Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B++' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

(As per New Education Policy 2020)

Syllabus: MICROBIOLOGY

Name of the Course: B.Sc. I (Sem.–I & II)

(Syllabus to be implemented from June 2024)

Preamble:

The Curriculum development plays a very vital role in the development of quality of education. The education system should be such that students will be able to compete locally, regionally, nationally as well as globally. The present situation demands developing "learner-centric approach while redesigning of curriculum. There is also need to allow the flexibility in education system. The choice-based credit system (CBCS) allows students to choose inter-disciplinary, intra-disciplinary courses, skill-oriented papers and thus offers more flexibility for student. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. In view of this, PAH Solapur University, Solapur has implemented Choice Based Credit System of Evaluation at Undergraduate level. While designing the syllabus of microbiology for undergraduate course for semester I and II an attempt has been made to follow the pattern given in the UGCs Undergraduate Template. This will help to bring a match across all the Indian universities.

Introduction:

Microbiology deals with the study of microorganisms. This branch of life science has immensely grown up widening its horizons and opening new frontiers of knowledge. The scope of microbiology as a subject is immense due to its ability to control all critical points of many fields like medical, dairy, pharmaceutical, industrial, clinical, research, water industry, agriculture, nanotechnology, etc. A career in microbiology is lucrative option. There is demand of trained microbiologists in a various sectors of industries and institutes like research and development laboratories of government and private hospitals, research organizations, pharmaceutical, food, beverage and chemical industries. To cater the needs, discipline specific papers on industrial, agricultural, environmental, medical microbiology, microbial biochemistry, virology and immunology have been included in the curriculum for semester V and VI. At the same time, the frame work is so designed as to maintain standards of microbiology degree and the learning outcomes.

Learning Outcomes based approach to Curriculum Planning:

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Honours) degree in Microbiology is designed to suit the need of the hour, in keeping with the emergence of new areas of microbiology. The framework is architected to allow for flexibility in program design and course content development, while at the same time maintaining a basic uniformity in structure in comparison with other universities across the country. The program is designed to build a strong microbiology knowledge base in the student and furthermore, acquaints the students with the applied aspects of this fascinating discipline as well. The student is thus equipped to pursue higherstudies in an institution of her/his choice, and to apply the skills learnt in the programme to solvingpractical societal problems. The programme offers an elective course to the student for skill enhancement courses that prepares the student for an eventual job in academia or industry.

Programme Outcomes (POs):

PO 1. Students will have a firm foundation in the fundamentals and applications of microbial and scientific theories in microbiology.

PO 2. Students will be able to design and carry out scientific experiments as well as accurately record and analyze the data of such experiments.

PO 3. Students will develop skill in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO 4. Students will be able to explore new areas of research in both microbiology and allied fields of science and technology.

PO 5. Students will appreciate the central role of microbiology in our society and use this as a basis for ethical behavior in issues facing. microbiologist understands the importance of safe handling of b i o chemical, environmental issues and key issues facing our society in energy, health and medicine.

PO 6. Students will be able to function as a member of an interdisciplinary problem-solving team.

Programme Specific Outcomes (PSOs):

PSO1: Apply the basic knowledge of microbiology to perform various tasks assigned at the workplace.
PSO2: Undertake research activities and use modern scientific tools to analyze various topics in the research area.
PSO3: Exhibit professional work ethics and norms of scientific development.
PSO4: Understand and contribute to solve basic societal issues based on principles of scientific knowledge he/she has gained.
PSO5: Practice the art of analytical reasoning to become lifelong learner.

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SYLLABUS FOR B. Sc. – I (MICROBIOLOGY)

CHOICE BASED CREDIT SYSTEM (CBCS) SYLLABUS

Structure of the Course:

- Structure of B.Sc. course in faculty of science and Technology has total of 08 semesters for 4 years.
- B.Sc.-I comprises of total two semesters. Each semester will have **One** theory paper of 30 marks for university examination and 20 marks for internal examination for each paper.
- Practical examination will be conducted at the end of even semester of each academic year. The weightage of practical is of 60 marks for university practical examination and 40 marks for internal practical examination.
- The titles and marks distribution for each paper are as under.

