પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગતનો માઈક્રોબાયોલોજી વિષયનો (બી.એસ.સી. વિથ ઓનર્સ) નો સેમેસ્ટર-૧ (શિક્ષણ વિભાગની SOP પ્રામાણેની પેપર સ્ટાઈલ સાથે), સેમેસ્ટર-૨ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૩થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

Bhakta Kavi Narsinh Mehta University Junagadh.

08/01/2024

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૧૮૪/૨૦૨૪
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૦૮/૦૧/૨૦૨૪

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાનાઃ-

- માન.કુલપતિશ્રી/કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થેઃ

- સીસ્ટમ મેનેજરશ્રી, આઇ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)

Bhakta Kavi Narsinh Mehta University
Junagadh

BOARD OF LIFE SCIENCE
FACULTY OF SCIENCE
SYLLABUS FOR
BACHELOR OF SCIENCE (HONOURS) PROGRAMME
(SEMESTER- I & II)
EFFECTIVE FROM JUNE, 2023

Bhakta Kavi Narsinh Mehta University
Syllabus of Bachelor of Science (B.Sc.) as per NEP
Effective from June 2023
Subject: B.Sc. MICROBIOLOGY

Preamble

Microbiology is the study of microorganisms or microbes such bacteria, viruses, fungi, algae, cyanobacteria, protozoa 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. Thus, the microbiology has an important role to play crucial role in agriculture, health, environment and industry sector. Therefore, microbiology has been holding the central position in the curriculum of these subjects. Several discoveries in the last two to three decades, which significantly impact this area have put Microbiology on the centre stage of teaching, research and development all over the globe.

The Choice Based Credit System (CBCS) curriculum for Microbiology at the undergraduate level has now been developed into a new system called Learning Outcome Curriculum Framework (LOCF) under the recommendations and guidance of University Grants Commission (UGC). The LOCF approach first envisioned the programme learning outcomes of the B.Sc (Hons) program in Microbiology. The curriculum was then developed in tune with the learning outcomes. It is envisaged that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology.

As per the NEP -2020 and UGC guidelines, a student must be offered the latest courses contains diverse nature with societal, environmental, and economic implications. The curriculum should offer multiple entry-exit and a choice of vast subjects to select from to a student to facilitate his learning abilities, aptitude, and inclination. The NEP syllabus has been formulated by combined efforts by all the members of microbiology board of study of the Bhakta Kavi Narsinh Mehta University.

The proposed curriculum for the subject of Microbiology requires the following criteria to be considered.

- The curriculum is as per the NEP, UGC and state government recommendation
- Regional needs and Present National and International trends in the subject
- Relationship with other related subjects and resources of educational needs.
- Geographical parameters of the University and its demographic property

The curriculum is designed per the guidelines of UGC, NEP-2020, and state government which reflects the courses total credit, teaching hours, and question paper style. The syllabus units are formulated very precisely which provides the description, objectives, and outcomes of the course is given in detail. A list of reference books is provided at the end of each course. The following objectives have been considered while formulation the curriculum:

1. To provide an updated, feasible, and modern syllabus to the students, emphasizing knowledge and skill to build up their valuable college education and job-oriented carrier.
2. To frame the syllabus in accordance with the semester system and UGC – NEP 2020 guidelines and in consultation with all stakeholders.
3. To offer the students an array of Core, Interdisciplinary, Skill enhancement, Ability enhancement and Value-added courses to select from and to facilitate his academic, intellectual and social grooming.

The Board of Studies for Microbiology expresses heartfelt gratitude to the chairman and members of Board of Studies, Bhakta Kavi Narsinh Mehta University, for valuable guidance and the Academic Section for valuable support.

Bhakta Kavi Narsinh Mehta University
Syllabus of Bachelor of Science (B.Sc.) as per NEP
Effective from June 2023
Subject: B.Sc. MICROBIOLOGY

BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUANAGADH
B.Sc. (Honours) / B.Sc. (Honours with Research) MICROBIOLOGY PROGRAMME
Curriculum Framework & Syllabus for A. Y. 2023-2024

ELIGIBILITY

A candidate who has passed the Higher Secondary Certificate (10+2) examination with Science subjects in respective streams of Gujarat State or any other examination recognized as equivalent to that with a good academic record shall be eligible for admission, subject to such other conditions prescribed by the University and State Government from time to time.

DURATION OF THE PROGRAMME

The program shall extend over three / four years, comprising six / eight semesters for the fresh entrants. For lateral entrants, it shall of two / three years, comprised of four / six semesters. The program comprises two semesters in one academic year, wherein each semester will usually be of 15 weeks or at least 90 teaching days.

PROGRAM LEARNING OUTCOME BASED COURSE

The National Higher Education Qualifications Framework (NHEQF) envisages that students must possess the quality and characteristics of the Graduate of a program of study, including learning outcomes relating to the disciplinary area(s) in the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the program (s) of study. It focuses on measuring students' performance, i.e., outcomes at different levels.

STRUCTURE OF THE PROGRAMME

UG program shall have a curriculum comprising theory and practical (separate/inbuilt with theory) courses with a specified syllabus. The curriculum of the program is a blend of Language Courses, Core Courses, Interdisciplinary Courses (IDC), Discipline Specific Electives (DSE), Trans-disciplinary Electives (TDE), and Ability Enhancement Courses (AEC).

MEDIUM OF INSTRUCTION AND EXAMINATIONS

The medium of instruction and examinations shall be English, except for courses in Languages other than English.

EVALUATION

The evaluation shall generally comprise Internal Assessment (IA) and External Assessment (ExA) with percentage weightage as specified below.

Components	**Internal Assessment (CIA)**	**External Assessment (ExA)**
Theory Courses	50 %	50 %
Practical Courses	50 %	50 %

GENERAL INSTRUCTIONS

- The Medium of Instruction will be English for all Theory and Practical courses.
- Each semester consists of 15 weeks, 1 credit = 1 lecture/week for theory courses
- Each Lecture will be 50 Mins. (1 lecture = 50 Mins).
- In a semester of 15 weeks, 1 credit = 2 hours/week for practical courses
- Each Semester's Theory course will be of FOUR Units. There will be 45 hrs. of Theory teaching / Course/ Semester and 30 hrs. Practical/ Course/ Semester.
- Each Theory course / Semester will be of 75 Marks. There will be 25 marks for internal evaluation and 50 marks for external evaluation. Each Practical course / Semester will be 25 Marks, and internal evaluation.

INSTRUCTIONS TO THE CANDIDATES FOR PRACTICAL EXAMINATION

- The practical examination will be conducted for one (01) day.
- The time duration of the practical examination will be Three (03) hrs.
- All the students must remain at the examination center 15 minutes before the scheduled time.
- Students must a maintain journal and certified journal before examination, ID card or examination receipt, Slide box, Apron, and all other requirements for examination.
- Candidates should not leave the laboratory without permission of the examiner.
- The use of a calculator is allowed, but the use of Mobile phones is strictly prohibited.
- The candidate can leave the laboratory only after submitting all the answer sheets to the examiner.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY, JUANAGADH
B.Sc. (Honours) / B.Sc. (Honours with Research) MICROBIOLOGY PROGRAMME
Curriculum Framework & Syllabus
Effective from June 2023-2024

OBJECTIVES OF THE PROGRAMME

The curriculum is designed to attain the following learning goals, which students shall accomplish by the time of their graduation:

1. This program shall enable students to understand the basics of Microbiology and its scope.
2. Students will learn about various microorganisms, their distinguishing features, characteristic properties, and their place in the world.
3. The program will impart a detailed understanding of the allied fields of Microbiology, like Cell Biology, Metabolism, Immunology, applied microbiology, Bioprocess Technology, and Molecular Biology, to enable them to understand the emerging and advanced concepts in modern biology and help them to take up a career in this field.
4. After completing the program, the students will be able to acquire the necessary knowledge and skill in Microbiology to undertake higher studies in recognized Institutions of advanced learning and engage in gainful self-employment.
5. The program shall facilitate students to be innovative and to develop versatile personalities in the field of Life Science with quality education and can be skilled human resources required in academic research, industrial development, Institutions of Higher Learning, and Industry.

