

B.Sc.

Microbiology

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN INSTITUTE OF
SCIENCE, SATARA
(AUTONOMOUS)**

Reaccredited by NAAC with 'A+' Grade

Proposed Syllabus For

Bachelor of Science

MICROBIOLOGY

Syllabus to be implemented w.e. f. August, 2021

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Syllabus for B.Sc. I Microbiology

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.

B.Sc. Programme Objectives and outcomes General Objectives of the programme:

- i] To nurture academicians with focus and commitment to their subject.
- ii] To shape good and informed citizens from the students entering into the programme.
- iii] To create a skilled work force to match the requirements of the society.
- iv] To impart knowledge of science is the basic objectives of this programme.
- v] To develop scientific attitude is the major objective so as to make students open minded, critical and curious.
- vi] To develop skill in practical work, experiments and laboratory materials and equipment's along with the collection and interpretation of scientific data to contribute to science.

Programme Outcomes:

- i] The students will graduate with proficiency in the subject of their choice.
- ii] The students will be eligible to continue higher studies in their subject.
- iii] The students will be eligible to pursue higher studies abroad.
- iv] The students will be eligible to appear for the examinations for jobs in government organizations.
- v] The students will be eligible to apply for jobs with a minimum requirement of B.Sc. programme.

Programme Specific Objectives:

- i] The broad goal of the teaching of under graduate students in microbiology is to provide an understanding of various basic concepts in wide ranging contexts which involve the use

of knowledge and skills of Microbiology. Their understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research - based projects where they are guided and mentored by the academic and other experts of the subject.

- ii] The graduate students of microbiology should have knowledge of the diverse places where microbiology is involved.
- iii] The graduate students of microbiology should have Understanding of diverse Microbiological processes.
- iv] The graduate students of microbiology should have basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.
- v] The graduate students of microbiology should have Moderately advanced skill sin working with microbes such as pilot scale culturing, downstream processes, diagnostics etc.
- vi] The main objective of the course is to provide students with the basis to face the study of the major fundamentals of microbiology including Bacteriology, Virology, Immunology, Medical microbiology, Genetics, Cytology, Agriculture and Environmental microbiology etc.
- vii] At the time of completion of the programme the student will have developed extensive knowledge in various areas of Microbiology

Programme Specific Outcomes (PSOs):

- i] At the end of the three-year programme the student will understand and be able to explain different branches of Microbiology such as Bacteriology and Virology.
- ii] The student will be able to explain about various applications of Microbiology such as Environmental Microbiology, Industrial Microbiology, Food Microbiology, and Microbial Pathogenicity.
- iii] The students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, etc.
- iv] The students will be able to execute a short research project incorporating techniques of Basic and Advanced Microbiology undersupervision.
- v] The student will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired.

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Proposed Syllabus For

Bachelor of Science

Part- I

MICROBIOLOGY

Syllabus to be implemented w.e. f. August 2021

B.Sc.– I: Microbiology**Title:** Microbiology

- 1. Year of Implementation:** - Revised Syllabus will be implemented from August, 2021 onwards.
- 2. Duration:** The course shall be a full-time course.
- 3. Pattern:** Semester Examination
- 4. Medium of Instruction:** The medium of instruction shall be English.
- 5. Structure of course:**

B.Sc.- I Semester I

Sr. No.	SUBJECT TITLE	Theory			Practical Course – I : BMiP-103	Practical	
		COURSE NO & COURSE Code	No. of lectures per week	Credits		No. of Hours Per week	Credits
1	Introduction to Microbiology & Scope	Course-I: BMiT-101	5	4		4	2
	Bacteriology	Course –II BMiT- 102					

B.Sc.- I Semester II

Sr. No.	SUBJECT TITLE	Theory			Practical Course – II : BMiP-203	Practical	
		COURSE NO & COURSE Code	No. of lectures per week	Credits		No. of Hours Per week	Credits
1	Microbial Physiology	COURSE-III: BMiT-201	5	4		4	2
	Biochemistry	COURSE –IV BMiT - 202					

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

SEMESTER –I								
Sr. No.	SUBJECT TITLE	COURSE 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	COURSE 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 (1 A & 1 B) – English**

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)****Course – I - Introduction and Scope of Microbiology****Learning Objectives: Student should be able to**

- 1) Study of contributions of scientists in the development of Modern microbiology.
- 2) Understand theory of Abiogenesis and biogenesis.
- 3) Study the different branches of Microbiology.
- 4) Study the difference between prokaryotic and eukaryotic microorganisms and their cell structures.
- 5) Study bacterial nomenclature and classification
- 6) Understand the scope of microbiology.
- 7) Study the microorganisms used in biopesticide, biofertilizer, fermented food products etc.