Level/ Difficulty	Sem.	Faculty			Generic/ Open Elective GE/ OE (Credits)	Vocational and Skill Enhancement Courses (SEC/VSC)	Ability Enhancement Course (AEC), IKS, VEC	Field Project/ RP/CC/Internship/ App renticeship/ Community Engagement & Services	Credits	Cumulative Credits
		Major		Minor						
		DSC (Credits)	DSE							
4.5 100-200	I	**DSC1-1 (2) Basics in Microbiology (Theory)** **DSC 1 -1(2) Basics in Microbiology (Practical)**	----	------	GE 1/OE 1 (2) Human health and hygiene	**SEC1- Human health and Hygienic techniques (2)**	L1-1 (2) **IKS (2) – General IKS** VEC1 (2) (Environmental Science	-	**22**	**44**
	II	DSC1-2 (2) **Applied Microbiology (Theory)** DSC1-2 (2) **Applied Microbiology (Practical)**	----	----	GE2/ OE2(2) **Food and Dairy Microbiology**	**SEC 2- Clinical Microbiological Laboratory Techniques (2)**	L1-2 (2) VEC2 (2) (Constitution of India)	CC1 (2)	**22**	

Name of the Subject- Microbiology

Semester	Paper No.	Course code	Title of Paper	Total Lectures	Examination			Total Credits
					Univ. Exam	Internal Exam	Total Marks	
Semester I	**DSC1-1**	**G04-0106**	**Basics in Microbiology(T)**	**30**	**30**	**20**	**50**	**02**
	DSC 1-2 (2+2)		**To be selected from otherthan Microbiology (T+P)**	**60**	**60**	**40**	**100**	**04**
	DSC 1-3 (2+2)		**To be selected from otherthan Microbiology (T+P)**	**60**	**60**	**40**	**100**	**04**
	DSC 1-1	**G04-0106 (P)**	**Basics in Microbiology(P)**	**04 hr /Week /batch**	**30**	**20**	**50**	**02**
	GE 1/ OE 1	**G04-GE-106**	**Human Health and Hygiene**	**30**	**30**	**20**	**50**	**02**
	SEC 1 Microbiology	**G04-SEC-106**	**Human health and Hygienictechniques**	**04 hr /Week /batch**	**30**	**20**	**50**	**02**
	L1-1	**GO4-ENG-0106**	**English**	**30**	**30**	**20**	**50**	**02**
	IKS	**GO4-IKS-0106**		**30**	**30**	**20**	**50**	**02**
	VEC 1	**GO4-ICD-106**	**India Constitution and Democracy**	**30**	**30**	**20**	**50**	**02**
Semester II	**DSC1-2**	**G04-0206**	**Applied Microbiology (Theory)**	**30**	**30**	**20**	**50**	**02**
	DSC 1-2 (2+2)		**To be selected from otherthan Microbiology (T+P)**	**60**	**60**	**40**	**100**	**1`**
	DSC 1-3 (2+2)		**To be selected from otherthan Microbiology (T+P)**	**60**	**60**	**40**	**100**	**04**
	DSC 1-2	**G04-0206 (P)**	**Applied Microbiology(P)**	**04 hr /Week /batch**	**30**	**20**	**50**	**02**
	GE 2 /OE 2	**G04-GE-206**	**Food and Dairy Microbiology**	**30**	**30**	**20**	**50**	**02**
	SEC 2	**G04-SEC-206**	**Clinical Microbiological Laboratory Techniques**	**04 hr /Week /batch**	**30**	**20**	50	02
L	L2-	**GO4-ENG-206**	**English**	**30**	**30**	**20**	50	02
	VEC 2	**GO4-ENS-24**	**Environmental Studies**	**30**	**30**	**20**	50	02
	CC1		**NCC/NSS/Cultural/ Social/Sports**	**30**	**30**	**20**	50	02

Microbiology Practical papers is of 60 marks for university practical examination. Duration of examination will be of two day (three Hours each day). Nature of practical question paper will be as follows,

