

1VANITA VISHRAM WOMEN'S UNIVERSITY
SCHOOL OF SCIENCES
DEPARTMENT OF MICROBIOLOGY



VANITA VISHRAM
WOMEN'S UNIVERSITY
— SURAT —

BACHELOR OF SCIENCE (B.Sc.) HONOURS
MICROBIOLOGY PROGRAMME
under Learning Outcomes-based Curriculum Framework (LOCF)
for Under Graduate (UG) Education

SEMESTERS 1
Core Courses Syllabus

Syllabus applicable to the students seeking admission in the
B.Sc.- Microbiology (Honours)
under LOCF
w.e.f. the Academic Year 2021-2022

NAME OF THE PROGRAMME (B.Sc. HONOURS- Microbiology)

Sr. No.	Contents	Page No.
1	Preamble – VVWU	2
2	Introduction of the Programme	3
3	Programme Specific Objectives	4
4	Programme Specific Outcomes	5
5	Structure of the Programme – Credit Structure	6
6	Course Structure – Paper Titles of two Semesters	7
7	Course Objectives – Course Outcomes – Course Contents*	8
8	Teaching Methodology	12

* Only for First Year, Semesters 1

1. Preamble – VVWU

Vanita Vishram Women’s University (VVWU) is the First-ever Women’s University of Gujarat approved by the Government of Gujarat under the provisions of the Gujarat Private Universities Act, 2009. It is a University committed to achieve Women’s Empowerment through Quality Education, Skill Development, and by providing employment opportunities to its girl students through its model curriculum, integration of technology in pedagogy and best-in-class infrastructure. The focus is on prioritizing practical component and experiential learning supported through academia-industry linkages, functional MoUs, skill development training, internships etc. It aims at providing opportunities to the girl students for holistic development and self-reliance.

VISION: Empowerment of women through quality education and skill development, so as to make them strong pillars of stability in the society.

MISSION: To provide Education & Professional Training to all women for their all-round development, so as to enable them to become economically independent and socially empowered citizens.

2. Introduction of the Programme:

This Learning Outcomes based Curriculum Framework (LOCF)-Microbiology for undergraduate education has been prepared in consonance with the generic guidelines prepared by UGC that provides the basic template for Universities to follow. Fundamental approach to learning outcome-based curriculum framework emphasizes upon demonstration of understanding, knowledge, skills, attitudes and values in particular programme of study. The LOCF based programme intended to follow flexibility and innovation in design of the programme, its assessment, and expect graduate attributes demonstrating the level of learning outcome. It is further expected to provide effective teaching – learning strategies including periodic review of the programme and its academic standard. To achieve this goal, it is imperative that their educational training is improved such that it incorporates the use of newer technologies, use of newer assessment tools for mid-course corrections to make sure that they become competitive individuals to shoulder newer social responsibilities and are capable of undertaking novel innovations in their areas of expertise. In the face of the developing knowledge society, students should be well aware about the resources of self-development using on-line resources of learning which is going to be a major component of learning in the future. The learning should also be a continuous process so that the students are able to re-skill themselves so as to make themselves relevant to the changing needs of the society. In the face of this need, the educational curricula, teaching learning processes, training, assessment methods all need to be improved or even re-invented. The higher educational institutions of India needs to keep pace with all these developments as occurring all over the globe.

B.Sc. (Hons) in Microbiology is a three-year undergraduate programme imparting comprehensive knowledge to the students in various areas of microbiology to meet the demand of industry & academia. The discipline of Microbiology involves the study of microorganisms viz., bacteria, viruses, fungi, algae, cyanobacteria, protozoan parasites and prions. They are extremely important as their diverse activities range from causation of deadly diseases in humans, animals and plants to production of highly useful products like antibiotics, enzymes, alcohol, fermented foods, and recycling of dead and decaying organic matter in the nature. Microbiology has contributed enormously to the growth of modern medical and health science, agriculture, environment and industry. Several discoveries in the last few decades, which significantly impact these area have put Microbiology on the center stage of teaching, research and development all over the globe.

Microbiology has applications in dairy, food manufacturing, agriculture, clinical diagnosis & health care, manufacture of various industrial bio-products, environmental clean-up etc.

