GONDWANA UNIVERSITY

GADCHIROLI

SYLLABI AND COURSE OF STUDIES IN

MICROBIOLOGY

FYUGP B.Sc.

SEMESTER I AND II

UNDER NEP 2020 PROGRAMME

SESSION 2024-ONWARDS

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Programme Name - B.Sc. Sem I
Subject – Microbiology

Sr. No.	Course Category	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Core Group Subject-I	Subject – I General Microbiology and Microbial Techniques	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		Subject - II Major subject from science	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		Practical Based on Subject - I	02	04	04	--	--	--	--	--	--	30	20	50	25	50
		Practical Based on Subject - II	02	04	04	--	--	--	--	--	--	30	20	50	25	50
2	OE (Any one form Group A)	Group-A 1. Development of Microbiology 2. Microbial world and diversity 3. Bacteriology and Virology 4. Microbial Products – Biofertilizer and Biopesticide	02	02	--	02	40	10	50	20	02	--	--	--	--	50
3	VSC	Basic Microbiology Methods	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Instrumentation in Microbiology	02	02	--	02	40	10	50	20	02	--	--	50	25	50
5	VEC	Audit Course (Any one from Annexure –V)	02	--	04	04	--	50	50	20	--	--	--	--	--	50
6	AEC	English/Marathi/Hindi/Bengali/Pali	02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	IKS	Generic IKS	02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	CC	NCC/NSS/Yoga/Sports	02	--	04	04	--	--	--	--	--	--	50	50	25	50
		Total	22	14	16	30	240	110	350	140	12	90	100	200	100	550

GONDWANA UNIVERSITY, GADCHIROLI

SCHEME AND EXAM PATTERN

Bachelor of Science (Honors/Research)
(Microbiology - Major)
FYUGP (Honors)
B.Sc. SEM I & II

- There shall be two semesters in B.Sc. Part I. Each semester comprises of theory papers, Practicals and internal assessment.
- The syllabus is based on two theory periods and four practical periods per week.
- Each theory paper divided into four units.
- **Scheme of examination:** It is divided into two parts- Internal assessment (college assessment) and external assessment (semester end examination conducted by university).

  The internal assessment marks assigned to each theory paper shall be awarded on the basis of Based on Assignment, Seminar, Unit Test & overall attendance and performance of the student

- **The Semester End Examination for Microbiology course will be as follows:**
- 40 marks Paper (External assessment- University examination)
- 10 marks (Internal assessment/College Assessment)
- 50 marks One practical course (30 marks UA and 20 marks CA)
- **Total - 100 Marks (4 credit)**
- Duration of examination for each theory paper will be 2 hours.
- The practical examination shall be of 4 hours duration for 1 days.
- Question paper will consist of five questions and each question will be of 08 marks.
- All questions will be compulsory and with internal choice.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA& CGPA

Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks -** **100** Continuous Internal Evaluation (CIE) **10** University Assessment (UA) **40** University Practical Assessment (PA) **50**		
Internal Assessment Continuous Internal Evaluation (CIE)	Class Test Attendance	05
	Assignment (Charts/Models/Seminar/Rural Service/Report of Excursion/Lab visit/Industrial visit/project or review work)	05
	Total	**10**
External Assessment Practical Exam	Experimentation, *Viva Voce,* Spotting etc. Practical Record, attendance	30 20
	Total	**50**
External Assessment University Theory Exam	Section (A) – one Long Question or four short questions	08 2X4 = 08
	Section (B) – one Long Question or four short questions	08 2X4 = 08
	Section (C) – one Long Question or four short questions	08 2X4 = 08
	Section (D) one Long Question or four short questions	08 2X4 = 08
	Section (E) – 8 Short questions	1X 8 = 08
	Total	**40**
	Gross Total	**100**

SAMPLE QUESTION PAPER PATTERN

F.Y. B.Sc. Semester I &II
MICROBIOLOGY (Major)