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, Ivanowsky, Martinus W. Beijerinck, Sergei N. Winogradsky
- Establishment of fields of Medical Microbiology and Immunology through the work of Paul Ehrlich, Edward Jenner.

Unit – II: Branches of Microbiology**[09]**

- Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology.

Unit - III: Introduction to Types of Microorganisms.**[09]**

A] Difference between prokaryotic and eukaryotic microorganisms

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

B] Bacterial Nomenclature and classification:

- Taxonomic Ranks
- Common or Vernacular name
- Scientific or International Name
- Whittaker's five Kingdom and Carl Woese's Three Kingdom Classification Systems

Unit – IV – Scope of Microbiology.**[09]**

- Beneficial and Harmful effects of microorganisms:
- Medical Microbiology (Enlist diseases caused by various microorganisms and antibiotics)
- Environmental Microbiology (Eutrophication, red tide, Sewage treatment, bioremediation)
- Food and Dairy Microbiology (Food spoilage, Food borne diseases, Fermented Food, Probiotics)
- Agriculture Microbiology (Plant diseases and biofertilizers and Biocontrol agents)
- Industrial Microbiology (Production of antibiotics, enzymes, solvent-contaminants-bacteria and phages)
- Immunology (Normal flora, Three lines of defense)

Books recommended:

- Michael J. Pelczar, Jr. E.C.S. Chan, Noel R. Krieg, Microbiology (McGraw Hills Publication, 1986) 5th edition. Unit I -IV
- A. J. Salle, Fundamental Principles of Bacteriology (McGraw-Hill Book Co. New York and London 1973) 7th Edition (UNIT - I to IV)
- Martin Frobisher, Fundamentals of Microbiology (W. B. Saunders, Philadelphia, 1962) 7th edition. (UNIT - I to IV)
- Cruick Shank, R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. Medical Microbiology., (Churchill Livingstone Publishing, Edinburgh, Vol. 2, 12th Edition UNIT- I)
- Ananthanarayan and Paniker's, A Textbook of Microbiology (Orient Black Swan, 7th edition) 2016 (UNIT - I)
- R. Y. Stanier, J. L. Ingraham, M. L. Wheelis and P. R. Painter, General Microbiology (Macmillan Education Ltd., London, 2001) 5th edition. (UNIT I to IV)
- Dr. C.B. Powar, Dr. H.F. Dagainawala, General Microbiology (Himalaya Publications, 2010) (UNIT I to IV)
- Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, Prescott, Harley, and Klein's Microbiology (McGraw Hill Education) 2nd edition. (UNIT I to IV)
- Dr. H. A. Modi, Elementary Microbiology, Fundamentals of Microbiology (Akta. Prakashan Nadiad, 1995) Vol. I. (UNIT I to IV)
- C. P. Baveja, Microbiology (Arya publications, 6th Edition, 2019) UNIT I to IV
- K.P. Tolaro, Foundations in Microbiology (McGraw Hill Education) 7th International edition 2009. UNIT I to IV
- Michael T Madigan; Thomas D Brock, Brock biology of microorganisms, (San Francisco, CA: Pearson/Benjamin Cummings) 12th edition 2008. (UNIT I to IV)

Learning Outcomes:**UNIT-I: After completion of the Unit, students will be able to:**

- Study the contributions of eminent scientists in the overall development of modern Microbiology.
- Examine and understand the importance of the theory of abiogenesis.

UNIT-II: After completion of the Unit, students will be able to:

- Learn about different branches of Microbiology.

UNIT-III: After completion of the Unit, students will be able to:

- Learn the fundamental aspects of prokaryotic and eukaryotic cell structures and the differences between them.
- Learn bacterial nomenclature and classification
- Comprehend the mega diversity among microorganisms.

