetic group and active site.
- c) Types – extracellular, intracellular, constitutive and inducible enzyme.
- d) Feature of enzyme substrate reactions.
- e) Mechanism of enzyme action - lock and key hypothesis and Induced fit hypothesis.
- f) Classification of enzymes

**Unit :- IV
Nucleic Acids**

- a) DNA –
 - e) Composition – Structure of purines , Pyrimidines , Structure of nucleoside , nucleotide
 - ii) Structure of DNA - Watson and Crick's double helical model, salient features
 - i) Functions of Mitochondrial and chloroplast DNA .
- b) RNA – Composition – Structure and function of mRNA , tRNA , rRNA .

Learning outcomes-

1. Study the structure and functions of chemical cellular materials.
2. Imbibe the basics of macromolecules like DNA, RNA and proteins.
3. Understand the essentials of enzymology and the mechanism of various enzymes.
4. Learn the fundamentals of carbohydrates with their structures

Books recommended for Theory

- 1 Principles of Biochemistry by Nelson and Cox (Lehninger) 5th edition (**UNIT I To IV**)
- 2 Biochemical Methods by Sadasivam and Manickam
- 3 Biochemistry by U.Satyanarayana and U. Chakrapani (**UNIT I To IV**)
- 4 General Microbiology Vol. II by Powar and Dagainawala, Himalaya Publications (**UNIT I & II**)
- 5 Biochemistry by Berg , Tymoczko and Stryer 7th edition (**UNIT III & IV**)
- 6 Biochemistry by Powar and Chatwal, Himalaya Publishing House (**UNIT I To IV**)

BMiP 203 Practicals

Credit :-2

1. Demonstration of laboratory equipments- Colorimeter, Laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter.
2. Preparation and sterilization of nutrients broth, MacConkey's agar, Sabouraud's agar, Rose Bengal agar.
3. Isolation of bacteria by streak plate technique, pour plate technique, Spread plate technique.
4. To detect the ability of bacteria to produce amylase enzyme.
5. To detect the ability of bacteria to produce catalase enzyme.
6. To detect the ability of bacteria to produce caseinase enzyme.
7. Qualitative analysis of biomolecules –
 - a. Carbohydrate .
 - b. Proteins .
8. Cultivation of anaerobic bacteria by using special media components.
9. Cultivation of anaerobic bacteria by using anaerobic jar.
10. Direct Microscopic count of given bacterial suspension.
11. Study of growth phases and growth curve of bacteria

Learning outcomes -

1. Student should be able to weigh ingredients, adjust the pH of medium and operate the autoclave.
2. Student should be able to carry out various techniques of isolation.
3. Student should be able to operate anaerobic jar.
4. Student should understand mechanism of enzyme activity and their applications.
5. Student should be able to detect protein and types of carbohydrate in given sample.
6. Student should be able to determine time period of different phases.

Books recommended for Practical

- 1 Introduction to Practical Biochemistry by D. Plummer , J Wiley and Sons
- 2 Introduction to Microbial Techniques by Gunasekaran
- 3 Laboratory Methods in Biochemistry by J. Jayraman
- 4 Experimental Microbiology by Patel and Patel
- 5 Laboratory Manual for Practical Biochemistry Shivraja Shankara YM
- 6 Introduction to Practical Biochemistry by Sawhney and Singh
- 7 A Biologist's guide to principles, techniques of Practical Biochemistry by K.Wilson and K.H. Goulding, Edward Arnold Publication

List of minimum equipments

1. Hot air oven01
2. Incubator01
3. Autoclave.....01
4. Refrigerator01
5. Medical microscopes.....10 per batch

6. Chemical balance02
7. pH meter01
8. Seitz filter01
9. Centrifuge01
10. Colorimeter01
11. Distilled water plant01
12. Laminar airflow cabinet01
13. Arrangement for gas supply and fitting of two burners per table
14. One working table of 6' x 2 ½' for two students
15. One separate sterilization room attached to laboratory (10' x15')
16. At least one wash basin for group of five students
17. Colony counter
18. Water bath
19. One separate instrument room attached to laboratory (10' x15')
20. One laboratory for one batch including working table (6' x 2 ½') per two students for one batch.
21. Store room ((10' x15')

Practical Examination

- A) Practical examination will be conducted separately for every semester of 35 Marks each.
- B) The practical examination for Semester I will be one day examination conducted for 6 hrs. and for Semester II will be conducted for two consecutive days for 3hrs.each.
- C) Each candidate must produce certified Journal , checked and signed by member of teaching staff and certified by the Head of the Department at the end of each semester.
- D) Candidate must produce their Journal at the time of Practical Examination.
- Nature of Question paper and Distribution of Marks in Practical examination

Semester I

- Q.1. Determination of efficacy of alcohol / copper / sanitizer 10 Marks
- Q.2. Special staining/ Gram staining / Fungal Mounting10 Marks
- Q.3. Spotting 10 Marks
- O.4 Journal 05 Marks

Total Marks : 35

Semester II

- Q.1. Isolation and Identification of bacteria by
Streak plate or Spread plate technique..... 15 Marks
- Q.2. Enzyme activity.....10 Marks
- Q.3. Qualitative analysis of Carbohydrates and Proteins..... 10 Marks
- O.4 Journal 05 Marks

Total Marks : 35