Time: 3 Hours **Max. Marks: 40**

Q 1 Long answer type question from Unit I 08 Marks

OR

a) Short answer type question from Unit I 2 Marks each

b) Short answer type question from Unit I

c) Short answer type question from Unit I

d) Short answer type question from Unit I

Q 2 Long answer type question from Unit II 08 Marks

OR

a) Short answer type question from Unit II 2 Marks each

b) Short answer type question from Unit II

c) Short answer type question from Unit II

d) Short answer type question from Unit II

Q 3 Long answer type question from Unit III 08 Marks

OR

a) Short answer type question from Unit III 2 Marks each

b) Short answer type question from Unit III

c) Short answer type question from Unit III

d) Short answer type question from Unit III

Q 4 Long answer type question from Unit IV 08 Marks

OR

a) Short answer type question from Unit IV 2 Marks each

b) Short answer type question from Unit IV

c) Short answer type question from Unit IV

d) Short answer type question from Unit IV

Q 5 Solve 8 questions (2 questions from each unit) 1 Marks Each

Microbiology B.Sc. I Semester – (Major)		
Credit: 2		**Total Hours:48**
Course Code – STUG01MCB01		**Marks - 40**
GENERAL MICROBIOLOGY AND MICROBIAL TECHNIQUES		
Course outcomes: Students completing this course will be able to - • Understand the Structure and function of Microorganisms • understand about structure and function of viruses • use various microbial techniques to study the microorganism • Apply the various methods of microbial control to maintain aseptic conditions.		
Unit	**Contents**	**Hrs.**
1.	**History and Development of Microbiology** History of microbiology, Contributions of Following scientists: Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Martinus W Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Elie Metchnikoff, A.M. Chakraborty, H.G. Khorana. **Theory of Abiogenesis and Biogenesis:** Experiments of F. Redi, John Needham, Spallanzani, Louis Pasteur, Schulze and Schwann, Schroder and von Dusch, and John Tyndall **Germ theory of disease** – Koch's postulates	12
2.	**Structure of Bacteria -** Concept and comparison between Prokaryotes and Eukaryotes. Typical structure of bacterial cell. **Structure and function of bacteria** – Cell wall, Plasma membrane (cytoplasmic membrane), Ribosome, Capsule, Flagella, Pili, Endospore: Structure and stages in Sporulation **Study of Virus** - Structure of viruses, Lytic cycle of T4 Phage, Lysogenic cycle of Lambda phage, Methods of cultivation of animal viruses: Animal inoculation, chick embryo method, Tissue culture technique. **General Characteristics of Archaebacteria**	12
3.	**Microscopy, Staining techniques and Microbial Nutrition** **Microscopy:** Definitions – Resolving power, Numerical Aperture. Objective lenses (low, high and oil immersion) Principle, construction and working mechanism and applications of – Bright field microscopy,Dark field microscopy, Electron Microscopy (SEM and TEM) **Staining techniques:** Definition and types of stains, Mechanism, procedure and application of Gram staining, Endospore staining, **Culture media:** Components of media, types of media - Selective media, differential media, enriched and enrichment media. **Methods of preparation of pure culture**- Streak plate method pour plate method and spread plate method. **Methods of preservation of pure culture**- Agar, slant, lyophilization, oil sealing and stock culture collection centers.	12
4.	**Microbial Control** **Definitions-** Sterilization and Disinfection, Antiseptic, Germicide, Microbiostatic, Microbicidal. **Physical** agents- i) Temperature - dry heat, moist heat, incineration. ii) Radiations: Ionizing and Non-ionizing. **Chemical agents-** i) phenol and phenolic compounds. ii) Alcohols iii) Halogens. iv) Heavy metals and their compounds v) aldehydes vi) gaseous agents vii) Quaternary ammonium compounds. Characteristics of an Ideal disinfectant, Phenol Coefficient Experiment**.**	

Books Recommended for Theory & Practical

1. General Microbiology by Hans G. Schlegel.
2. General Microbiology by R.Y. Stainer.
3. Fundamentals of Microbiology by Crabtree, & Martin Frobisher.
4. Fundamentals of Bacteriology by A. J. Salle
5. A text of Microbiology by Dubey RC and Maheswari DK (2012).
6. Geeta Sumbali and Mehrotra RS (2009). Principles of Microbiology.
7. General Microbiology volume 1 and 2 by Powar CB and Daginawala H F.
8. Microbiology by Pelczar TR M J Chan ECS and Kreig N R.
9. Robert F Boyd (1984). General microbiology.
10. Microbiology by Prescott L M, J P Harley and D A Klein.
11. Introduction to Microbiology by Ingraham J.L. and Ingrahm C.A
12. History of Microbiology & Microbiological Methods by A.B. Solunke, V.S. Hamde, R.S. Awasthi& P.R. Thorat.
13. General Microbiology by Hans G. Schlegel.
14. General Microbiology by R.Y. Stayner.
15. A text of Microbiology by Dubey R.C and Maheswari D.K.
16. Manual of Methods for Pure Culture Study by A.B. Solunke, V.S. Hamde, R.S. Awasthi& P.S. Wakte.
17. Text Book of Microbial Chemistry and Physiology by P.H.Kumbhare & V. U. Thool RajaniPrakashan, Nagpur.
18. Text Book of Applied Microbiology by P.H.Kumbhare & V.U.Thool, RajaniPrakashan, Nagpur.
19. General Virology by Luria S.E.
20. A textbook of Fungi and Viruses by Dubey H.C.
21. Introduction to Microbial Techniques by Gunasekaran
22. Elementary Microbiology Vol. I & II by Modi H.A.
23. Handbook of Media, Stain and Reagents in Microbiology by Deshmukh A.M.,
24. Biology of Microorganisms by Brock T.D. and Madigan M.T.
25. Biochemistry by J.L. Jain