B.Sc. (H) in Microbiology programme enlightens students with the evolutionary relationships between microbes and their habitats, role of microbes in maintaining health and pathogenesis of diseases, their significance in various ecosystems and environment, various aspects related to microbes viz., microbial physiology & metabolism, microbial genetics, molecular biology, immunology etc. Through the present curriculum attempt has been made to generate enough interest among students so that they can pursue higher education in Microbiology to take up the career of teaching, research or to serve the needs of medicine, agriculture, food and dairy and other related industrial establishments.

3. Programme Specific Objectives:

1. Major objectives of this program for students are:

a. **Knowledge acquisition and probing the future:** gathers in-depth knowledge of basic and applied areas of microbiology acquiring which students may opt for higher studies or join industry, academia, public health etc. and play their role as microbiologists in a useful manner contributing their role in the development and welfare of the society

b. **Core microbiology laboratory skills attainment:** understands various methods of safe handling, culturing and storage of microorganisms in the laboratory.

c. **Realization of Interdisciplinary approach of Microbiology:** becomes aware of the role of microbiology in interdisciplinary research as well as in daily life.

d. **Apprehending Environmental literacy:** develops a basic understanding of the microbiological principles that have environmental implications and gains an awareness of regulatory requirements and their compliance in biotechnology and microbiological research.

e. **Field Exposure & awareness of Ethics:** acquires an awareness of work environment through training placements, field trips, expert talks, interaction with entrepreneurs etc. and be familiarized with ethics and ethical issues in scientific research, biosafety, Intellectual Property Rights etc.

4. Programme Specific Outcomes:

A candidate who is conferred a B.Sc. (Hons) degree in microbiology needs to have acquired/developed following competencies during the programme of the study:

a. Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.

b. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.

c. Explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats, their role in these ecological niches, influence of microbiome on our health, environmental clean-up, variety of industrial product development, and their significance in human wellbeing.

d. Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, learning use of microbes as a model organisms to understand facts about living systems, analyze the genetic makeup of different types of microbes, articulate these with peers/ team members/ other stake holders through effective communication, and undertake remedial measures/ studies etc.

e. Developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal or global, economical, environmental, energy related and other problems and plan his professional career to develop innovative solutions for such problems.

5. Credit Structure of the Programme:

B.Sc. MICROBIOLOGY HONOURS STRUCTURE AND DISTRIBUTION OF COURSES						
Semester	CC Total Credits (84)	DSE Total Credits (24)	GE Total Credits (24)	SEC Total Credits (08)	AECC Total Credits (08)	Total Credits
1	MB11010 MB11020 MB11030 MB11040		MB13010 MB13020* (For non-Microbiology discipline)		EN12010 BT12010	84+ 24+ 24+ 8 +8 = 148
2	MB11050 MB11060 MB11070 MB11080		MB13030 MB13040* (For non-Microbiology discipline)		EN12020 BT12030	
3	MB11090 MB11100 MB11110 MB11120 MB11130 MB11140		MB13070 MB13080* (For non-Microbiology discipline)	MB14010 (MB14020)		
4	MB11150 MB11160 MB11170 MB11180 MB11190 MB11200		MB13090 MB13100* (For non-Microbiology discipline)	MB14030 (MB14040)		
5	MB11210 MB11220 MB11230 MB11240	MB12010 MB12020 OR MB12030 OR MB12040 MB12050 MB12060				
6	MB11250 MB11260 MB11270 MB11280	MB12070 MB12080 OR MB12090 OR MB12100 MB12110 MB12120				

- **1 Credit Theory = 1 hour; 1 Credit Practical = 2 hours**
- **CC- Core Course, GE- Generic Elective, DSE: Discipline Specific Elective, SEC- Skill Enhancement Course, AECC- Ability Enhancement Core Course**

