સૌરાષ્ટ્ર યુનિવર્સિટી

એકેડેમિક વિભાગ

યુનિવર્સિટી કેમ્પસ, યુનિવર્સિટી રોડ, રાજકોટ-૩૬૦૦૦૫

ફોન નં.(૦૨૮૧)૨૫૭૮૫૦૧ એક્સટે. નં.૨૦૨, ૩૦૪ ફેક્સ નં.(૦૨૮૧)૨૫૭૬૩૪૭ ઈ-મેઈલ : academic@sauuni.ac.in

નં.એકે/વિજ્ઞાન/૨૪૦૩૨૭/૨૦૨૪

તા.૧૨/૦૪/૨૦૨૪

માઈક્રોબાયોલોજી

પરિપત્ર:-

સૌરાષ્ટ્ર યુનિવર્સિટીની વિજ્ઞાન વિદ્યાશાખા હેઠળની સ્નાતક કક્ષાના બી.એસસી (માઈક્રોબાયોલોજી)ના અભ્યાસક્રમ ચલાવતી સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓને આથી જાણ કરવામાં આવે છે કે, ચેરમેનશ્રી દ્વારા માઈક્રોબાયોલોજી સેમેસ્ટર ૧ અને ૨ નો નવો સુધારેલો અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિ, વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ તથા બોર્ડ ઓફ મેનેજમેન્ટની બહાલીની અપેક્ષાએ મંજુરી આપવાં માન કુલપતિ.સાહેબને ભલામણ કરેલ છે. જે માન.કુલપતિશ્રીએ મંજુર કરેલ છે. જેથી સંબંધિત તમામે તે મુજબ તેની ચુસ્તપણે અમલવારી કરવી.

(મુસદ્દો કુલસચિવશ્રીએ મંજુર કરેલ છે.)

સહી/-
(ડૉ.આર.જી.પરમાર)
કુલસચિવ

બિડાણ:- ઉક્ત અભ્યાસક્રમ (સોફ્ટ કોપી)

રવાના કર્યું

12/4/24

એકેડેમિક ઓફીસર

પ્રતિ,

(૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની માઈક્રોબાયોલોજીનું વિષય ચલાવતી સ્નાતક કક્ષાની સર્વે સંલગ્ન કોલેજોના આચાર્યશ્રીઓ તરફ

નકલ જાણ અર્થે રવાના:-

૧. માન.કુલપતિશ્રી/કુલસચિવશ્રીના અંગત સચિવ

નકલ રવાના (યોગ્ય કાર્યવાહી અર્થે):-

૧. પરીક્ષા વિભાગ ૨. પી.જી.ટી.આર.વિભાગ ૩. જોડાણ વિભાગ

તા. 08/02/2024

પ્રતિ,

એકેડેમિક ઓફિસર

એકેડેમિક વિભાગ

સૌરાષ્ટ્ર યુનિવર્સિટી

રાજકોટ

વિષય : **આગામી શૈક્ષણિક વર્ષ જુન – ૨૦૨૩ થી બી.એસસી. (માઈક્રોબાયોલોજી) વિષયનો અભ્યાસ ક્રમ NEP-2020 નાં અભ્યાસક્રમો મંજૂર કરવા અંગે...**

શ્રીમાન,

ઉપરોક્ત વિષય પરત્વે જણાવવાનું કે, આગામી શૈક્ષણિક વર્ષ જુન - ૨૦૨૩ થી **માઈક્રોબાયોલોજી** વિષયનો અભ્યાસક્રમ **NEP-2020** મુજબનાં **બી.એસસી.(માઈક્રોબાયોલોજી) સેમેસ્ટર:- ૦૧ & 02** સ્નાતક કક્ષાનો અભ્યાસક્રમ અમલ માં આવે તે રીતે મંજૂર કરવા **માઈક્રોબાયોલોજી** વિષયની અભ્યાસ સમિતિ, **વિજ્ઞાન વિદ્યાશાખા, એકેડેમિક કાઉન્સિલ** તથા **સિન્ડીકેટ** ની બહાલી ની અપેક્ષા એ મંજૂરી આપવા માનનીય કુલપતિશ્રી સાહેબ ને નમ્ર વિનંતિ સાથે ભલામણ કરવામાં આવે છે.