Microbiology B. Sc. I (Semester – I)	
Credit: 2	**Total Hours:30**
Course Code – STUG01MCB02	**Marks - 30**
Practicals Based on Core Subject - I	

Course outcomes: Student completing this course will be able to-

- Learn about the good laboratory practices and biosafety
- Use and handle the instruments used in laboratory
- Determine the microbial techniques during the isolation and identification of microorganism from samples.

1. Microbiology Good Laboratory Practices and Biosafety
2. Staining Techniques * (a) Monochrome / Simple staining (b) Gram Staining (c) Endospore staining
3. *Study of Motility by Hanging Drop technique
4. Preparation of Culture Media: Nutrient Broth, Nutrient agar, McConkey's agar, Starch Agar, Potato Dextrose agar, Baird-Parker Agar.
5. *Demonstration of presence of Microbes and their colony characters present in Air, Skin, Soil, Teeth, and Water.
6. *Isolation of pure culture by Streak plate.
7. Isolation of pure culture by Streak Spread plate method.
8. Isolation of pure culture by pour plate methods.
9. *Enumeration of bacteria by standard plate count method (Serial Dilution Method)
10. Cultivation and Staining of Fungi.
11. *Antibiotic sensitivity test by Kirby-Bauer disc diffusion method
12. Oligodynamic action of heavy metals.

Note:

i) Minimum 4 major and 4 minor experiments are compulsory

ii) Underlined experiments are considered to be major experiments

iii) Experiments with asterisks are compulsory

iv) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained.

v) Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year.

vi) Candidates must produce their certified journals at the time of practical examinations.

vii) Duration of practical examination will be 4 hours for one day.

Distribution of marks for practical examination:

One major experiment	10 Marks
One minor experiment	05 Marks
Spotting	05 Marks
Viva-Voce	05Marks
Practical Record	05 Marks
Total	**30 marks**

Course Code - STUG01MCB03		Marks: 50
Credits: 2		**Total Hours :12**
Vocational Skill Course (VSC)		
Basic Microbiology Methods		
Objective: To make the students to understand the fundamental Practical knowledge of Microbiology		
Unit No.	**Content**	**Hrs**
1.	1. Microbiology Good Laboratory Practices and Bio-safety. 2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.	**4**
2.	1. Preparation of culture media (liquid & solid) for bacterial cultivation. 2. Handling and care of laboratory equipment - autoclave, hot air oven, incubator, and laminar airflow.	**4**
3.	1. Sterilization of media using autoclave and assessment of sterility. 2. Sterilization of glassware using hot air oven. 3. Sterilization of heat sensitive material by membrane filtration.	**4**
4.	1. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air. 2. Observation of microorganisms - bacteria, cyanobacteria protozoa, fungi, yeasts, and algae from natural habitats. 3. Study of common fungi, algae and protozoan using temporary / permanent mounts.	**4**

Microbiology B. Sc I Semester –I	
Credit: 2	**Total Hours:30**
Course Code – STUG01MCB04	**Marks - 50**
Skill Enhancement Course (SEC)	
INSTRUMENTATION IN MICROBIOLOGY LABORATORY	
Course Outcome - Study of principle and applications of important instruments	

1. Glassware used in microbiology laboratory and their use – Petri plate beakers, conical flask etc. Care and handling

2. Incubator

Principle of operation

Applications in laboratory settings for cultivating and growing microorganisms

Temperature and humidity control, and monitoring techniques

3. Hot Air Oven

Principle of operation and uniform heat distribution

Applications in laboratory settings for sterilizing glassware and heat-resistant materials

Temperature settings and monitoring procedures

4. Microscope

Introduction to different types of microscopes (light microscope, electron microscope)

Parts and functions of a microscope

5. Anaerobic Jar

Principle of creating anaerobic conditions

Applications in laboratory settings for culturing and studying anaerobic microorganisms

Assembly, maintenance, and precautions while using an anaerobic jar

6. Gel Electrophoresis

Types of gel used in electrophoresis, Gel electrophoresis procedure.