GRADUATE ATTRIBUTES

Graduates should be able to demonstrate the acquisition of the following:

- **Academic excellence**: Comprehensive knowledge and coherent understanding of Microbiology and
- other interdisciplinary areas of study
- **Practical, professional, and procedural knowledge** required for carrying out professional or highly skilled work/tasks related to Microbiology, including knowledge required for undertaking self-employment initiatives and knowledge and mindset required for entrepreneurship, improved product development, or a new mode of organization
- **Critical and Analytical reasoning/thinking and Effective communications**: Analysis and evaluation of information to form a judgment about a subject or idea and ability to communicate the same in a structured form.
- **Research-related skills**: the ability to understand basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.
- **Leadership qualities and Teamwork abilities:** The graduates should be able to demonstrate the capability for mapping out the tasks of a team and setting direction and inspiring vision, and building a team that can help achieve the goals
- **Global Citizenship**: Mutual understanding with others from diverse cultures, perspectives, and backgrounds by embracing and practicing constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, and scientific temper.
- **Life Long Learning**: Ready to imbibe new knowledge, values, and skills with an open mind and willing to adopt change for constructive development.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

This program will produce Graduates who will attain the following PEOs after a few years.		
PEO 1	**:**	**Core subject competency:** will acquire the competency to pursue higher education, develop a professional career, or be self-employed with the knowledge and skills of Microbiology and allied sciences.
PEO 2	**:**	**Application of knowledge**: will show the ability to apply the knowledge of Microbiology to independently design and execute minor research problems for societal and human welfare.
PEO 3	**:**	**Overall Preparedness: I** will have the ability to undertake any assignment as a leader or team member and will be able to contribute to academics, entrepreneurship, and research, with good communication skills.
PEO 4	**:**	**Professionalism:** will possess strong professional ethics to fulfill moral duties towards his profession, community, society, and the nation.
PEO 5	**:**	**Learning environment:** will show readiness for lifelong learning to meet personal, professional, social, and global demands through knowledge and skills.

PROGRAM OUTCOMES:

After completion of the B.Sc. Microbiology program, the Graduate will be able to:		
PO 1	**:**	**Specific Disciplinary knowledge:** Demonstrate an understanding of fundamental principles, scope, and applications of Microbiology and can appreciate the beneficial and harmful role of microorganisms
PO 2	**:**	**Problem analysis:** Accurately identify and critically analyze problems in various domains of Biological sciences.
PO 3	**:**	**Designing viable solutions:** Search for and successfully arrive at viable conclusions/solutions about various aspects of life sciences using the right approach and appropriate tools and techniques
PO 4	**:**	**Scientific aptitude:** Ability to solve local, regional, national, or global problems scientifically using logical thinking and advanced techniques.
PO 5	**:**	**Modern tool usage:** Understand standard operating procedures and safety measures and acquire in-depth technical competence to handle the basic laboratory instruments and retrieve scientific information with modern data search tools.
PO 6	**:**	**Global citizen:** Demonstrate the ability to understand the needs of changing world from a Microbiology perspective and with an insight into his constructive role for the societal benefits honestly and consistently with a strong sense of ethics and values.
PO 7	**:**	**Environment and sustainability:** Can be an ambassador for Environmental protection and advocate for the need to advocate for sustainable development.
PO 8	**:**	**Ethics:** Commitment to professional and social ethics and work accordingly
PO 9	**:**	**Individual and team work:** Exhibit the potential to effectively accomplish tasks as a leader or a member of a team as well as independently in multidisciplinary settings.
PO 10	**:**	**Communication:** Possess practical Communicate skills in spoken and written forms for practical idea sharing with the scientific community, society, and colleagues.
PO 11	**:**	**Scientific Innovations and fund management:** Ability to design a research project and manage its execution to generate new scientific insights, innovations, and revenues with proper time and fund management.
PO 12	**:**	**Life-long learning:** Ready to undertake life-long learning to periodically update scientific knowledge and its application.

PROGRAM SPECIFIC OUTCOMES (PSOs) for B. Sc. Microbiology program

After completion of the program, the Graduate will:		
PSO1	**:**	Acquire sound knowledge about the fundamentals of Microbiology to develop a solid base to enable the understanding of emerging and advanced concepts in life sciences.
PSO2	**:**	Be equipped with knowledge, skill, and inspiration to pursue higher education and research in Microbiology and allied fields to answer urgent global problems.
PSO3	**:**	Use Microbiology principles and applications to find innovative solutions for environment, agriculture, and health-related issues at local and global levels.
PSO4	**:**	Acquire the skill and the required knowledge to be an entrepreneur/self-employed and serve the scientific community and society by generating problem solutions and employment.
PSO5	**:**	Become competent and eligible to appear in various competitive exams, placement in government and private sectors of academia, research, and industries, and become a successful Microbiologist serving the Nation.

Bhakta Kavi Narsinh Mehta University
Syllabus of Bachelor of Science (B.Sc.) as per NEP
Effective from June 2023
Subject: B.Sc. MICROBIOLOGY

Curriculum Framework
NEP- Level 4.5: B.Sc. Semester I (Certificate in Sciences)

Sr. No	Course Group	Course (Paper) Title	Paper No.	Credit	Total Credits	Teaching Hours	Internal Marks	External Marks	Practical internal Marks	Practical external Marks	Total Marks	Total Marks
1	MAJOR	Basics of Microbiology (Theory)	MAJM BT101	3	4	45	25	50	-	-	75	100
2	MAJOR	Basics of Microbiology (Practical)	MAJM BP101	1		30	-	-	25	-	25	
3	MAJOR	Principles of Microbiology (Theory)	MAJMBT202	3	4	45	25	50	-	-	75	100
4	MAJOR	Principles of Microbiology (Practical)	MAJM BP202	1		30	-	-	25	-	25	
5	MINOR	Basics of Microbiology (Theory)	MINM BT101	3	4	45	25	50	-	-	75	100
6	MINOR	Basics of Microbiology (Practical)	MINM BP101	1		30	-	-	25	-	25	
7	MDC/IDC	Microbiology in Everyday Life (Theory)	IDCM BT101	3	4	45	25	50	-	-	75	100
8	MDC/IDC	Microbiology in Everyday Life (Practical)	IDCM BP101	1		30	-	-	25	-	25	
9	SEC	Mushroom Cultivation	SECM BP101	2	2	45	-	-	25	25	50	50
Total					**18**	**330**	**125**	**225**	**100**		**450**	

Abbreviation: Interdisciplinary courses (IDC); SEC (Skills Enhancement Course);

* Any one course is to be selected as **Minor course** as per the expertise and resources available in the College.

** University will prepare a basket of **Interdisciplinary courses (IDC),** from which the college/department shall select the one for which the expertise and resources are available in the college.

SKELETON OF THEORY EXAMINATION (EXTERNAL)

SEMESTER – I and II

Time: 2 Hours **Total Marks: 50**

Instructions:

1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

QUESTION-1: (From UNIT-1) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

OR

QUESTION-1: (From UNIT-1) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

QUESTION-2: (From UNIT-2) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

OR

QUESTION-2: (From UNIT-2) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

QUESTION-3: (From UNIT-3) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

OR

QUESTION-3: (From UNIT-3) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

QUESTION-4: (From UNIT-4) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

OR

QUESTION-4: (From UNIT-4) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

QUESTION-5: (From UNIT-1 and UNIT-2) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

OR

QUESTION-5: (From UNIT-3 and UNIT-4) (10 Marks)
(1)…….. (05)
(2)……..……..(05)

SKELETON OF PRACTICAL EXAMINATION (INTERNAL)

SEMESTER – I and II

INTERNAL EVALUATION SCHEME			
INTERNAL ASSESSMENT			
No.	**Particulars**	**Marks**	**Weightage**
1	Internal Test	25	15
2	Assignment		05
3	Attendance		05
	Total		25

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	**Particulars**	**Weightage**
1	Practical Performance	15
2	Viva	10
	Total	25

Paper Style: External

ASSESSMENT BY UNIVERSITY		
Que. No.	**Particulars**	**Marks**
SECTION-1 EXAMINER EXTERNAL		
1	Perform any one from the given list of exercises as per the instruction of the examiner exercise	**15**
2	Viva-voce	**10**

LIST OF INSTRUMENTS FOR MICROBIOLOGY LABORATORY
SEMESTERS I AND II

Listed instruments is necessary for the suggested B Sc. programmed moreover the institute/collage is also procuring necessary instrument as per the multidisciplinary and skill-based courses for the B. Sc. programme.