Practical Paper Microbiology-I

Q. 1. Staining Techniques : 10 marks

Q. 2. Mounting of Fungus / Media Components / Parts of Microscope : 10 marks

Q. 3. Certified Journal : 05 Marks

Q. 4. Oral : 05 Marks

Total Marks: 30 marks

Practical Paper Microbiology-II

Q. 1. Isolation of Microorganisms / Study of bacterial motility by Hanging drop technique : 10 marks

Q. 2. Biochemical tests : 10 marks

Q. 3. Certified Journal : 05 Marks

Q. 4. Oral : 05 Marks

Total Marks: 30 marks

- **Continuous Internal Assessment:**
  1) Each theory paper has 20 marks for internal examination.
  2) Each Practical paper has 20 marks for internal examination.

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SEMESTER-I
PAPER –DSC1-1: Basics in Microbiology

Learning Objectives:

1) Students will know the historical contributions of scientists for the development of subject
2) To create awareness in learners about the scope of the subject in modern era.

Course Outcome:

1) Students will know the evolution of the microbiology subject.
2) Students will understand the applied branches of microbiology and scope of microbiology.
3) Students will be able to understand diversity amongst microorganisms.
4) Understand beneficial and harmful effects of microorganisms in different fields of Microbiology

DSC 1-1 Basics in Microbiology (Total credits 2+2)		
THEORY COURSE (02credits) **Total Lectures 30L** **Total Marks 30+20** **Course code – G04-0106**		
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**History, Scope and Branches of Microbiology** **A. Historical Background:** a) Contribution of Robert Hooke, Antony Van Leuwenhoek, ErnstRuska b) Theory of spontaneous generation: Francisco Redii, John Needham, Friedrich Schroder and Van Dusch, Louis Pasteur (Swan neck flask experiment) and John Tyndall. c) Golden era of Microbiology (1857-1914) - i) Germ theory of fermentation ii) Germ theory of disease d) Contribution of Martinus Beijerinck, Sergei Winogradsky, Joseph Lister and Dmitri Ivanovski, Edward Jenner, Eli Metchnikoff, Salman Waksman, Alexander Fleming. In development of applied microbiology. B. **a) Branches of Microbiology:** (Water, Air, Agriculture, Food and Dairy, Environmental, Medical, Industrial, Geomicrobiology, SpaceMicrobiology) **b) National Institutes related to Microbiology in India–**NIV, NARI, NCCS, CCMB, Serum Institute of India, Vasantdada Sugar Institute, National Research center on Pomegranate (NRCP). IMTECH (Institute of Microbial Technology, Chandigarh), Agharkar Research Institute, Pune, NIN Hydrabad.	**15**

	Microbial Diversity **A) Concept of prokaryotic and eukaryotic cell** **B) General Characteristics of Microorganisms** i) Bacteria (Size, Shape and Arrangement) ii) *Mycoplasma* iii) *Rickettsia* iv) Actinomycetes v) Algae vi) Fungi vii) Viruses **C) Structure and Functions of Bacterial Cell:** i) Cell wall - Gram-positive and Gram-negative bacteria, spheroplast and protoplast ii) Composition and functions of Cell membrane, Mesosome, Capsule, slime layer, Flagella and Pili iii) Cytoplasm-Ribosome and nucleoid **D) Bacterial Taxonomy** - a) Basic principles of Nomenclature b) Criteria for bacterial classification and identification– Morphological, Cultural and Biochemical Characteristics.	**15 L**

References-

- Pelczar Microbiology: - Michale J. Pelczar JR, E.C.S. Chan, Noel R. Krieg Publisher: Affiliated East – West Press Edition: 5th Edition,2023 ISBN: 9788176711234
- Prescott's Microbiology; McGraw-Hill Education (Asia) Johanne M. Willey is Full Professor at the Hofstra University in Long Island, New York.
- Biology of Microorganisms – Brock, Parker, Madigan, 9th edition
- Microbiology – Prescott and Harley, 5th edition
  General microbiology – Stanier
- General microbiology – Pawar and Daginawala Vol I and II