7. pH Meter

Principle of pH measurement and pH scale

Applications in laboratory settings for measuring acidity or alkalinity of solutions

Calibration, maintenance, and accurate pH measurement techniques

8. Laminar Air Flow

Principle of creating a sterile working environment

Applications in laboratory settings for aseptic handling and manipulation of samples

Proper usage, maintenance, and safety precautions while working with a laminar air flow cabinet

9. Spectrophotometer

Principle of measuring light absorption and transmission

Working and application of UV visible spectrophotometer

10. Centrifuge

Principle of centrifugation and separation of substances based on density

Applications in microbiology labs for pelleting cells, separating components, and purifying samples, Proper handling, balancing, and safety precautions while using a centrifuge.

Note - Students can be taught about general guidelines for handling laboratory instruments Safety precautions, maintenance, and troubleshooting common issues. Practical demonstrations, hands-on exercises, and case studies can be incorporated to enhance the learning experience.

OPEN ELECTIVES

Group A – Select any one form Annexure - II

Annexure - II

SN	Semester	Open Elective Paper Name	
		Group A	
1	I	Development of Microbiology	Microbial World and Diversity
		Bacteriology and Virology	Microbial product – Biofertilizer and Biopesticide

Microbiology B. Sc I Semester –I		
Credit: 2		**Total Hours:48**
Course Code – STUG01MCB06		**Marks - 50**
Open Elective (OE-1)		
DEVELOPMENT MICROBIOLOGY		
Course outcome - The course aims to provide students with a comprehensive understanding of the history, principles, and significant experiments in microbiology, allowing them to develop a solid foundation in the field and prepare them for further studies or careers in microbiology and related areas.		
Unit	**Content**	**Hrs.**
1.	**History and Development of Microbiology** • Introduction to Microbiology, Branches of microbiology, Scope of microbiology. • Controversy over spontaneous generation • Development of Microbiology with special reference to work of following scientists. Antony van Leuwenhoek, Louis Pasteur, Robert Koch, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming, Selman Waksman, Anand Mohan Chakraborty, H. G. Khorana, M S Swami Nathan.	12
2.	**Microbial Taxonomy and Classification** • General criteria used for bacterial classification, Concepts of taxa, genus, species, family, strain, order, division and kingdom. • Various approaches of bacterial taxonomy (Artificial, Natural, Evolutionary), Two kingdom (linear) system, Three kingdom (Heckel), Four kingdom (Stanley Van Neil) system and Five kingdom (Whittaker) system. **Methods of classification of bacteria** • Intuitive method, Numerical taxonomy and genetic relatedness (DNA Base composition), DNA homology, rRNA homology and sequencing method. • Bergey's manual of determinative and systemic Bacteriology (Introduction).	12
3.	**Revolutionary experiments in microbiology** • Kosch postulates • River's Postulates • Chicken cholera experiment of Louis Pasteur • Louis Pasteur's Swan-Neck Flask Experiment (1861) • Experiments of Martinus Beijerinck and Dmitry Ivanov sky in the late 19th and early 20th centuries led to the discovery of viruses. • Alexander Fleming's Penicillin Discovery (1928) • Oswald Avery, Colin MacLeod, and Maclyn McCarty's Transformation Experiment (1944)	12
4	**Archaebacteria and Eubacteria** • General Characteristics, Comparison betweenArchaebacteria and Eubacteria. • Group of Archaebacteria - i) Methanogen ii) Halophiles iii) Thermophiles • General characteristics of - i) Rickettsia ii) Chlamydia iii) Mycoplasma iv) Actinomycetes	12

Microbiology B. Sc. I Semester –I		
Credit: 2		**Total Hours:48**
Course Code – STUG01MCB07		**Marks – 50**
OPEN ELECTIVE (OE-2)		
MICROBIAL WORLD AND MICROBIAL DIVERSITY		
Course outcome - At the conclusion of this course the students - 1. Have developed a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field. 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.		
Unit	**Content**	**Hrs.**
1.	• History of microbiology and introduction to the microbial world. • Germ theory of disease, Development of various microbiological • techniques and golden era of microbiology. • Contributions of Antony von 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
2.	• Physiochemical and biological characteristics of microorganisms (including viruses); • Baltimore classification. 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 - MLO (mycoplasma and spheroplasts) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance	12
3.	• General concept of phytoplankton and zooplanktons. General characteristics, structure, mode of reproduction and economic importance of actinomycetes with special reference to its application in medicine and industry. • General characteristics, occurrence, structure, reproduction and importance of protozoa.	12
4.	• Methods of studying microorganism; Staining techniques: simple staining, Gram staining, negative staining and acid-fast staining. • Sterilization techniques (physical & chemical sterilization). Culture media & conditions for microbial growth. • Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, • maintenance and preservation of pure cultures.	12