No.	Name of Instrument	No.	Name of Instrument
1	Compound Microscopes	**14**	Bunsen burner
2	Autoclave	**15**	Micrometer (stage and ocular)
3	Incubator	**16**	Colorimeter
4	Hot air oven	**17**	Membrane filter set
5	Vortex mixer	**18**	Centrifuge
6	Water bath	**19**	Electronic shaker Incubator
7	Heating mantle	**20**	Electronic Analytical Balance
8	Magnetic stirrer	**21**	Double-pan Analytical Balance
9	UV chamber	**22**	Spectrophotometer
10	Inoculation chamber	**23**	Computers
11	pH meter	**24**	Water distillation system
12	Colony counter	**25**	Hemocytometers
13	Refrigerator	**26**	Inspissator

Course Level	U.G		**Teaching Hours**	45
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	I		**External Marks**	50
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Basics of Microbiology		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MAJMBT101		**Practical Exam Duration**	00

Course Description:
Microbiology is a branch of science that deals with the study of microorganisms. The course will discuss microbiology's basic concepts, including the scope, history, groups, and places of microorganisms in the living world. General characteristics including structure mode of reproduction and economic importance of organism have been covered in the course. Moreover, the nutritional requirement, environmental conditions have also been part in the course.

Course objectives:
After completing this course, the student should be able to:

- Identify the significant contributions of the early scientists and the historical milestones that laid the groundwork for modern microbiology.
- Understand the characteristics of major groups of microorganisms.
- Understand the organism's classification systems.
- Understand the general characteristics of microorganism and its economic importance.
- Identify, discuss, and illustrate morphological features of the bacterial cell and its organelles.
- Understand the reproductive system nutritional requirements of microbes.

Course outcomes: Upon completion of this course, the learner will be able to:
Course outcomes: Upon completion of this course, the learner will be able to:

- Understand the scope and History of Microbiology and recognize the contributions made by prominent scientists in this field.
- 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.
- Understand the mode of reproduction and economic important of organisms.
- Able to understand nutritional requirement and physical conditions of organisms.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**SCOPE AND HISTORY OF MICROBIOLOGY** • Microbiology as a field of Biology • The Place of Microorganisms in the living world • Introduction to Groups of Microorganisms • Distribution of Microorganisms in Nature	**12**

	• Applied areas of Microbiology • Spontaneous generation versus Biogenesis • Germ Theory of disease • Eminent scientists of Microbiology: • Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Paul Ehrlich, and Edward Jenner.	
Unit 2.	**CLASSIFICATION OF MICROORGANISMS** • 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**
Unit 3.	**CHARACTERISTICS AND IMPORTANCE OF ORGANISMS** • General concept of phytoplanktons 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**
Unit -4.	**MICROBIAL NUTRITION** • Nutritional requirements of bacteria • Nutritional types of bacteria • Bacteriological media and their types • Physical conditions required for growth • Gaseous requirements and oxygen toxicity • Selective methods • Cultural characteristics	**10**

Reference Books

1. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
2. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
3. Modi, H.A. Elementary Microbiology - Vol –I & II, Akta Prakashan, Nadiyad.
4. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.
5. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
6. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
7. Stanier, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5 Edition. MacMillan Press Ltd., London.
8. Frobisher M., Hinsdill, Crabtree and Goodherat Fundamentals of Microbiology, Edition. W.B Saunders Co. USA.
9. Mani, A., Selwaraj, A.M., Narayanan L.M., and Arumngam, N., Microbiology, Saras Publication, Delhi

Suggested Online E-resources

https://onlinecourses.swayam2.ac.in/cec23_bt14/preview

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	-
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Basic of Microbiology (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MAJMBP101		**Practical Exam Duration**	3:00 Hrs.

Course Description:

This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Techniques of isolation and purification of bacterial culture and Preservation of microbial culture, along with the operation and use of basic instruments, will help students to carry out advanced practicals in the next semesters.

Course Objective:

The course aims to provide a basic understanding of microbiology, microbial techniques and instrument operations. The course is designed so that learners can understand the Good laboratory practices, basic instrumentation needed for conducting experiments in a Microbiology laboratory, simple techniques of observation and study of microbial morphology and cellular structure, methods of microbial control, etc., in detail. This course will make students skillful in isolating and purifying a bacterial culture, measuring microbial growth, and interpreting different microbes' cultural characteristics and growth patterns. Further, it will also facilitate students to understand which method to choose for effective control of microbial growth.

Course Outcomes Statement

- Understand the operation of various basic instruments in a Microbiology Laboratory.
- Comprehend the principle and procedure of various types of staining techniques.
- Analyse growth requirements and media selection for isolating specific microbes
- Learn & Apply techniques of microbial isolation, purification, and growth measurement.
- Learn & apply the methods of microbial control

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Microbiology Good Laboratory Practices and Bio-safety	**30**
2	Principles, working, and uses of the following laboratory instruments: (a) Microscope|, (b) Incubator, (c) pH meter, (d) Refrigerator, (e) Colorimeter (f) Colony counter	
3	Principles, working, and uses of the following sterilizers: (a) Autoclave, (b)Hot air oven, (c) Steam sterilizer, (d) Inspissator, (e) Bacteriological filters.	
4	Preparation of glassware for sterilization and disposal of laboratory media and cultures.	

5	Sterilization of heat sensitive material by membrane filtration.	
6	Preparation of Stains and Staining Reagents.	
7	Study of Permanent Slides of Bacteria, Fungi, Algae, and Protozoa.	
8	Study of bacterial motility by hanging drop method.	
9	Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.	

Practical Reference Books

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

Course Level	U.G		**Teaching Hours**	45
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	I		**External Marks**	50
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Principles of Microbiology		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MAJMBT102		**Practical Exam Duration**	-

Course Description:
The course will discuss microbiology basic concepts including structure and function, microscopic and staining techniques which covers the uses of microscope and examination cells for study the cell morphology, shape and size. Function and the structure of cell and growth pattern of bacteria have also been covered in the course.

Course objectives:
After completing this course, the student should be able to:
- Explain the fundamentals of microscopy and staining technique.
- Understand the characteristics of prokaryotic cells and eukaryotic cells.
- Identify, discuss, and illustrate morphological features of the bacterial cell and its organelles.
- Explain the principle and the techniques of microbial cultivation.
- Comprehend various phases of the bacterial lifecycle and the techniques of its measurement.
- Know the methods of pure culture and preservation of culture.