UNIT-IV: After completion of the Unit, students will be able to:

- Study beneficial and harmful effects of microorganisms
- Describe the scope of Microbiology in various fields.

BMiT-102**Total Hours:36 (Credit:-04)****Course – II: Bacteriology****Learning Objectives: Students should be able to**

- 1) Study the size, shape and arrangements of Bacteria.
- 2) Study the Gram positive and Gram-negative organisms.
- 3) Study the different types of microscopes, image formation and their application
- 4) Study the classification of stain and Different types of staining procedure.
- 5) Learn the difference between Stain and Dye.
- 6) Understand the concept of Sterilization, disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis and sanitization.
- 7) Study the various physical and chemical agents for control of microorganisms

Unit - I: Bacterial cell organization.**[09]**

- Morphology- Size, shape, Arrangement of bacteria
- Cytology of bacterial cell
- 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]**

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

Unit- III : Stains and staining procedure.**[09]**

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

Unit – IV: Control of microorganisms.**[09]**

- Definitions of - sterilization, disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis & sanitization.
- Physical agents of control of microorganisms-
 - a) Temperature (dry heat and moist heat),
 - b) Filtration (asbestos and membrane filter),
 - c) Desiccation,
 - d) Osmotic Pressure,
 - e) Radiations- U.V Rays, Gamma Rays
- Chemical agents for control of microorganisms- mode of action, applications and advantages of
 - a) Phenolic and phenolic compound.
 - b) Alcohol (Ethyl alcohol)
 - c) Halogen compounds (Chlorine & Iodine)
 - d) Heavy metal (Cu and Hg)
 - e) Gaseous Agents – Ethylene oxide, Beta-propiolactone and formaldehyde

Books recommended for Theory

- Michael J. Pelczar, Jr. E.C.S. Chan, Noel R. Krieg, Microbiology (McGraw Hills Publication, 1986) 5th edition. Unit I -IV
- A. J. Salle, Fundamental Principles of Bacteriology (McGraw-Hill Book Co. New York and London 1973) 7th Edition (UNIT - I to IV)
- Martin Frobisher, Fundamentals of Microbiology (W. B. Saunders, Philadelphia, 1962) 7th edition. (UNIT - II to III)
- Cruick Shank, R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. Medical Microbiology., (Churchill Livingstone Publishing, Edinburgh, Vol. 2, 12th Edition) (UNIT- IV)
- Ananthanarayan and Paniker's, A Textbook of Microbiology (Orient Black Swan, 7th edition) 2016 (UNIT - IV)

- R. Y. Stanier, J. L. Ingraham, M. L. Wheelis and P. R. Painter, General Microbiology (Macmillan Education Ltd., London, 2001) 5th edition. (UNIT I)
- Dr. C.B. Powar, Dr. H.F. Daginawala, General Microbiology (Himalaya Publications, 2010) (UNIT I)
- Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, Prescott, Harley, and Klein's Microbiology (McGraw Hill Education) 2nd edition. (UNIT I to IV)
- Dr. H. A. Modi, Elementary Microbiology, Fundamentals of Microbiology (Akta. Prakashan Nadiad, 1995) Vol. I. (UNIT III)
- C. P. Baveja, Microbiology (Arya publications, 6th Edition, 2019) UNIT II
- K.P. Tolaro, Foundations in Microbiology (McGraw Hill Education) 7th International edition 2009. UNIT I to IV
- Michael T Madigan; Thomas D Brock, Brock biology of microorganisms, (San Francisco, CA: Pearson/Benjamin Cummings) 12th edition 2008. (UNIT I)

Learning Outcomes**UNIT - I: After completion of the Unit, students will be able to:**

- Study the size, shape and arrangements of Bacteria.
- Study the Gram positive and gram-negative organisms.

UNIT - II: After completion of the Unit, students will be able to:

- Learn the different types of microscopes.
- Understand the working and principle of Compound and Electron microscope.

UNIT - III: After completion of the Unit, students will be able to:

- Learn the classification of stain and Different types of staining procedure.
- Study the difference between Stain and Dye.