SEMESTER I

DSC 1-1 Basics in Microbiology (Practical)
Total Credits: 2

Contact hrs: 4 hrs per week **Total Marks 30+20**
Course code – G04-0106 (P)

1. Good microbiology laboratory practices and Biosafety
2. Principle, working and applications of Common laboratory instruments -

a) Autoclave

b) Hot Air Oven

3. Principle, working and applications of Common laboratory instruments -

a) Incubator

b) Colony Counter

4. Principle, working and applications of Common laboratory instruments -

a) PH Meter

b) Laminar Air flow

c) Water Bath

5. Handling and Care of compound Microscope
6. Monochrome staining
7. Negative staining
8. Gram staining
9. Special Staining Procedures - Cell Wall (Chance's Method)
10. Special staining Procedures - Capsule (Maneval's Method)
11. Preparation of Saline and culture media a) Peptone Water b) Nutrient Broth c) Nutrient agar d) MacConkey's agar e) Starch Agar f) Milk agar g) Sabouraud's agar
12. Study of inoculation techniques – Broth, Slant, Stab, Spot.
13. Study of inoculation techniques –Spread and Streak.
14. Study of inoculation techniques –Pour plate.
15. Study of morphology of fungi by Mounting method –

(a) Aspergillus (b) *Rhizopus* (c) *Penicillium* (d) *Mucor*

OE 1: Human Health and Hygiene (Total Credits 2)

Learning Objecti- -106ves:

1) To know the concept of microbiology in health care management.

2) To identify and determine the geographical pattern of a particular disease.

Course Outcome: After completion of the course, students will learn about

1) How to diagnose the health of a community

2) Application of good hygienic practices

3) The prophylactic measures for the prevention of diseases.

OE – 1 Human health and Hygiene (Total Credits - 02)		
THEORY COURSE (02credits) **Total Lectures 30L** **Total Marks- 30+20** **Course code – G04-OE-106**		
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Unit I** **Concept of Health and health care agencies** **a. Concept of Health** Health – determinants of health, key health indicators Personal health, environmental health and public health Health Education – principles and strategies, Aims of HealthEducation, Methods of Health education, Effects of health education, levels and practices of Health Education **b. Healthcare agencies –** 1. Health policies and health organizations 2. National health Mission 3. Disaster Management – a. Containment b. Control and prevention ofepidemics and pandemics c. Acts, guidelines and role of govt. and public.	**15 L**
II	**Unit II: Concept of Hygiene and preventive measures** **a. Hygiene and Microorganisms** 1. Hygiene Indicator Microorganisms 2. Good Hygiene Practices – Reducing the spread ofInfections and Viruses 3. Normal flora of Human body and its role in Human health, 4. Community and personal Hygiene – EnvironmentalSanitation and Sanitation in public Places **b. Preventive and control measures for measures** 1) Water and food borne diseases.- Cholera, typhoid, Foodpoisoning and food infections- Introduction 2) Air borne diseases. Examples- tuberculosis, influenza 3) Vector borne diseases Examples- Dengue, malaria 4) Diseases transmitted through physical contact	**15 L**

References: -

1. Personal Health and Hygiene - Dr. Balbinder Singh
2. Gullybaba IGNOU DNHE (Latest Edition) DNHE-2 Public Health and Hygiene in English Medium.
3. Public Health and Hygiene- Dr. K. Das.
4. Human Health Safety: Prioritizing Wellness in an Evolving World- Santoshkumar D.V.
5. Public Health and Hygiene; Saras Publication V. Kumaresan, R. Sorna Raj

Semester I

SEC 1- Microbiology (2 Credits)