Course outcomes: Upon completion of this course, the learner will be able to:

- Understand the structure and function of prokaryotic organism.
- Use the knowledge of staining techniques and microscopes in microscopic examination.
- Describe characteristics of bacterial cells, cell organelles, cell wall composition
- and various appendages like capsules, flagella or pili.
- Describe the concepts of sterilization, bacteria identification, pure culture and preservation of organisms.
- Understand the growth pattern of bacteria.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**PROKARYOTIC CELL: STRUCTURE AND FUNCTION** • Size, Shape and Arrangement of Bacteria • Bacterial Structures – External to Cell Wall: Capsule, Flagella, Pili, Prostheca, Sheath & Stalk • The cell wall of Bacteria – Structure and chemical composition of Gram negative and Gram positive Bacterial cell wall • Bacterial Structures – Internal to Cell Wall: Cell Membrane, Protoplast, Spheroplast, Membranous intrusions and intracellular membrane system, Cytoplasm, Cytoplasmic inclusions and Vacuoles, Nuclear Material	**12**

	• Bacterial Spores and Cyst – Types of spores, Structure, and formation of Endospores (Sporogenesis).	
Unit 2.	**MICROSCOPY AND SPECIMEN PREPARATION** • Bright field Microscopy – Principle, Construction and Working • Dark field Microscopy - Principle, Construction and Working • Fluorescent Microscopy - Principle, Construction and Working • Phase Contrast Microscopy - Principle, Construction and Working • Electron Microscopy – Types, working and Limitations • Introduction to Confocal Microscopy • Introduction to Stains, Mordents, Decolorizers and Fixatives • Preparations for Light Microscope Examinations.	**12**
Unit 3.	**STAINING AND CULTURE TECHNIQUES IN MIROBIOLOGY** • 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**
Unit -4.	**MICROBIAL GROWTH** • Reproduction of Bacteria: Modes of cell division and new cell formation • Growth of Bacteria: Generation time, Growth rate • Bacterial Growth Curve • Synchronous growth and Continuous culture of Bacteria	**10**

Reference Books

1. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
2. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
3. Modi, H.A. Elementary Microbiology - Vol –I & II, Akta Prakashan, Nadiyad.
4. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.
5. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
6. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
7. Stanier, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5 Edition. MacMillan Press Ltd., London.
8. Frobisher M., Hinsdill, Crabtree and Goodherat Fundamentals of Microbiology, Edition. W.B Saunders Co. USA.
9. Mani, A., Selwaraj, A.M., Narayanan L.M., and Arumngam, N., Microbiology, Saras Publication, Delhi

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	-
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Principles of Microbiology (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MAJMBP102		**Practical Exam Duration**	3:00 Hrs.

Course Description:

This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Techniques of isolation and purification of bacterial culture and Preservation of microbial culture, along with the operation and use of basic instruments, will help students to carry out advanced practicals in the next semesters.

Course Objective:

The course aims to provide a basic understanding of microbiology, microbial techniques and instrument operations. The course is designed so that learners can understand the Good laboratory practices, basic instrumentation needed for conducting experiments in a Microbiology laboratory, simple techniques of observation and study of microbial morphology and cellular structure, methods of microbial control, etc., in detail. This course will make students skillful in isolating and purifying a bacterial culture, measuring microbial growth, and interpreting different microbes' cultural characteristics and growth patterns. Further, it will also facilitate students to understand which method to choose for effective control of microbial growth.

Course Outcomes

- Understand the operation of various basic instruments in a Microbiology Laboratory.
- Comprehend the principle and procedure of various types of staining techniques.
- Analyse growth requirements and media selection for isolating specific microbes
- Learn & Apply techniques of microbial isolation, purification, and preservation of microbes.
- Learn & apply the methods for microbial growth

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Demonstration and handling of microscope.	**30**
2	Monochrome Staining: (a) Negative Staining, (b) Positive Staining	
3	Differential Staining: Gram's Staining	
4	Special staining of bacteria: (a) Capsule staining – Hiss's method, (b) Cell wall staining – Webb's method (c) Spore staining – Schaeffer's method, (d) Metachromatic granule staining – Albert's method, (e) Spirochete staining – Harrie's method	
5	Isolation of bacteria by streak plate/pour plate and spread plate technique	

6	Study of liquid/solidified culture media	
7	Isolation of pure cultures of bacteria by streaking method.	
8	Preservation of bacterial cultures by various techniques.	
9	Growth curve of Bacteria by colorimetric method and determination of Generation time and the growth rate of *E. coli* by colorimetric method.	

Practical Reference Books

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

Course Level	U.G		**Teaching Hours**	45
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	I		**External Marks**	50
Course Type	MINOR		**Practical Marks (Int)**	25
Course title	Basics of Microbiology		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MINMBT101		**Practical Exam Duration**	-

Course Description:

Microbiology is a branch of science that deals with the study of microorganisms. The course will discuss microbiology's basic concepts, including the scope, history, groups, and places of microorganisms in the living world. General characteristics including structure mode of reproduction and economic importance of organism have been covered in the course. Moreover, the nutritional requirement, environmental conditions have also been part in the course.

Course objectives:
After completing this course, the student should be able to:

- Identify the significant contributions of the early scientists and the historical milestones that laid the groundwork for modern microbiology.
- Understand the characteristics of major groups of microorganisms.
- Understand the organism's classification systems.
- Understand the general characteristics of microorganism and its economic importance.
- Identify, discuss, and illustrate morphological features of the bacterial cell and its organelles.
- Understand the reproductive system nutritional requirements of microbes.

Course outcomes: Upon completion of this course, the learner will be able to:

- Understand the scope and History of Microbiology and recognize the contributions made by prominent scientists in this field.
- 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.
- Understand the mode of reproduction and economic important of organisms.
- Able to understand nutritional requirement and physical conditions of organisms.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**SCOPE AND HISTORY OF MICROBIOLOGY** • Microbiology as a field of Biology • The Place of Microorganisms in the living world • Introduction to Groups of Microorganisms • Distribution of Microorganisms in Nature	**12**

	• Applied areas of Microbiology • Spontaneous generation versus Biogenesis • Germ Theory of disease • Eminent scientists of Microbiology: • Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Paul Ehrlich, and Edward Jenner.	
Unit 2.	**CLASSIFICATION OF MICROORGANISMS** • 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**
Unit 3.	**CHARACTERISTICS AND IMPORTANCE OF ORGANISMS** • General concept of phytoplanktons 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**
Unit -4.	**MICROBIAL NUTRITION** • Nutritional requirements of bacteria • Nutritional types of bacteria • Bacteriological media and their types • Physical conditions required for growth • Gaseous requirements and oxygen toxicity • Selective methods • Cultural characteristics	**10**

Reference Books

1. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
2. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
3. Modi, H.A. Elementary Microbiology - Vol –I & II, Akta Prakashan, Nadiyad.
4. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.
5. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
6. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
7. Stanier, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5 Edition. MacMillan Press Ltd., London.
8. Frobisher M., Hinsdill, Crabtree and Goodherat Fundamentals of Microbiology, Edition. W.B Saunders Co. USA.
9. Mani, A., Selwaraj, A.M., Narayanan L.M., and Arumngam, N., Microbiology, Saras Publication, Delhi

Suggested Online E-resources

https://onlinecourses.swayam2.ac.in/cec23_bt14/preview

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	-
Course Type	MINOR		**Practical Marks (Int)**	25
Course title	Basic of Microbiology (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MINMBP101		**Practical Exam Duration**	3:00 Hrs.

Course Description:

This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Techniques of isolation and purification of bacterial culture and Preservation of microbial culture, along with the operation and use of basic instruments, will help students to carry out advanced practicals in the next semesters.

Course Objective:

The course aims to provide a basic understanding of microbiology, microbial techniques and instrument operations. The course is designed so that learners can understand the Good laboratory practices, basic instrumentation needed for conducting experiments in a Microbiology laboratory, simple techniques of observation and study of microbial morphology and cellular structure, methods of microbial control, etc., in detail. This course will make students skillful in isolating and purifying a bacterial culture, measuring microbial growth, and interpreting different microbes' cultural characteristics and growth patterns. Further, it will also facilitate students to understand which method to choose for effective control of microbial growth.

Course Outcomes

- Understand the operation of various basic instruments in a Microbiology Laboratory.
- Comprehend the principle and procedure of various types of staining techniques.
- Analyse growth requirements and media selection for isolating specific microbes
- Learn & Apply techniques of microbial isolation, purification, and growth measurement.
- Learn & apply the methods of microbial control

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Microbiology Good Laboratory Practices and Bio-safety	**30**
2	Principles, working, and uses of the following laboratory instruments: (a) Microscope|, (b) Incubator, (c) pH meter, (d) Refrigerator, (e) Colorimeter (f) Colony counter	
3	Principles, working, and uses of the following sterilizers: (a) Autoclave, (b)Hot air oven, (c) Steam sterilizer, (d) Inspissator, (e) Bacteriological filters.	
4	Preparation of glassware for sterilization and disposal of laboratory media and cultures.	

5	Sterilization of heat sensitive material by membrane filtration.	
6	Preparation of Stains and Staining Reagents.	
7	Study of Permanent Slides of Bacteria, Fungi, Algae, and Protozoa.	
8	Study of bacterial motility by hanging drop method.	
9	Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.	