UNIT - IV: After completion of the Unit, students will be able to:

- Understand the concept of Sterilization, disinfection and sanitization.
- Study the function, application and advantages of Chemical and physical agents

BMiP 103 – Practical [Credit – 02]**Learning objectives - Students should be able to**

- 1) Learn basic techniques in Microbiology
- 2) Know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
- 3) Learn preparation of stains, Buffer, Reagents & Physiological Saline.
- 4) Understand the construction and working of laboratory equipments.
- 5) Learn different staining techniques.

Practical

- 1) Demonstration of basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing glassware, biological waste disposal.
- 2) Introduction and use of common laboratory glass ware: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri Plates, pipettes, Erlenmeyer flask, Volumetric Flask, Glass spreader, Durham's Tube, Cragie's Tube, inoculating needles (Wire Loop, stab needles)
- 3) Biosafety- Aseptic techniques, Table disinfection, Hand Washing, Use of Apron, Proper disposal of used material, Cleaning and sterilization of glassware
- 4) Use, care and study of compound microscope.
- 5) Preparation of: Stains (0.5% basic fuchsin & 0.5% crystal violet),
Buffer (Phosphate buffer pH 7.0),
Reagents (1N and 1M HCl and NaOH Solutions),
Physiological Saline
- 6) Demonstration/Working principle and application of laboratory equipments - Incubator, Autoclave, Hot air oven, Seitz filter, Distilled water plant, Anaerobic jar.
- 7) Microscopic Examination of Bacteria by
 - a) Monochrome staining method
 - b) Negative staining method
 - c) Gram staining.
 - d) Hanging drop technique.
 - e) Acid fast staining - Permanent slide only.
- 8) Staining of parts of bacterial cell – Capsule staining by Maneval's method
- 9) Cell wall staining by Chance's method
- 10) Volutin granule staining by Albert's method
- 11) Wet mount of *Aspergillus* and *Penicillium*.

Learning outcomes: Students will be able to

- 1) Know and practice the safety measures while working in the Microbiology laboratory and handling of Microscope.
- 2) Learn preparation of stains, Buffer, Reagents & Physiological Saline.
- 3) Prepare smear and examine bacteria using various staining procedures / techniques.
- 4) Learn to critically observe and record the observations of all experiments.

Table activity

- Small exhibition on fermented foods and dairy products.
- Poster display of merits of biofertilizers and biopesticides.

Books recommended for Practical

- Desai and Desai, Stains and Staining procedures
- Dr. Nikunj Patel, Experimental Microbiology (Educreation Publishing)
- Cruick Shank, R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. Medical Microbiology., (Churchill Livingstone Publishing, Edinburgh, Vol. 1 & 2, 12th Edition, 1980)
- F. J. Baker, Bacteriological techniques (Butter worth & Co Publishers Ltd, 1967)
- Rakesh Patel, Experimental Microbiology (Aditya Book Centre, 5th edition, Vol. I and Vol. II, 2009)
- Ronald Atlas, Handbook of Media for Clinical and Public Health Microbiology, (CRC Press, 2013)
- Emanuel Goldman and Lorrence Green, Practical Handbook of Microbiology (Taylor & Francis, 2008)

Semester II**BMiT-201****Total Hours: 36 [Credit: 04]****Course– III: Microbial Physiology****Learning Objectives: Student should be able to**

- 1) Learn the basic concepts of microbial nutrition and the various groups of microorganisms grouped as per their nutritional requirements.
- 2) Study the concept of culture media and their components.
- 3) Understand the techniques used for isolation of pure culture.
- 4) Learn the various techniques used for cultivation of anaerobes.
- 5) Understand Morphological and cultural characteristics of microorganisms
- 6) Understand biochemical characterization of microorganisms

Unit - I: Microbial Nutrition**[09]**

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

Unit - II: Culture Media**[09]**

- Common components of culture media and their functions.
- Types of media based on consistency – Liquid, Solid, Semisolid, Biphasic
- Types of culture media – Natural and Synthetic, Semisynthetic, Differential, Enriched, Enrichment, Selective, Transport, Indicator media.