Microbiology B. Sc I Semester –I		
Credit: 2		**Total Hours:48**
Course Code – STUG01MCB08		**Marks – 50**
OPEN ELECTIVE (OE-3)		
Bacteriology and Virology		
Course outcome - by the conclusion of this course, the students- Has acquired a fairly good understanding of the different types of bacteria and viruses. Has acquired a fairly good understanding of the structure and other salient characteristics of bacteria and viruses.		
Unit	**Content**	**Hrs.**
1.	Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall and archaeal cell wall, Structure, chemical composition and functions of bacterial and archaeal cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure, formation and stages of sporulation	12
2.	Taxonomy, nomenclature, systematics, types of classifications Morphology, ecological significance and economic importance of the following groups: Archaea: methanogens, thermophiles and halophiles Eubacteria: Gram negative and Gram-positive Gram negative:	12
3.	Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses.	12
4.	Morphological characters: Capsid symmetry and different shapes of viruses with examples Viral multiplication in the Cell: Lytic and lysogenic cycle Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses)	12

Microbiology B. Sc I Semester –I		
Credit: 2		**Total Hours:48**
Course Code – STUG01MCB09		**Marks – 50**
OPEN ELECTIVE (OE-4)		
Microbial Product – Biofertilizers and Biopesticides		
Objective: To make the students to understand the fundamental knowledge of Biofertilizers and Biopesticides.		
Unit	**Content**	**Hrs.**
1.	**Biofertilizers** A) General account of the microbes used as biofertilizers (any one) for various crop plants and their advantages over chemical fertilizers. B) Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants	12
2.	**Non-Symbiotic Nitrogen Fixers** Free living Azotobacter- free isolation, characteristics, mass inoculums, production and field application.	12
3.	**Phosphate Solubalizers** A) Phosphate solubilizing microbes (any one) - Isolation, characterization, mass inoculum production, field Application. B) Mycorrhizal Biofertilizers: Importance of Mycorrhizal inoculum, types of Mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhiza and VAM.	12
4.	**Bioinsecticides** A) General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications.	12

SEMESTER - II

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Programme Name - B.Sc. Sem-II
Subject - Microbiology

Sr. No.	Course Category	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
							Theory					Practical				
				Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1	Groups Subject-II	Subject – I Applied Microbiology	02	02	--	04	40	10	50	20	02	--	--	--	--	50
		Subject – II Any subject from science	02	02	--	04	40	10	50	20	02	--	--	--	--	50
		Practical Based on Subject - I	02	--	04	04	--	--	--	--	--	30	20	50	25	50
		Practical Based on Subject - II	02	--	04	04	--	--	--	--	--	30	20	50	25	50
2	OE	Group -A 1. Food Microbiology 2. Food Fermentation Technology	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		Group-B 1. Air, Soil and water Microbiology 2. Mushroom cultivation Tech.	02	02	--	02	40	10	50	20	02	--	--	--	--	50
3	VSC	Food Testing and Biomolecule Analysis	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	SEC	Any one from Annexure – IX Vermicomposting	02	02	--	02	40	10	50	20	02	--	--	50	25	50
5	VEC	Audit Course any one from annexure - X	02	--	04	04	--	50	50	--	--	--	--	--	--	50
6	AEC	English/Marathi/Hindi/Bengali/Pali	02	02	--	02	40	10	50	20	02	--	--	--	--	50
7	CC	NCC/NSS/Yoga/Sports	02	02	04	04	--	--	--	--	--	--	50	50	25	50
Total			22	14	16	30	240	110	350	140	12	90	110	200	100	550