Practical Reference Books

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

Course Level	U.G		**Teaching Hours**	45
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	I		**External Marks**	50
Course Type	Interdisciplinary Course		**Practical Marks (Int)**	25
Course title	Microbiology in Everyday Life		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	IDCMBT101		**Practical Exam Duration**	-

Course Objectives:

By completing this lesson, students will be able to:

- To know the history and scope of microorganism.
- To examine the importance of microbes in the field of Agriculture and Environment
- Courses describe the role of microbes in the industrial such as food, pharmaceutical and fermentation.
- to study the role and functions of the microbes in Health and Hygiene

Course outcome:

- To enable the students to understand the nature and occurrence of microorganisms.
- To provide an overview of the beneficial as well as harmful role of microorganisms in agriculture, industry, environment, health, and food, as well as in spoilage of valuable objects

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**INTRODUCTION TO MICROORGANISMS** • Definition, Brief History, and Scope of Microbiology, • Groups of Microorganisms. • Nutrition and cultivation of microorganisms • Place of Microbes in the living world	**12**
Unit 2.	**MICROBES IN AGRICULTURE AND ENVIRONMENT** • Plant-Microbe interaction – PGPR and Plant pathogens • Biofertilizer & Biopesticide • Biodegradation, Bioremediation, and Bioleaching • Wastewater treatment, Biohazards & Microbial pollution	**12**
Unit 3.	**MICROBES IN INDUSTRY** • Microbes in food and spoilage of food • Alcohol and alcoholic beverages • Enzyme Production; Probiotics and functional foods • Antibiotics, Vaccine, interferon, antibodies.	**12**
Unit -4.	**MICROBES IN HEALTH AND HYGIENE** • Normal flora and pathogens, Importance of personal hygiene	**10**

	• Water and food-borne infections • Airborne infections • Infections of direct contact	

Reference books

- Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
- Modi, H.A. Elementary Microbiology - Vol -I, Akta Prakashan, Nadiyad.
- Modi, H.A. Elementary Microbiology – Vol-II, Akta Prakashan, Nadiyad.
- Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
- Stanier, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5 Edition. MacMillan Press Ltd., London
- Salle, S.J. (1974).Fundamental Principals of Bacteriology, Tata McGraw Hill Publication Co. Ltd. New DelhiKaul T N 2001. Biology and conservation of mushrooms. Oxford and IBH publishing company.Delhi
- Frobisher M., Hinsdill, Crabtree and Goodherat Fundamentals of Microbiology, 9 Edition. W.B Saunders Co. USA.

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	-
Course Type	Interdisciplinary Course		**Practical Marks (Int)**	25
Course title	Microbiology in Everyday Life (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	IDCMBP101		**Practical Exam Duration**	3:00 Hrs.

Course outcome:

- Students will benefit to understand the nature and occurrence of microorganisms.
- Practical course provides an overview of the beneficial as well as harmful role of microorganisms in agriculture, industry, environment, health, and food, as well as in spoilage of valuable objects

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Microbiology Good Laboratory Practices and Bio-safety	**30**
2	Media preparation and sterilization.	
3	Estimate the dissolve oxygen content from wastewater.	
4	Determine the quality of milk by methylene blue reduction test.	
5	Isolate the amylase enzyme producing microorganisms	
6	Isolation of airborne microorganism.	
7	Study the effects of chemical compounds (ethanol, phenol etc) on microbial growth.	
8	Study the skin flora.	

Practical Reference Book

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

Course Level	U.G		**Teaching Hours**	15+30 =45
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	25
Course Type	Skill Enhancement Course		**Practical Marks (Int)**	25
Course title	Mushroom Cultivation		**Total**	50
Credit	01		**Exam Duration**	1:00 Hrs.
Course Code	SECMBT101		**Practical Exam Duration**	-

Course learning outcomes: By the conclusion of this course, the students will benefit as:

- Have developed a very good understanding of nutritional aspects and commercial use of mushrooms for human consumption.
- Have developed a very good understanding of practical cultivation of mushrooms, management of diseases affecting mushrooms, mushroom harvesting and various avenues for using it into an entrepreneurship.
- Enhance the skill of mushroom cultivation in control environment

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**INTRODUCTION OF MUSHROOM** • Introduction: Morphology, Classification and identification of edible &non-edible/poisonous mushroom. • Nutritional and Medicinal value of mushroom, Scope of mushroom cultivation.	**4**
Unit 2.	**STRUCTURE AND LIFE CYCLE OF MUSHROOM** • Structure & Life cycle: Button mushroom (Agaricus bisporus), Milky mushroom (Calocybe indica), Oyster mushroom (Pleurotus sajor caju) and paddy straw mushroom (Volvariellavolvcea). • Breeding and genetic improvement of mushroom strains..	**4**
Unit 3.	**CULTIVATION CONDITIONS** • Principles & Requisites: Sterilization and disinfections of substrates, • Pasteurization of different substrates, Isolation, growth media, Spawns production and their maintenance.	**4**
Unit -4.	**TECHNIQUES OF CULTIVATION** • 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. • Pest management: chemical control Harvest and Post harvest technology; freezing, dry freezing, drying, canning and entrepreneurship.	**3**

Reference Books

1. Handbook on Mushrooms by Bahl N.
2. Benjamin Hirst Mushrooms: A Beginners Guide to Home Cultivation Paperback (20150)
3. V. N. Pathak .Mushroom Production and Processing Technology IST Edition Hardcover – 2011**.**
4. Eiri Staff Hand Book of Mushroom Cultivation, Processing and Packaging Paperback – Import, 2007

Paper Style:

Time: 1 Hours **Total Marks: 25**

Instructions:

1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

QUESTION-1: (A) (From UNIT-1) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-1: (B) (From UNIT-2) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-2: (A) (From UNIT-3) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-2: (B) (From UNIT-4) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-3: (Five short questions from all four units) (05 Marks)
(1) ..... (01)
(2) ……..(01)
(3) ……..(01)
(4) ……..(01)
(5) ……..(01)

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	I		**External Marks**	-
Course Type	Skill Enhancement Course		**Practical Marks (Int)**	25
Course title	Mushroom Cultivation (Practical)		**Total**	50
Credit	01		**Exam Duration**	-
Course Code	SECMBP101		**Practical Exam Duration**	3:00 Hrs

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Introduction to Mushrooms	**30**
2	Collection & Identification of Mushrooms	
3	Cultivation techniques of button Mushrooms	
4	Cultivation Technology Oyster Mushrooms	
5	Cultivation Technology of Paddy Straw Mushroom	
6	Cultivation Technology of Milky Mushroom	
7	Post Harvest Technology- Preservation of Mushrooms	

Suggested Online E-resources
http://ecoursesonline.iasri.res.in/course/view.php?id=596

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	**Particulars**	**Weightage**
1	Practical Performance	15
2	Viva	10
	Total	25

Paper Style: External

ASSESSMENT BY UNIVERSITY		
Que. No.	**Particulars**	**Marks**
SECTION-1 EXAMINER EXTERNAL		
1	Perform any two from the given list of exercises as per the instruction of the examiner exercise	**15**
2	Viva-voce	**10**

CREDIT STRUCTURE SEM-II

Sr. No	Course Group	Course (Paper) Title	Paper No.	Credit	Total Credits	Teaching Hours	Internal Marks	External Marks	Practical internal Marks	Practical external Marks	Total Marks	Total
1	MAJOR	Microbial Physiology-I (Theory)	MAJMBT201	3	4	45	25	50	-	-	75	100
2	MAJOR	Microbial Physiology-I (Practical)	MAJMBP201	1		30	-	-	25	-	25	
3	MAJOR	Microbial Physiology-II (Theory)	MAJMBT202	3	4	45	25	50	-	-	75	100
4	MAJOR	Microbial Physiology-II (Practical)	MAJMBP202	1		30	-	-	25	-	25	
5	MINOR	Microbial Physiology-I (Theory)	MINMBT201	3	4	45	25	50	-	-	75	100
6	MINOR	Microbial Physiology-I (Practical)	MINMBP201	1		30	-	-	25	-	25	
7	MDC/IDC	Basic Computer & Biostatistics (Theory)	IDCMBT201	3	4	45	25	50	-	-	75	100
8	MDC/IDC	Basic Computer & Biostatistics (Practical)	IDCMBP201	1		30	-	-	25	-	25	
9	SEC	Microbial Quality Control in Food & Pharmaceutical Industries	SECMB201	2	2	30	-	25	25	-	50	50
Total					**18**	**330**	**125**	**225**	**100**		**450**	

DSC: Discipline Specific Course [**Major (Core), Minor (Elective**)]

MDC: Multi-Disciplinary Course, **IDC**: Inter Disciplinary Course

SEC: Skill Enhancement Course.