Unit - III: Bacteriological techniques**[09]**

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

Unit – IV: Systematic study of pure cultures:

[09]

A] Morphological characteristics

B] Cultural characteristics:

- Colony characteristics on solid media
- Growth in liquid media
- Growth on Agar Slants

C] Biochemical Characteristics-

- Sugar Fermentation
- Production of metabolites- H₂S gas
- Production of Enzymes- Amylase, Caseinase and Catalase

Books recommended for Theory

- Michael J. Pelczar, Jr. E.C.S. Chan, Noel R. Krieg, Microbiology (McGraw Hills Publication, 1986) 5th edition. Unit I -IV
- A. J. Salle, Fundamental Principles of Bacteriology (McGraw-Hill Book Co. New York and London 1973) 7th Edition (UNIT - I to IV)
- Martin Frobisher, Fundamentals of Microbiology (W. B. Saunders, Philadelphia, 1962) 7th edition. (UNIT - II to III)
- Cruick Shank, R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. Medical Microbiology., (Churchill Livingstone Publishing, Edinburgh, Vol. 2, 12th Edition, 1980) UNIT- IV
- Ananthanarayan and Paniker's, A Textbook of Microbiology (Orient Black Swan, 7th edition) 2016 (UNIT - IV)
- R. Y. Stanier, J. L. Ingraham, M. L. Wheelis and P. R. Painter, General Microbiology (Macmillan Education Ltd., London, 2001) 5th edition. (UNIT I)
- Dr. C.B. Powar, Dr. H.F. Dagainawala, General Microbiology (Himalaya Publications, 2010) (UNIT I)
- Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, Prescott, Harley, and Klein's Microbiology (McGraw Hill Education) 2nd edition. (UNIT I to IV)
- Dr. H. A. Modi, Elementary Microbiology, Fundamentals of Microbiology (Akta. Prakashan Nadiad, 1995) Vol. I. (UNIT III)
- C. P. Baveja, Microbiology (Arya publications, 6th Edition, 2019) UNIT II
- K.P. Tolaro, Foundations in Microbiology (McGraw Hill Education) 7th International edition 2009. UNIT I to IV
- Michael T Madigan; Thomas D Brock, Brock biology of microorganisms, (San Francisco, CA: Pearson/Benjamin Cummings) 12th edition 2008. (UNIT I)

Learning outcomes:**UNIT - I: After completion of the unit, students will be able to:**

1. Learn the basic concepts of microbial nutrition.
2. Study the various groups of microorganisms grouped as per their nutritional requirements.

UNIT - II: After completion of the unit, students will be able to:

1. Study the concept of culture medium, its types and the components used in it.
2. Understand working and principle of Compound and Electron Microscope.

UNIT - III: After completion of the unit, students will be able to:

1. Understand the techniques employed for isolation of pure culture.
2. Learn the various techniques used for cultivation of an aerobes.

UNIT - IV: After completion of the unit, students will be able to:

1. Understand Morphological and cultural characteristics of microorganisms
2. Understand biochemical characterization of microorganisms

BMiT - 202

Total Hours: 36 [Credit: 04]

Course – IV: Biochemistry

Learning Objectives: Student should be able to

- 1] Learn the classification of carbohydrates and their structures.
- 2] Understand the classification of Amino acid.
- 3] Study the structure and functions of protein.
- 4] Understand the basics of enzymology
- 5] Learn the classification of lipids and their function.
- 5] Understand the structure and composition of DNA and RNA.
- 6] Learn the functions of mitochondrial and chloroplast DNA.

Unit - I: Carbohydrates

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

Unit - II : A] 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] Oligopeptide – 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.

B] Enzymes**a] Definitions.**

b] Structure - Concept of apoenzyme, Coenzyme, Cofactor prosthetic group and active site.

c] Types- extracellular, intracellular, constitutive and inducible enzyme

Unit: III - Lipids:

a] Simple Lipids- Fats and oils, waxes

b] Compound Lipids- Phospholipids, Glycolipids

c] Derived lipids

Unit: IV- Nucleic Acid

a] DNA

i] Composition- Structure of Purines, Pyrimidines, Structure of nucleoside, nucleotide.

ii] Structure of DNA- Watson and Crick's double helical model, salient features.

iii] Functions of Mitochondrial and chloroplast DNA.