Microbiology B. Sc. I Semester-II		
Course Code – STUG02MCB01		**Marks - 40**
Credits: 2		**Total Hours :48**
APPLIED MICROBIOLOGY		
Objective: To make the students to understand and aware the fundamentals of National Mission on Environmental cleanliness, health and hygiene.		
Unit No.	**Content**	**Hrs.**
1	**Air Microbiology:** a. Definition and composition of air. b. Sources of microorganisms in air. c. Enumeration of microorganisms in air: Solid and liquid impingement technique (Lemon's sampler, Anderson sampler) d. Room sterilization techniques (Radiation, Fumigation, Laminar air flow) e. Droplet, Aerosol, Droplet nuclei and Droplet infection, Air borne diseases (List with causative organisms)	**12**
2	**Water Microbiology:** a. Indicators of excretal pollution. b. Collection and handling of water sample for analysis c. Bacteriological analysis of water for coliforms (MTDT, MPN) d. Identification of faecal and non-faecal coliforms by (IMViC and Eijkmann test) e. Chlorination of water (mechanism), Different methods of Chlorination f. Water borne diseases (List with causative organisms)	**12**
3	**Sewage Microbiology** a. Definition and Types of Sewage, Composition and strength of sewage (BOD, COD, ThOD) b. Microbiology of sewage, c. General Flow Sheet of Waste Water Treatment d. Preliminary, Primary and Secondary sewage treatment methods. (Screening, Grit Removal, Septic Tank, Imhoff Tank, Trickling Filter, Activated Sludge, Oxidation Pond, Rotating Biological Contactor)	**12**
4	**Milk Microbiology** a. Definition and composition of milk, sources of contamination of milk. b. Desirable and undesirable changes in milk. c. Milk borne diseases (List with causative organisms). d. Bacteriological examination of milk by SPC, DMC, Reductase test (MBRT), checking of pasteurization of milk by phosphatase test. e. Milk products- Cheese, Yoghurt (production)	**12**

Reference books:

1. Air Microbiology An environment & Health Prospective by S.C. Aithal, P.S. Wakte & A.V. Manwar.
2. Water Microbiology by S.C. Aithal, & N. Kulkarni.
3. General Microbiology by R.Y. Stayner.
4. A text of Microbiology by Dubey RC and Maheswari DK.
5. Manual of Methods for Pure Culture Study by A.B. Solunke, V.S. Hamde, R.S. Awasthi & P.S. Wakte.
6. Text Book of Microbial Chemistry and Physiology by P.H.Kumbhare & U.V.Thool Rajani Prakashan, Nagpur.
7. Text Book of Applied Microbiology by P.H.Kumbhare & U.V.Thool, Rajani Prakashan, Nagpur.
8. General Virology by Luria S.E.
9. A textbook of Fungi and Viruses by Dubey H.C.
10. Alcamo Fundamentals of Microbiology
11. Experiments in Microbiology by Aneja K.R.
12. Introduction to Microbial Techniques by Gunasekaran,
13. Elementary Microbiology by Modi H.A.
14. Handbook of Media, Stain and Reagents in Microbiology by Deshmukh A.M.,
15. Biology of Microorganisms by Brock T.D. and Madigan M.T.
16. Biochemistry by J.L. Jain
17. Biochemistry by Zubay
18. Principles of Biochemistry by Nelson David L and Cox Michael M. Lehninger.
19. Disinfectants and Disinfection by A.G. Young
20. Filtration by F.E. Vey
21. Biological Stains By H.J. Conn.

Microbiology B. Sc I Semester –II	
Credit: 2	**Total Hours:30**
Course Code – STUG02MCB02	**Marks - 30**
Practicals Based on Core Subject – I	

1. Bacteriological examination of water for potability (MTDT)
   i) Presumptive (MPN) test
   ii)Confirmatory test
   iii) completed test;
2. Identification of Coliforms by IMViC test.
3. Determination of quality of Milk by Methylene blue reduction test.
4. Checking of Pasteurization of milk by phosphatase test.
5. Determination of BOD of water
6. Determination of DO of water
7. Determination of COD of water
8. Determination total alkalinity of water
9. Determination of residual chlorine of water
10. Determination of TDS of water
11. Isolation and study of Air micro flora
12. Visit to the water treatment plant

Note: i) Minimum 4 major and 4 minor experiments are compulsory
ii) Underlined experiments are considered to be major experiments
iii) Experiments with asterisks are compulsory
iv) Duration of practical examination will be 10 hours i.e. 5 hours each for two consecutive days.