AEC and **VAC** are to be selected as per BKNMU NEP norms

Course Level	U.G		**Teaching Hours**	45+30 =75
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	II		**External Marks**	50
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-I		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MAJMBT201		**Practical Exam Duration**	-

Course Description:

Microbiology is a branch of science that deals with the study of microorganisms. The course will offer the microbial physiology including the microbial biochemistry, their biomolecules as nucleic acid, protein, lipid, carbohydrates, enzymes, and control and defense mechanisms against the radiation and chemical agents will also discuss.

Course Objectives:

After completing this course, the student should be able to:

- Understand the biomolecule classification their structure and function in the microorganisms.
- Understand the fundamentals of enzymes their characteristics, classification and mechanisms of the enzymes.
- Explain the physical and chemical agents on the microbial growth and understand their effect in physiological properties.

Course Outcomes:

Upon completion of this course, the learner will be able to:

- Courses provide the basic understanding about the structures and functions of biomolecules in the microbial physiology.
- Understand the concepts of classification of biomolecules.
- Describing the physical and chemical properties, regulation of enzymes in prokaryotic and eukaryotic systems.
- Describe the ultra-structure and organelles of a bacterial cell.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**INTRODUCTION TO BIOMOLECULES** • Classification, Structures and Biological function of Carbohydrates • Classification, Structures and Biological function of Lipids • Classification, Structures and Biological function of Proteins • Classification, Structures and Biological function of Nucleic acids	**12**
Unit 2.	**ENZYMES** • Characteristics of Enzymes, Chemical & Physical Properties of Enzymes • Classification and Nomenclature of Enzymes • Enzyme activity: Nature & Mechanism of enzyme activity, Inhibition of	**12**

	enzymes • Mechanism and Regulation of Enzymes Activity and Synthesis • Differences between Prokaryotic & Eukaryotic Enzyme Regulation	
Unit 3.	**MICROBIAL CONTROL-I** • Fundamentals of Microbial Control: Principle and Types, Definition of Sterilization, Disinfectant, Antiseptic, Sanitizer, Germicide, Bactericide and Bacteriostasis • Characteristics, Evaluation and Selection of Ideal antimicrobial Agent Bacteriological media and their types	**12**
Unit -4.	**MICROBIAL CONTROL-II** • Physical Agents of Microbial Control: • High Temperature, Low temperature, Desiccation, Osmotic Pressure, Radiation, Ultraviolet lights, X- rays, Gamma rays, Cathode rays, surface tension and interfacial tension, filtration. • Chemical Agents of Microbial Control: • Phenol and phenolic compound, Alcohol, Halogen, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, Aldehydes, Gaseous sterilization. • Phenol Coefficient Method for the evaluation of chemical antimicrobial agents.	**10**

REFERENCE BOOKS:

1. Atlas. R.M., Microbiology, 2nd Edition. Wm. C. Brown Publishers
2. Satyanarayana. U., Biochemistry, Books and allied Pvt. Ltd.
3. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
4. Mathew, Van Holde & Ahern, Biochemistry,3 rd Edition. Pearson Education (Singapore) Pte. Ltd. India Branch, New Delhi
5. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
6. Powar and Daginawala, General Microbiology Vol-I. Himalaya Publishing House, Mumbai.
7. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
8. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	-
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-I (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MAJMBP201		**Practical Exam Duration**	3:00 Hrs.

Course Description:

- This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Techniques of isolation and purification of bacterial culture and Preservation of microbial culture, along with the operation and use of basic instruments, will help students to carry out advanced practicals in the next semesters.

Course Objectives:

The course aims to provide a basic understanding of microbiology.

- To biological function of Carbohydrates, protein and nucleic acid material.
- To understand the role and mechanism of enzymes.
- To study the microbial control mechanism against the different conditions
- To examine the effect of various physical and chemical agents.

Course Outcomes:

- Students have able to be estimating the interpreting the various biomolecules.
- Developed the understanding about the enzyme nomenclature, activity, and function of enzymes.
- Able to understand the effect of various chemical and physical agents on microbial growth.
- Course also help to understand the how microbial growth can control.

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Qualitative analysis of Amino acids and Proteins	**30**
2	Qualitative analysis of Carbohydrates.	
3	Colorimetric estimation of Protein by Folin and Lowry's method.	
4	Titrimetric estimation of reducing Sugars by Cole's method.	
5	Colorimetric estimation of reducing sugar by DNSA method.	
6	Assay of Alpha – Amylase by iodometric method.	

7	Effect of Chemicals on growth of bacteria.	
8	Effect of Antibiotics on growth of bacteria: Agar ditch method and Agar cup Method	
9	Effect of physical Agents on growth of bacteria.	
10	Enumeration of bacterial number by viable count technique.	

REFERENCE BOOKS:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

6. David T. Plummer. An Introduction to Practical Biochemistry.

Course Level	U.G		**Teaching Hours**	45+30 =75
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	II		**External Marks**	50
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-II		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MAJMBT202		**Practical Exam Duration**	-

Course Description:

Microbiology is a branch of science that deals with the study of microorganisms. The course will offer the microbial physiology that covers the microbial biochemistry, growth response, transport systems, and control and defence mechanisms towards the solutes will discuss. Some of the physiological mode of action of antimicrobial compounds are also as part of the course.

Course Objectives:
After completing this course, the student should be able to:

- To understand the essential molecules and their role in microbiology.
- To explore the growth response of the microorganisms against the nutrient and energy.
- Understand the transport and uptake mechanisms of the organism.
- To comprehend therapeutics agents and its mode of action.

Course Outcomes:
Upon completion of this course, the learner will be able to:

- Course provides the depth knowledge about the essential biomolecules and its role in microbial composition.
- Describing the growth characteristics of the microorganisms which require different nutrient for growth and the associated mechanisms of energy generation for their survival like autotrophs, heterotrophs, chemolithoautotrophs etc.
- Describing the mode of action of antibiotic and its effects on the cell.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**CHEMISTRY FOR THE MICROBIOLOGIST** • Chemicals, Elements and structure of Atoms • Molecules and Chemical bonds • Chemical reactions • Water and pH • The essence of biochemistry for microbiologist	**12**
Unit 2.	**MICROBIAL RESPONSE** • Microbial growth in response to nutrition and energy Autotroph/Phototroph, heterotrophy, • Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph,	**12**

	Chemolithotroph, • Photolithoautotroph, Photoorganoheterotroph	
Unit 3.	**TRANSPORT SYSTEMS** • Passive and facilitated diffusion. • Primary active transport, concept of uniport, sodium potassium pump and proton pump. • Secondary active transport, symport and antiport Group translocation Iron uptake.	**12**
Unit -4.	**ANTIBIOTICS AND THEIR MODE OF ACTION** • Chemotherapeutic agents and Chemotherapy • Characteristics of ideal chemotherapeutic agent • Antibiotics and their mode of action: • Inhibition of cell wall synthesis, Damage to cytoplasmic membrane, Inhibition of nucleic acid and protein synthesis, Inhibition of specific enzyme system. • Antifungal, antiviral and antitumor chemotherapeutic agents • Microbiological assay of antibiotics • Nonmedical uses of antibiotics	**10**

REFERENCE BOOKS:

1. Atlas. R.M., Microbiology, 2nd Edition. Wm. C. Brown Publishers
2. Satyanarayana. U., Biochemistry, Books and allied Pvt. Ltd.
3. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
4. Mathew, Van Holde & Ahern, Biochemistry,3 rd Edition. Pearson Education (Singapore) Pte. Ltd. India Branch, New Delhi
5. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
6. Powar and Daginawala, General Microbiology Vol-I. Himalaya Publishing House, Mumbai.
7. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
8. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi
9. Umbreit. Essentials of Bacterial Physiology.