6. Course Structure (Semester-1 & 2)

Core Course	Discipline Specific Elective	General Elective	Skill Enhancement Course	Ability Enhancement Core Course
Semester I				
MB11010 Microbial World and Principles of Microbiology MB11020 Practical I MB11030 Prokaryotic Microbes (Archaea & Bacteria): Basics and Systematics MB11040 Practical II		MB13010 Microbial World and Microbial Diversity MB13020* (For non-Microbiology discipline)		EN12010 Communication Skills I BT12010 Environmental Studies
Semester II				
MB11050 Basic Biochemistry MB11060 Practical III MB11070 Microbial techniques & Instruments MB11080 Practical IV		MB13030 Bacteriology and Virology MB13040* (For non-Microbiology discipline)		EN12020 Communication Skills II BT12030 Environmental Studies

B.Sc. Microbiology (Honours) (SEMESTER-1)

Core Courses

Course Objectives – Course Outcomes – Course Contents

MB11010 Microbial World and Principles of Microbiology		
Course Objectives: Knowledge on Landmark discoveries in Microbiology, nomenclature and classification of living organisms, physicochemical and biological characteristics of microorganisms, Familiarity with general characters of prokaryotic and Eukaryotic microorganisms, methods of studying microorganisms, practical exposure about principle, operation, applications and care of important instruments used in microbiology, preparation and sterilization of microbiological media.		
Course learning outcomes: At the conclusion of this course the students -		
Outcome 1. Have developed a good knowledge of the development of microbiology and the contributions made by prominent scientists in this field.		
Outcome 2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.		
Outcome 3. Can understand the useful and harmful activities of the microorganisms.		
Outcome 4. Can perform basic experiments to grow and study microorganisms in the laboratory.		
THEORY COURSE		
(4 Credits)		
Unit – 1	History and scope of microbiology: Germ theory of disease, Development of various microbiological techniques and golden era of microbiology. Contributions of Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff and Edward Jenner.	12 Lectures
Unit – 2	Physicochemical and biological characteristics of microorganisms (including viruses); Baltimore classification of Viruses. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. General characteristics of Cellular microorganisms, wall-less forms- mycoplasma and spheroplasts etc. with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.	15 Lectures
Unit – 3	Eukaryotic members of Microbial World: General characteristics, occurrence, structure, reproduction and importance. Beneficial and harmful microbes and their role in daily life. Concept of disease in plants and animals caused by microorganisms.	15 Lec.
Unit – 4	Overview of methods of studying microorganism: Staining techniques: basics of stains & staining process and its	18 Lecture

	understanding using simple staining and differential staining Sterilization techniques: concept physical & chemical sterilization Culture media & physical conditions influencing microbial growth. Pure culture isolation, cultivation, maintenance and preservation.	s
LAB. COURSE: MB11020: PRACTICAL-I (2 Credits)		
<ol style="list-style-type: none"> 1. Microbiology Good Laboratory Practices and Bio-safety. 2. Study of Microscope. 3. To study the principle, operation, applications and care of important instruments (autoclave, incubator, hot air oven, light microscope, pH meter, laminar airflow, Centrifuge, Colorimeter, bacteriological filter assembly) used in the microbiology laboratory. 3. Sterilization of glassware using a hot air oven. 4. Preparation and sterilization of culture media (liquid & solid) for bacterial cultivation. (Demonstration) 5. pH adjustment by Lovibond/ Hellige's comparator & pH meter 6. Study of living microorganisms from Hay Infusion by wet mount technique. 7. Study of bacterial motility by Hanging Drop Technique. 8. Measurement of dimensions of fungal structures by Ocular and stage Micrometer 9. Observation of microorganisms - bacteria, cyanobacteria, protozoa, fungi, yeasts, and algae from natural samples and permanent mount. 10. Study of common fungi, algae and protozoan using temporary/permanent mounts. 11. Determination of the presence of microflora in the environment by settle plate technique. 		
Reference Books <ol style="list-style-type: none"> 1. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004). 2. Alcomo, I . E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001). 3. Black J.G. Microbiology- Principles and Explorations. John Wiley & Sons Inc. New York, (2002). 4. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill. 5. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson 6. Eugene W. Nester, Denise G. Anderson, C. Evans Roberts, Martha T. Nester. Microbiology, a Human Perspective, 6th Edition, Mc GRAW-HILL. 7. Presscot, M.J., Harley, J.P. and Klein, D.A. Microbiology. 10th Edition WCB McGraw Hill, New York, (2002). 8. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya. 9. Patel, R. J., & Patel, R. K., (2011). Experimental Microbiology, Vol. 2, 8th ed., Aditya. 10. Cappuccino, J.G., (2016). <i>Microbiology: A Laboratory Manual</i>, 11th ed., Pearson Education (Singapore) Pvt. Ltd. 11. Aneja, K.R., (2003). <i>Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology</i>, 4th ed., New Age International Publishers. 		