Distribution of marks for practical examination:

One major experiment …….	8 marks
Two minor experiments 4 × 2 =	8 marks
Spotting	4 marks
Viva-Voce	5 marks
Practical Record	5 marks
Total …….	**30 marks**

Course Code - STUG02MCB03		Marks: 50
Credits: 2		Total Hours :16
Vocational Skill Course (VSC)		
Production of Biofertilizers and Biopesticides		
Objective: To make the students to understand the fundamental knowledge of Biofertilizers and Biopesticides.		
Unit No.	**Content**	**Hrs**
1.	**Biofertilizers** A) General account of the microbes used as biofertilizers (any one) for various crop plants and their advantages over chemical fertilizers. B) Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants C) Visit to the Biofertilizer industry	**4**
2.	**Non-Symbiotic Nitrogen Fixers** Free living Azotobacter- free isolation, characteristics, mass inoculums, production and field application.	**4**
3.	**Phosphate Solubalizers** A) Phosphate solubilizing microbes (any one) - Isolation, characterization, mass inoculum production, field Application. B) Mycorrhizal Biofertilizers: Importance of Mycorrhizal inoculum, types of Mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhiza and VAM.	**4**
4.	**Bioinsecticides** A) General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications.	**4**

Microbiology B. Sc I Semester –II	
Credit: 2	**Total Hours:60**
Course Code – STUG02MCB04	**Marks - 50**
Skill Enhancement Course (SEC)	
Vermicomposting	

Course outcome - By achieving these course outcomes, participants will be equipped with the knowledge and skills to implement and manage vermicomposting systems effectively. They will also understand the importance of vermicomposting in waste reduction, soil health improvement, and sustainable agricultural practices.

Unit 1: Introduction to Vermicomposting

- Definition and concept of vermicomposting
- Importance and benefits of vermicomposting in waste management and soil enrichment
- Types to earthworms used in vermicomposting (e.g., Eisenia fetida, Perionyx excavates, etc.)
- Basic characteristics of vermicomposting earthworms
- Selection and sourcing of earthworms for vermicomposting

Unit 2: Vermicomposting Process and Techniques

- Types of vermicomposting methods and detail process -Bed and Pit method, etc.
- Suitable organic waste materials for vermicomposting
- Optimization of vermicomposting conditions (e.g., moisture, temperature, pH)

Unit 3: Vermicompost Harvesting and Utilization

- Techniques for harvesting vermicompost
- Post-harvest processing and storage of Vermicompost
- Application methods and benefits of vermicompost in gardening and agriculture

Unit 4: Troubleshooting and Quality Assurance in Vermicomposting

- Common challenges and solutions in vermicomposting
- Quality parameters and testing methods for vermicompost
- Best practices for maintaining quality and consistency in vermicomposting

Additional sessions and topics can be taught, such as vermicomposting in specific settings (e.g., urban, rural), vermicompost tea production and application, vermicomposting as a business opportunity, and case studies of successful vermicomposting projects.
Practical demonstrations, hands-on activities, and field visits to vermicomposting facilities can also enhance the learning experience for participants.

Reference books

1. "Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management" by Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman. Publisher: CRC Press
2. "Vermiculture and Vermicomposting for Organic Farming" by P. P. Jadhav and S. N. Harish. Publisher: Agrotech Publishing Academy
3. "Vermicomposting: Principles, Methods, and Applications" by G. R. Pathak. Publisher: New India Publishing Agency
4. "Vermicompost: A Sustainable Organic Manure" by G. Lakshmi Prabha. Publisher: Astral International Pvt. Ltd.
5. "Vermiculture and Vermicomposting: Techniques for Sustainable Agriculture" by D. M. Pamidimarri. Publisher: Satish Serial Publishing House.

OPEN ELECTIVES

Select any one form Annexure – VII

Group A – 1. Food Microbiology
2. Food Fermentation Technology

Group B – 1. Air, Soil and Water Microbiology
2. Mushroom Cultivation Technology

Microbiology B. Sc I Semester –II		
Credit: 2		**Total Hours:32**
Course Code – STUG02MCB06		**Marks - 50**
OPEN ELECTIVE (OE)		
OE-1 - FOOD MICROBIOLOGY		
Outcomes of the course - Students should acquire the knowledge of concepts of FOOD MICROBIOLOGY. By learning these aspects students could get the idea of food content, biochemistry, spoilage and preservation food and food products.		
Unit No.	**Content**	**Hrs.**
1.	**Food and Food Contamination** • Definition and types of food, significance of microbes in food, sources of contamination in food. • Food borne diseases. • Food infection • Food intoxication, • Food poisoning (Botulism, Staphylococcus intoxication and salmonellosis)	08
2.	**Fermented Foods** • Fermented vegetables: - Pickles, sauerkraut, • Fermented fish/ meat • Fermented food: idli • fermented soy products - kinema, soy sauce • Probiotic: Concept, microorganisms used in probiotic products (list), Curd/yoghurt, • Application of probiotic food as nutraceuticals. (examples) • Concept of HACCP	08
3.	**Spoilage of Food** • Spoilage of food, types of spoilage with example. Factors affecting food spoilage in general. • Spoilage of fruits and vegetables • Spoilage of meat and meat products • Spoilage of poultry and poultry products • Spoilage of milk and milk products • Spoilage of canned food.	08
4.	• **Environmental Biotechnology** • Microbial Leaching-Bioleaching of Uranium and Copper-process and applications • Bioremediation- Acid Mine drainage, Desulfurization of coal • Biodegradation of pesticides: Xenobiotics, Plastics • Biogas plant: Construction and working mechanism • Biotransformation of Mercury • Microbial Enhanced Oil Recovery	08