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	-
Course Type	MAJOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-II (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MAJMBP202		**Practical Exam Duration**	3:00 Hrs.

Course Description:

This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Course covers the microbial physiology which will discuss the mode of action of antimicrobial substance and its role in modification of cellular process. Course will be helpful to students to distinguish the physiological mechanism against the diversified outer environmental conditions.

Course Objectives:

The course aims to provide a basic understanding of microbiology, microbial properties and physiological conditions. The designed course aim to understand the microbial growth physiology in the presence of various nutrient and energy sources. Course also cover the effect of various antimicrobial components on the growth of microbes and its uptake mechanisms. Hence The proposed course will make students skillful in bacterial culture, measuring microbial growth, and interpreting different microbes' cultural characteristics and growth patterns. Further, it will also facilitate students to understand which method to choose for effective control of microbial growth.

Course Outcomes:

Upon successful completion of the course, the student will:

- Understand the operation of various basic instruments in a Microbiology Laboratory.
- Comprehend the principle and procedure of various types of staining techniques.
- Analyse effect of carbon and nitrogen source on microbes.
- Describing the effect of Antibiotics on growth of bacteria.
- Learn & apply the methods of microbial control.

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Effect of pH on growth of bacteria.	**30**
2	Effect of salt on growth of bacteria.	
3	Effect of Antibiotics on growth of bacteria: Agar ditch method and Agar cup Method	

4	Effect of carbon and nitrogen sources on growth of bacteria	
5	Enumeration of bacterial number by viable count technique.	

REFERENCE BOOKS:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

6. David T. Plummer. An Introduction to Practical Biochemistry.

Course Level	U.G		**Teaching Hours**	45+30 =75
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	II		**External Marks**	50
Course Type	MINOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-I		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	MINMBT201		**Practical Exam Duration**	-

Course Description:

Microbiology is a branch of science that deals with the study of microorganisms. The course will offer the microbial physiology including the microbial biochemistry, their biomolecules as nucleic acid, protein, lipid, carbohydrates, enzymes, and control and defense mechanisms against the radiation and chemical agents will also discuss.

Course Objectives:

After completing this course, the student should be able to:

- Understand the biomolecule classification their structure and function in the microorganisms.
- Understand the fundamentals of enzymes their characteristics, classification and mechanisms of the enzymes.
- Explain the physical and chemical agents on the microbial growth and understand their effect in physiological properties.

Course Outcomes:

Upon completion of this course, the learner will be able to:

- Courses provide the basic understanding about the structures and functions of biomolecules in the microbial physiology.
- Understand the concepts of classification of biomolecules.
- Describing the physical and chemical properties, regulation of enzymes in prokaryotic and eukaryotic systems.
- Describe the ultra-structure and organelles of a bacterial cell.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**INTRODUCTION TO BIOMOLECULES** • Classification, Structures and Biological function of Carbohydrates • Classification, Structures and Biological function of Lipids • Classification, Structures and Biological function of Proteins • Classification, Structures and Biological function of Nucleic acids	**12**
Unit 2.	**ENZYMES** • Characteristics of Enzymes, Chemical & Physical Properties of Enzymes • Classification and Nomenclature of Enzymes • Enzyme activity: Nature & Mechanism of enzyme activity, Inhibition of enzymes	**12**

	• Mechanism and Regulation of Enzymes Activity and Synthesis • Differences between Prokaryotic & Eukaryotic Enzyme Regulation	
Unit 3.	**MICROBIAL CONTROL-I** • Fundamentals of Microbial Control: Principle and Types, Definition of Sterilization, Disinfectant, Antiseptic, Sanitizer, Germicide, Bactericide and Bacteriostasis • Characteristics, Evaluation and Selection of Ideal antimicrobial Agent Bacteriological media and their types	**12**
Unit -4.	**MICROBIAL CONTROL-II** • Physical Agents of Microbial Control: • High Temperature, Low temperature, Desiccation, Osmotic Pressure, Radiation, Ultraviolet lights, X- rays, Gamma rays, Cathode rays, surface tension and interfacial tension, filtration. • Chemical Agents of Microbial Control: • Phenol and phenolic compound, Alcohol, Halogen, Heavy metals and their compounds, Dyes, Detergents, Quaternary ammonium compounds, Aldehydes, Gaseous sterilization. • Phenol Coefficient Method for the evaluation of chemical antimicrobial agents.	**10**

REFERENCE BOOKS:

1. Atlas. R.M., Microbiology, 2nd Edition. Wm. C. Brown Publishers
2. Satyanarayana. U., Biochemistry, Books and allied Pvt. Ltd.
3. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies,
4. Mathew, Van Holde & Ahern, Biochemistry,3 rd Edition. Pearson Education (Singapore) Pte. Ltd. India Branch, New Delhi
5. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
6. Powar and Daginawala, General Microbiology Vol-I. Himalaya Publishing House, Mumbai.
7. Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications, Delhi.
8. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	-
Course Type	MINOR		**Practical Marks (Int)**	25
Course title	Microbial Physiology-I (Practical)		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	MINMBP201		**Practical Exam Duration**	3:00 Hrs.

Course Description:

- This course covers the study of basic skills in the subject of Microbiology. The course is segregated into different experiments as per their evolution from the very basic to slightly advanced. Techniques of isolation and purification of bacterial culture and Preservation of microbial culture, along with the operation and use of basic instruments, will help students to carry out advanced practicals in the next semesters.

Course Objectives:

The course aims to provide a basic understanding of microbiology.

- To biological function of Carbohydrates, protein and nucleic acid material.
- To understand the role and mechanism of enzymes.
- To study the microbial control mechanism against the different conditions
- To examine the effect of various physical and chemical agents.

Course Outcomes:

- Students have able to be estimating the interpreting the various biomolecules.
- Developed the understanding about the enzyme nomenclature, activity, and function of enzymes.
- Able to understand the effect of various chemical and physical agents on microbial growth.
- Course also help to understand the how microbial growth can control.

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Qualitative analysis of Amino acids and Proteins	**30**
2	Qualitative analysis of Carbohydrates.	
3	Colorimetric estimation of Protein by Folin and Lowry's method.	
4	Titrimetric estimation of reducing Sugars by Cole's method.	
5	Colorimetric estimation of reducing sugar by DNSA method.	
6	Assay of Alpha – Amylase by iodometric method.	

7	Effect of Chemicals on growth of bacteria.	
8	Effect of Antibiotics on growth of bacteria: Agar ditch method and Agar cup Method	
9	Effect of physical Agents on growth of bacteria.	
10	Enumeration of bacterial number by viable count technique.	

REFERENCE BOOKS:

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.

2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

3. John P. Harley, Lansing M. Prescott-Laboratory Exercises in Microbiology-McGraw-Hill. (2001)

4. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi

5. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

6. David T. Plummer. An Introduction to Practical Biochemistry.

Course Level	U.G		**Teaching Hours**	45+30 =75
Programme	B.Sc. Microbiology		**Internal Marks**	25
Semester	II		**External Marks**	50
Course Type	Interdisciplinary Course		**Practical Marks (Int)**	25
Course title	Basic Computer & Biostatistics		**Total**	100
Credit	03		**Exam Duration**	2:00 Hrs.
Course Code	IDCMBT201		**Practical Exam Duration**	-

Course Objectives:

By completing this lesson, students will be able to:

- To study the fundamental of computer and internet.
- To explore the uses of statistics and its application in biological sciences.
- Courses encourage students to observe the biological data validation by learning the various statistical methods/test.