MB11030 Prokaryotic Microbes (Archaea & Bacteria): Basics and Systematics

Course Objectives: This course introduces structure and structural peculiarities of bacterial cell, nutritional requirement, culture media, reproduction, logarithmic growth curve, classification, systematics and taxonomy of prokaryotes, general characteristics and phylogenetic overview of archaeobacteria, practical related to motility testing, staining bacteria and their specific structures, methods of isolation.

Course learning outcomes: After completing this course, the students can -

Outcome 1. Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages. Differentiate a large number of common bacteria by their salient characteristics.

Outcome 2. Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common chemical and physical microbial control agents.

Outcome 3. Explore microbial taxonomy and evolution—how and why microorganisms are classified using an evolutionary framework. Contrast and compare the structural differences between archaeal and eukaryotic microbes.

Outcome 4. Review archaea, which were once considered almost exclusively extremophiles and also know that they are physiologically and ecologically diverse.

**THEORY COURSE
(4 Credits)**

Unit – 1	Bacteria: Cell size, shape and arrangement, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, archaeobacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), spheroplasts, protoplasts, and L-forms. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasmic structures: Ribosomes, mesosomes, inclusion bodies, nucleoid. Endospore: Structure, formation, stages of sporulation, Capsule and Slime layer.	15 Lectures
Unit – 2	Nutritional requirements in bacteria and nutritional categories. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, enriched and enrichment media. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.	15 Lectures
Unit – 3	Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing and its importance. Differences between eubacteria and archaeobacteria.	15 Lectures

Unit – 4	General characteristics, phylogenetic overview of archaeobacteria. Introduction to Nanoarchaeota (<i>Nanoarchaeum</i>), Crenarchaeota (<i>Sulfolobus</i> , <i>Thermoproteus</i>) and Euryarchaeota [Methanogens (<i>Methanobacterium</i> , <i>Methanocaldococcus</i>), thermophiles (<i>Thermococcus</i> , <i>Pyrococcus</i> , <i>Thermoplasma</i>), and Halophiles (<i>Halobacterium</i> , <i>Halococcus</i>)].	15 Lectures
LAB. COURSE: MB11040: PRACTICAL-II (2 Credits)		
<ol style="list-style-type: none"> 1. Monochrome staining using basic stain. (Positive Staining) 2. Monochrome staining using acidic stain.(Negative Staining) 3. Gram Staining by Hucker’s Modification method 4. Acid fast staining – study using permanent slide 5. Capsule staining (Maneval’s method) 6. Endospore staining (Snyder’s modification of Dorner’s method) 7. Spirochetes staining (Fontana’s method) 8. Cell wall staining (Dyar’s method) 9. Cytoplasmic membrane staining (Ref:Aneja) 10. Metachromatic granules staining-Albert’s method 11. Isolation of pure cultures of bacteria by streaking method 12. Isolation of bacteria and estimation of CFU count by spread plate method/pour plate method. 13. Preservation of bacterial cultures by various techniques (Demonstration) 		
Reference Books <ol style="list-style-type: none"> 1. Prescott, M.J., Harley, J.P. and Klein, D. A. Microbiology. 5th Edition WCB Mc graw Hill, New York, (2002). 2. Tortora, G.J., Funke, B. R. and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004). 3. Alcomo,I. E. Fundamentals of Microbiology.VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001) 4. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002) 5. Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya. 6. Patel, R. J., & Patel, R. K., (2011). Experimental Microbiology, Vol. 2, 8th ed., Aditya. 7. Cappuccino, J.G., (2016). <i>Microbiology: A Laboratory Manual</i>, 11th ed., Pearson Education (Singapore) Pvt. Ltd. 8. Aneja, K.R., (2003). <i>Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology</i>, 4th ed., New Age International Publishers. 		