Microbiology B. Sc I Semester –II		
Credit: 2		**Total Hours:32**
Course Code – STUG02MCB07		**Marks - 50**
OPEN ELECTIVE (OE)		
OE-2 - Food Fermentation Technology		
Outcomes of the course - By the conclusion of this course, the students will developed a very good understanding of practical aspects commercially produced food and fermentative products.		
Unit No.	**Content**	**Hrs.**
1.	**Fermented Foods:** Definition, types, advantages and health benefits of fermented food	08
2.	**Milk Based Fermented Foods:** Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process	08
3.	**Grain Based Fermented Foods:** Soy sauce, Bread, Idli and Dosa: Microorganisms and production process	08
4.	**Vegetable Based Fermented Foods:** Pickels, Sauerkraut: Microorganisms and production process	08

Microbiology B. Sc I Semester –II		
Credit: 2		**Marks - 50**
Course Code – STUG02MCB08		**Total Hours-32**
Open Elective (OE)		
OE-3 - AIR, SOIL AND WATER MICROBIOLOGY		
Unit No.	**Content**	**Hrs.**
1.	**Air Microbiology** • Definition and composition of air • Sources of microorganisms in air • Enumeration of microorganisms in air- Solid and liquid impingements technique (Lemon's sampler Anderson's sampler) • Room sterilization techniques- radiation, fumigation and laminar air flow. • Droplet, aerosol, droplet nuclei and droplet infection, • Air borne diseases (list with causative organisms)	08
2.	**Soil Microbiology** • Composition of soil and types of soil • Humus formation (nature and characteristics and function) • Compost – aerobic and anaerobic methods of composting • Elemental cycles – Carbon Nitrogen, sulphur and phosphorus. • Microbial Association: a) Positive and Negative Microbial associations with examples -Symbiosis, Syntrophic, Synergism, Commensalism, Parasitism, Competition, Antibiosis. • Biological Nitrogen fixation - Nitrogen fixing bacteria, Symbiotic and non-symbiotic nitrogen fixation (in detail), Process of nodulation in legume, Nitrogenase complex, Nif gene.	08
3.	**Water Microbiology** • Indicators of excretal pollution • Collection and handling of water sample for analysis • Bacteriological analysis of water for coliform (MTDT, MPN) • Identification of fecal coliforms and non-fecal coliforms by (IMViC and Eijkman test) • Chlorination of water- mechanism of chlorination, different methods of chlorination • Water borne diseases (list with causative organisms)	08
4.	**Sewage of Microbiology** • Definition and types of sewage, composition and strength of sewage (BOD, COD, ThOD) • Microbiology of sewage • General flow sheet of waste water treatment • Preliminary, primary and secondary sewage treatment methods - (screening, grit removal septic tanks Imhoff's tank, trickling filter, activated sludge, oxidation pond, rotating biological control).	08

Microbiology B. Sc I Semester –II		
Credit: 2		**Marks - 50**
Course Code – STUG02MCB09		**Total Hours-32**
Open Elective (OE)		
OE-4 – Mushroom Cultivation Technology		
Unit No.	**Content**	**Hrs.**
1.	Introduction**:** Morphology, Classification and identification of edible & non-edible/poisonous mushroom. Nutritional and Medicinal value of mushroom, Scope of mushroom cultivation.	08
2.	Structure & Life cycle: Button mushroom (Agaricus bisporus), Milky mushroom (Calocybeindica), Oyster mushroom (Pleurotus sajor caju) and paddy straw mushroom (Volvariellavolvcea). Breeding and genetic improvement of mushroom strains.	08
3.	Principles & Requisites**:** Sterilization and disinfections of substrates, Pasteurization of different substrates, Isolation, growth media, Spawns production and their maintenance.	08
4.	Techniques of Cultivation: Structure and construction of mushroom house, layout of Traditional and Greenhouse method. Multiplication of spawn, Composting, bed and polythene bag preparation, spawning - casing – cropping	08