Human Health and Hygienic Techniques

Course code – G04-SEC-106

Contact hrs: 4 hrs per week **Total Marks 30+20**

1) Study of different disinfectants
2) Study of different collection containers.
3) Types of Clinical sample –Urine, pus, CSF, Blood, Stool and Sputum
4) Preparation of Stains and Reagents
5) Collection of clinical samples- Blood
6) Collection of clinical specimen urine/stool
7) Collection of clinical specimen pus/sputum
8) Microscopic observation of specimen urine/stool
9) Microscopic observation of specimen pus/sputum
10) Study of Micro-organisms from water by spread plate technique
11) Study of cultural characteristics of bacteria.
12) Study of Micro-organisms from skin/hand wash
13) Determination of blood group
14) Determination of potability of water by MPN of water
15) Preparation of serum/plasma

References -

1. Medical Laboratory Technology (Volume III): Procedure Manual for Routine Diagnostic Tests (INDIA HEALTHCARE ALLIED HEALTH MEDICAL TECHNOLOGY)- Kanai L Mukherjee
2. Handbook of Medical Laboratory Technology- Nanda Maheshwari
3. Medical Lab Technology- Garjeet Singh.
4. Manual of Clinical Microbiology- Patrick R Murray
5. Practical Medical Microbiology- Rajesh Bareja

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SEMESTER-II

PAPER-DSC1-2: Applied Microbiology (Total Credits 2+2)

Learning Objectives:

1. Understand the microbial content of air, water, soil and milk.
2. Study the health effects associated with air, water, soil borne microorganisms.
3. Understand the fundamental of microbiology and their importance in environmental process.
4. Study the methods and techniques used for milk, soil, air and water microbial monitoring and assessment.

Course Outcome: After completion of the course, students will be able to

1. Assess the types and role of microorganisms present in milk, air and water and sewage.
2. Analyse microbiological quality of milk, air and water.
3. Practice hygiene at individual and community level.
4. Evaluate food and milk safety and incorporate in daily life

DSC1-2 Applied Microbiology (Total Credits 2+2)		
THEORY COURSE (02 credits) **Course code – G04-0206**		**Total Lectures 30L** **Total Marks 30+20**
Unit No.	**Content of Unit**	**Lectures Allotted**
I	**Air, Water and sewage Microbiology** **A. Air Microbiology** a) Composition of air. Sources of microorganisms in air b) Definitions of Droplet, droplet nuclei, aerosols, Smog c) microbial examination of air - Liquid impingement and Solidimpaction **B. Water Microbiology:** a) Sources of Microorganisms in water b) fecal pollution of water and its indicator c) routine bacteriological analysis of water for detection and differentiation of coliforms– i) Qualitative (presumptive, confirmed and completed) and IMViCand Eijkman test ii) Quantitative Test –MPN d) Municipal water purification process: Sedimentation, Filtrationand Disinfection **C. Sewage Microbiology** : a) Definition, Types and Microflora of sewage	**15 L**

II	**Milk and Medical Microbiology** **A) Milk microbiology** a) Definition and Composition of Milk b) Sources of contamination of milk c) Microbiological examination of Milk: -DMC, SPC, MBRT test d) Pasteurization –Definition and types of pasteurization, Phosphatase test. **B) Medical Microbiology** a. Definitions: -Infection, etiology, etiological agents, disease, pathogen, opportunistic pathogen, pathogenicity, incubation period,fomite, virulence, morbidity rate, mortality rate, carriers, host, epidemiology, prophylaxis. b. Types of diseases: -Epidemic, endemic, pandemic & sporadic Types of infections: Primary, Secondary, acute, chronic, re-infection, cross-infection, Mixed infection, congenital, local, systemic and generalized Mode of transmission of diseases: 1) Inoculation 2) Ingestion 3) Contact 4) Inhalation c. Preventive and control of Microbial Diseases	**15 L**

Reference-

1. General microbiology – Pawar and Daginawala Vol I and II
2. Textbook of Microbiology by Pelczar, Tata McGraw Hill Publication.
3. Medical Microbiology – Cruickshank
4. Medical Microbiology - Davis and Dulbecco
5. Text book of Medical Microbiology – Ananthnarayan
6. Review of Medical Microbiology – Jawetz et al
7. Fundamentals of Bacteriology by A.J. Salle

SEMESTER II

DSC 1-2 Applied Microbiology (Practical)
Total Credits: 2

Course code – G04-0206 (P)