Course Outcomes:

The Course is designed:

- Developed skills to use computers for analysis of biological data.
- Have developed basic knowledge of statistics as applied to biological samples.
- Have developed basic concepts of statistics and their importance in the field of life sciences.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**COMPUTER FUNDAMENTALS** • Basic concept of computer organization, generations of computer, hardware, software, number system, flow chart and basics of operating systems (windows, unix), • Classification of computers and computer languages. • Internet & Web: MS office and internet - introduction, importance, requirements of internet. • Electronic mailing, chatting, search engines, webpages.	**12**
Unit 2.	**BASICS OF STATISTICS** • Applications and scope of statistics, Principles of statistical analysis of biological data. • Sampling parameters, Difference between sample and population, Sampling errors, Censoring, difference between parametric and non-parametric statistics.	**12**
Unit 3.	**STATISTICAL METHODS** • Measures of central tendency, Mean, Median and Mode, • Measures of dispersion, standard deviation and variance, • Skewness, kurtosis; Probability; Discrete and continuous random variable, Curve fitting; Correlation and regression.	**12**

	• Emphasis on examples from biological systems.	
Unit -4.	**STATISTIC TEST** • Sampling size determination, Testing of hypothesis, Level of significance and degree of freedom, • Large sample test based on normal distribution; Small sample test based on t-test, Z test and F test, • Confidence interval; Distribution-free test; Chi-square test; Basic introduction to multivariate statistics.	**10**

REFERENCE BOOKS:

1. Khan I A and Khan I A. Fundamentals of Biostatistics, Ukaaz Publications, (1994).
2. Chap T. Le and Lynn E. Eberly. Introductory Biostatistics 2nd Edition. Wiley (2016)
3. N. Gurumani. An Introduction to statistics 2nd edition
4. C R. Kothari. Research Methodology: Methods and Techniques 2nd edition

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	-
Course Type	Interdisciplinary Course		**Practical Marks (Int)**	25
Course title	Basic Computer & Biostatistics		**Total**	25
Credit	01		**Exam Duration**	-
Course Code	IDCMBP201		**Practical Exam Duration**	3:00 Hrs.

Course Objectives:

By completing this lesson, students will be able to:

- To set a hand on the computer exercise and internet.
- To explore the uses of statistics and its application in biological sciences.
- Courses encourage students to observe the biological data validation by learning the various statistical methods/test.

Course Outcomes:

The Course is designed:

- Advanced in computational skills for analysis of biological data.
- Have developed basic knowledge of statistics as applied to biological samples.
- Have developed basic concepts of statistics and their importance in the field of life sciences.

COURSE CONTENTS (Practical)		
Practical	**Title of the Unit and the Topics**	**No. of Lectures**
1	Introduction to different operating systems – Windows UNIX etc.	**30**
2	Introduction of internet searching	
3	Electronic mailing	
4	Mean, Median, Mode from grouped and ungrouped Dataset	
5	Standard Deviation and Coefficient of Variation	
6	Skewness and Kurtosis	
7	Curve fitting	
8	Correlation	
9	Regression	
10	Finding area under the curve using normal probability	

11	Testing of Hypothesis-Normal Distribution, t-test and Chi-Square-test	
12	Confidence Interval	

Reference Book

1. Khan I A and Khan I A. Fundamentals of Biostatistics, Ukaaz Publications, (1994).
2. Chap T. Le and Lynn E. Eberly. Introductory Biostatistics 2nd Edition. Wiley (2016)
3. N. Gurumani. An Introduction to statistics 2nd edition
4. C R. Kothari. Research Methodology: Methods and Techniques 2nd edition

Course Level	U.G		**Teaching Hours**	15+30 =45
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	25
Course Type	Skill Enhancement Course		**Practical Marks (Int)**	25
Course title	Microbial Quality Control in Food & Pharmaceutical Industries		**Total**	50
Credit	01		**Exam Duration**	1:00 Hrs.
Course Code	SECMBT201		**Practical Exam Duration**	-

Course Objectives:

By completing this lesson, students will be able to:

- To study the quality control in range of industrial sector.
- To explore the standard methods and conditions necessary for the food and pharmaceutical industries.
- Courses enrich the skill of the students towards the SOP and standards practice of the industries.

Course Outcomes:

By the completion of this course, the students will improve the skill and knowledge as:

- Have developed a very good understanding of practical aspects of microbiological safety, various detection methodologies and use of different microbiological media in food industries.
- Have developed a very good understanding of practical aspects of microbiological safety, various detection methodologies and toxicological testing of products in the pharmaceutical industries.
- Understanding and acquiring the knowledge of the food and drinking water standard.

COURSE CONTENTS		
Units	**Title of the Unit and the Topics**	**No. of Lectures**
Unit 1.	**MICROBIOLOGY LABORATORY AND PRACTICE** • Microbiological Laboratory and Safe Practices: • Good laboratory practices- Good laboratory practices, Good microbiological practices. • Biosafety cabinets: Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste.	**8**
Unit 2.	**STANDARD MICROBIAL METHODS-I** • Determining Microbes in Food / Pharmaceutical Samples: • Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts. • Biochemical methods: Limulus lysate test for endotoxin, sterility testing for pharmaceutical products. • Enrichment culture technique, Detection of specific microorganisms - on Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar.	**8**
Unit 3.	**STANDARD MICROBIAL METHODS-II** • Ascertaining microbial quality of milk by MBRT, Rapid detection	**7**

	• methods of microbiological quality of milk at milk collection centers • (COB, 10 min Resazurin assay).	
Unit -4.	**FOOD SAFETY AND MICROBIAL STANDARDS** • Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. • Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.	**7**

Reference Books

2. Quality Control in the Food Industry V1, S Herschdoerfer, ISBN: 9780323152068,: Academic Press, 1967
3. Prescott L.M., Microbiology 7th Edition, The McGraw−Hill Companies
4. Principles of Sensory Evaluation of Food- 1965 MA Amerine, RM , Pangborn and EB Roessler, Elsevier.
5. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
6. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.

Paper Style:

Time: 1 Hours **Total Marks: 25**

Instructions:

1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

QUESTION-1: (A) (From UNIT-1) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-1: (B) (From UNIT-2) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-2: (A) (From UNIT-3) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-2: (B) (From UNIT-4) (05 Marks)
(1)…….. (05)
OR
(2)……..(05)

QUESTION-3: (Five short questions from all four units) (05 Marks)
(1) ..... (01)
(2) ……..(01)
(3) ……..(01)
(4) ……..(01)
(5) ……..(01)

Course Level	U.G		**Teaching Hours**	30
Programme	B.Sc. Microbiology		**Internal Marks**	-
Semester	II		**External Marks**	-
Course Type	Skill Enhancement Course		**Practical Marks (Int)**	25
Course title	Microbial Quality Control in Food & Pharmaceutical Industries (Practical)		**Total**	50
Credit	01		**Exam Duration**	-
Course Code	SECMBP201		**Practical Exam Duration**	3:00 Hrs

Course Outcomes:

By the completion of this course, the students will improve the skill and knowledge as:

- Have developed a very good understanding of practical aspects of microbiological safety, various detection methodologies and use of different microbiological media in food industries.
- Have developed a very good understanding of practical aspects of microbiological safety, various detection methodologies and toxicological testing of products in the pharmaceutical industries.
- Understanding and acquiring the knowledge of the food and drinking water standard.

COURSE CONTENTS (Practical)

Practical	Title of the Unit and the Topics	No. of Lectures
1	Introduction to the good laboratory practices	**30**
2	Standard plate count	
3	Microscopic examination of organisms	
4	Sterility testing of pharmaceutical products	
5	Selective media preparation and cultivation	
6	MBRT test	
7	Resazurin test	
8	BIS guideline for food and water standard	

INTERNAL EVALUATION SCHEME

INTERNAL ASSESSMENT

No.	Particulars	Weightage
1	Practical Performance	15
2	Viva	10
	Total	25

Paper Style: External

ASSESSMENT BY UNIVERSITY

Que. No.	Particulars	Marks
SECTION-1 EXAMINER EXTERNAL		
1	Perform any two from the given list of exercises as per the instruction of the examiner exercise	**15**
2	Viva-voce	**10**