b] RNA - Composition - Structure and function of mRNA, tRNA, rRNA

Books recommended for Theory

- David L Nelson; Albert L Lehninger; Michael M Cox, Lehninger Principles of Biochemistry (Palgrave Macmillan, 2008) 5th Edition (UNIT - I to IV)
- S. Sadasivam, A. Manickam, Biochemical Methods, (New Age International (P) Limited, 2007)
- Dr. U Satyanarayana, Dr. U Chakrapani, Biochemistry (Elsevier India, 4th Edition, 2013) UNIT I to IV
- Dr. C.B. Powar, Dr. H.F. Dagainawala, General Microbiology (Himalaya Publications, 2010) (UNIT I & II)
- Jeremy M Berg, John L Tymoczko, and Lubert Stryer, Biochemistry (W H Freeman, New York, 2010) 7th edition (UNIT III & IV)
- CB Powar & GR Chatwal, Biochemistry (Himalaya Publishing House, 2012) (UNIT - I to IV)

Learning outcomes**UNIT: I - After completion of the Unit, students will be able to:**

1. Learn the fundamentals of carbohydrates with their structures.

UNIT: II - After completion of the Unit, students will be able to:

1. Understand the classification of Amino acid.
2. Learn the structure and functions of protein.
3. Learn the basics of enzymology.

UNIT: III - After completion of the Unit, students will be able to:

1. Classification of lipids and Function of lipids.

UNIT: IV - After completion of the Unit, students will be able to:

1. Understand the structure and composition of DNA and RNA.
2. Learn the functions of mitochondrial and chloroplast DNA.

BMiP203

Practical [Credit: 2]

Learning objectives: Student should be able to

1. Weigh ingredients, adjust the pH of medium and operate the autoclave.
2. Learn to carryout various techniques of isolation.
3. Understand mechanism of enzyme activity and their applications
4. Study to detect protein and types of carbohydrate in given sample.

List of Practical

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. To check the ability of microorganism to ferment sugar.
8. To check the ability of microorganism to utilize sugar.
9. To check the ability of microorganisms to produce H₂S.
10. Qualitative analysis of biomolecules
 - a] Carbohydrate.
 - General Test for Carbohydrate- Molisch Test
 - Test for Reducing Sugar – Benedict's Test
 - Test for Non reducing Sugar- Benedict's Test
 - Test for Starch- Iodine Test
 - b] Proteins.
 - Detection of Protein by Biuret Test
 - Acetic Acid Test
11. Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of
 - *E. coli*
 - *Bacillus species*

Learning outcomes: Student will be able to

1. To weigh ingredients, adjust the pH of medium and operate the autoclave.
2. To carry out various techniques of isolation.
3. To operate anaerobic jar.
4. Understand mechanism of enzyme activity and their applications.
5. To detect protein and types of carbohydrate in given sample.

Books recommended for Practical

- David T. Plummer, An Introduction to practical biochemistry (McGraw-Hill Book Company (U.K.) Ltd., London 1978) 2nd edition
- Gunasekaran, Introduction to Microbial Techniques
- J. Jayraman, Laboratory Methods in Biochemistry (New Age International, 2011)
- Dr. Nikunj Patel, Experimental Microbiology (Educreation Publishing)
- Shivaraja Shankara YM, Ganesh MK, Shivashankara AR, Laboratory Manual for Practical Biochemistry (Jaypee Brothers, Medical publisher Pvt. Ltd, 2008)
- R. Singh, S. K. Sawhney, Introductory Practical Biochemistry (Narosa, 2009)
- K Wilson, K H Goulding, Principles and techniques of Practical biochemistry (Edward Arnold, London. 1986) (third edition)

List of minimum equipments

- 1) Hot air oven01
- 2) Incubator01
- 3) Autoclave01
- 4) Refrigerator01
- 5) Medical microscopes 10 per batch
- 6) Chemical balance02
- 7) pH meter01
- 8) Seitz filter01
- 9) Centrifuge01
- 10) Colorimeter01
- 11) Distilled water plant 01
- 12) Laminar airflow cabinet.....01

- 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'x2½')per two students for one batch.
- 21) Store room (10'x15')

Practical Examination

- Practical examination will be conducted separately for every semester of **35 Marks each.**
- 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 3 hrs. each.
- 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.
- 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 Mounting.....	10 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