Contact hrs: 4 hrs per week **Total Marks 30+20**

1) Determination of Quality of Milk by MBRT
2) Study of colony characteristics of bacterial isolates.
3) Study of bacterial motility by Hanging drop technique
4) Isolation and identification of *E.coli* from sewage/ water sample by four quadrant method using MacConkeys Agar.
5) Isolation and identification of *E.coli* from food sample by four quadrant method using MacConkeys Agar.
6) Isolation and identification of *Bacillus spp* from soil by four quadrant method using Nutrient Agar.
7) Enumeration of bacteria in Milk sample by DMC .
8) Determination of Total viable count of bacteria in Milk sample SPC
9) Study of coliforms by IMViC test.
10) Study of sugar fermentation - Glucose, Lactose.
11) Detection of Amylase activity
12) Detection of Caseinase activity
13) Isolation of S.aureus from skin on milk agar or by Mannitol Salt Agar
14) Study of Air Microflora
15) Study of efficiency of pasteurization by phosphatase test

OE – 2: Food and Dairy Microbiology

Objectives-

1) To know the spoilage of different foods and handling of foods.
2) To study methods of food and milk preservation.
3) To learn fermented food and milk products.
4) know and study good dairy management.
5) Opportunities in food and dairy industry.

Course outcome-

After completing this course students will be able to:

CO 1- define and memorize food properties, food spoilage
CO 2- understand methods of food preservation
CO 3- Study different fermented food products and their applications.
CO 4- analyze and correlate various pasteurization methods.
CO 5 learn establishment of food and dairy industry.
CO5- know opportunities in food and dairy industry

OE – 2: Food and Dairy Microbiology		
THEORY COURSE (02credits) **Total Lectures 30L** **Total Marks30+20** **Course code – G04-OE-206**		
UNIT- I-	a) Definition of food, types of food, causes of spoilage, generalchanges caused by microorganisms. b) Spoilage of different foods c) Spoilage of milk and milk products B) Principles and methods of food preservation a) General principles of preservation of food. b) Methods of food preservation	**15 L**
UNIT-II	A) Fermented food and milk products a) Fermented food products with applications b) Fermented milk products B) Approaches in food and dairy industry. i)Establishment of standard dairy industry ii) Opportunities in food and dairy industry	**15 L**

References-

1)The Technology of Food Preservation: 4thEdi. Norman N. Potter (1987) CBS Public.
2) Milk and Milk Products: 4th Edi. Clasence Hanry. TMH Publications.
3) Food Processing: Biotechnological Applications (2000). S.S. Marwaha and Arora.Asiatech Publications, New Delhi.
4)Food Microbiology: Frazier.
5) Food Microbiology: James De and De.
6) Dairy Technology: Sukumar De. Food Science: 5th Edi, Norman N. Potter (1996).

Semester II
SEC -2- Microbiology (2 Credits)

Clinical Microbiological Laboratory Techniques

Course code – G04-SEC-206

Contact hrs.: 4 hrs. per week **Total Marks 30+20**

1) Study of blood for ESR
2) Estimation of Blood Glucose
3) Estimation of Blood urea
4) Estimation of Blood bilirubin
5) Method of culture preservation and Maintenance
6) Disposal of Laboratory waste & culture
7) Antimicrobial Susceptibility test
8) Widal test
9) Blood film Preparation and Staining (Technique of spread, types of blood film, smear preparation, types of stain)
10) Urine culture and its microbiological analysis
11) Study of Blood -Hb
12) Study of Micro-organisms from air.
13) Study of blood-WBC
14) Pregnancy test
15) Physical examination of urine sample.

References-

1. Medical Laboratory Technology (Volume III): Procedure Manual for Routine Diagnostic Tests (INDIA HEALTHCARE ALLIED HEALTH MEDICAL TECHNOLOGY)- Kanai L Mukherjee
2. Handbook of Medical Laboratory Technology- Nanda Maheshwari
3. Medical Lab Technology- Garjeet Singh.
4. Manual of Clinical Microbiology- Patrick R Murray
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