આભારસહ

આપનો વિશ્વાસુ

(**ડૉ.એન.ડી.પાંધી.**)

ચેરમેનશ્રી,

માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિ

સૌરાષ્ટ્ર યુનિવર્સિટી

રાજકોટ.

ડીનશ્રી

(વિજ્ઞાનવિદ્યાશાખા)

બિડાણ : ઉપરોક્ત અભ્યાસક્રમ ની હાર્ડકોપી

To,

The Academic Officer
Academic Section
Saurashtra University,
Rajkot
Dt: 08/02/2024

Subject: Regarding approval of NEP-2020 guidelines-based B.Sc. Microbiology Syllabus

to be effective from June 2023

Resp. Sir,

With reference to the above-mentioned subject, the **Board of Studies for Microbiology**, with the expectation of ratification from the **Faculty of Science, Academic Council**, and the **Syndicate,** make a humble request to the Honourable Vice – Chancellor to approve the NEP-2020 guidelines-based **B.Sc. Microbiology Syllabus for Semester – 1 & 2** to be effective from June 2023.

Thank you,

Yours faithfully

(Dr. N. D. Pandhi)

Chairman, **Dean**

Board of Studies for Microbiology **(Faculty of Science)**

Saurashtra University

Rajkot.

Encl: Hard copy of the above-mentioned syllabus

SAURAHSTRA UNIVERSITY

RAJKOT

NAME OF PROGRAM: **B.Sc. Microbiology**

TYPE OF PROGRAM: **Under Graduate**

NUMBER OF YEARS OF PROGRAM: **4**

Approved by

Name of Board of Studies:	**BoS of Microbiology**	**Dt: 11th August 2023**
Name of Faculty:	**Faculty of Science**	**Dt:**
Date of Academic Council Meeting	……	
Date of Syndicate Meeting	…….	
Date of Senate Meeting	……	
Board of Studies in the subject:	**MICROBIOLOGY**	Faculty of: **SCIENCE**

Chairman: **Dr. Neepa Pandhi** Dean**: Prof. Girish Bhimani**

Date: 08/02/2024 Date:

Check list

અભ્યાસક્રમ આનુસાંગિક બાબત

1. Program outcomes અને Program Specific Outcomesદર્શાવેલ છે? **હા**
2. અભ્યાસક્રમ અંતર્ગતના ઓર્ડિનન્સ તથા રેગ્યુલેશન પ્રવેશ, પરીક્ષા અને પરિણામને ધ્યાને લઇ દર્શાવેલ છે ?: **હા**
3. આ અભ્યાસક્રમમાં Multiple Entry and Exit ની જોગવાઈ કરેલ છે ?: **હા**
4. આ અભ્યાસક્રમ NEP-2020 ને ધ્યાને લઇ UGC દ્વારા પ્રકાશિત કરાયેલ Curriculum& Credit Framework for 4 year Under Graduate Program ગાઈડ લાઈન્સ મુજબ તૈયાર કરવામાં આવેલ છે? **હા**

વિષય આનુસાંગિક બાબત (દરેક વિષયની શરૂઆતમાં નીચેની બાબત દર્શાવવાની રહેશે)

1. Course Outcomes દરેક વિષયની શરૂઆતમાં દર્શાવેલ છે? **હા**
2. Employability/Entrepreneurship/Skill Developmentપર કેન્દ્રિત થયેલ છે કે નહિ? **હા**
3. Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે? **હા**
4. Major [√] Minor [√] Skill Enhancement Courses [√]
   Ability Enhancement Courses [√] Value Added Courses [√] Exit/ Vocational Courses [√]
5. Holistic Education [√] Multidisciplinary [√] Interdisciplinary [√]
6. દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ? **હા**
7. New India Literacy Programme (NILP) મુજબનો વિષય છે? **હા**
8. Swayam પ્લેટફોર્મ પરના MOOC વિષય પર આધારિત આ વિષય છે ? **હા**
9. ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ? **હા**

Board of Studies in the subject: **MICROBIOLOGY** Faculty of: **SCIENCE**

Chairman: **Dr. Neepa Pandhi** Dean**: Prof. Girish Bhimani**

Date: 08/02/2024 Date:

SAURASHTRA UNIVERSITY

FACULTY OF SCIENCE

Course Structure and Syllabus for Science FYUGP

B.Sc. Honours/ Honours with Research in Microbiology

Based on

UGC's guidelines NEP-2020 "Curriculum and Credit Framework for Undergraduate Programmes- CCFUP" and

Education Department, Government of Gujarat's
Uniform Credit Structure for all HEIs of Gujarat State and
Implementation of the Common Curriculum and Credit Framework under the National Education Policy-2020
(No: KCG/admin/2023-24/0607/kh.1 Sachivalaya, Gandhinagar dated 11/07/2023) and

Standard Operating Procedure for Implementation of NEP-2020 for the State of Gujarat- HEIs of Gujarat
(No: KCG/admin/2023-24/865/ dated 26/07/2023) and

Additional content to be added to SOP published by KCG
(No: KCG/NEP-2020/2023-24/893/ dated 28/07/2023)

EffectiveFromJune–2023 & onwards

PREFACE

Timely revision of the curriculum to encompass new knowledge and information is a prime criterion of IQAC and a prime need for the college educational systems affiliated with Universities. Under the NEP -2020 and UGC guidelines, a student must be offered the latest courses of varied nature with societal, environmental, and economic implications. The curriculum should offer multiple entry-exit and a choice of vast subjects to choose from to a student to facilitate his learning abilities, aptitude, and inclination.

Microbiology is a foundation subject for Agriculture, Biochemistry, Bioinformatics, Biotechnology, Environmental Science, Genetic engineering, Molecular biology, and Medical Microbiology and hence holds the central position in the curriculum of these subjects. Looking at the rapid inventions and technological developments in the field of Microbiology and keeping in view the recommendations of UGC and NEP-2020, this syllabus has been formulated by the combined and coordinated efforts of all the faculty members of all the Microbiology Departments of Colleges affiliated to Saurashtra University.

The composition of a curriculum for a particular subject requires the following criteria to be considered:

1. Guidelines and Model curriculum were given by the UGC, State Government, and the University
2. Regional needs and Present National and International trends in the subject
3. Geographical parameters of the University and its demographic property
4. Relationship with other related subjects and resources of educational needs.
5. Financial and statuary provisions of the State government

The content of a syllabus should be such that it maintains continuity with the course content of higher secondary classes and post-graduate courses. The current curriculum is made keeping this in mind and is an effort to impart fundamental knowledge of the subject needed at this level.The curriculum is designed per the guidelines of UGC and NEP-2020 and reflects the courses' total credit, teaching hours, and question paper style. The syllabus units are well-defined, and the scope of each is given in detail. A list of reference books is provided at the end of each course. Microbiology being an experimental science, sufficient emphasis is given to training and instrumentation. 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, Multidisciplinary, 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 Dean, Faculty of Science, Saurashtra University, for valuable guidelines and the Academic Section for much-needed cooperation. The Board wishes all the students pursuing Microbiology a very bright future.

(Dr. Neepa Dilipkumar Pandhi)
Chairman, Board of Studies, Microbiology
Saurashtra University, Rajkot (Gujarat)
Date:14th August 2023

Saurashtra University, Rajkot

MICROBIOLOGY PROGRAMME - B.Sc. (Honours) / B.Sc. (Honours with Research)

Curriculum Framework & Syllabus for A.Y. 2023-2024 & Onwards

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: (POs)		
After completion of the B.Sc. Microbiology program, the Student 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.

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – UG Certificate in Microbiology)

Semester I

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit			Hrs./ Week		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	**Major (Core) 1** (Microbiology)	**Microbiology-1:** Fundamentals of Microbiology **(4- Credit Course** including Theory & Practical components)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**
2	**Major (Core) 2** (Microbiology)	**Microbiology-2:** Introduction to Microbial Chemistry **(4- Credit Course** including Theory & Practical component)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**
3	**Minor (Elective)*-1**	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.2) **Any One from Basket** (As per the expertise and resources available in the college) **(4- Credit Course** including Theory & Practical components)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**
4	**Multi/Inter-Disciplinary Course -1** (MDC/IDC-1) **(Elective)**** **Categories**: Natural & Physical Science/ Maths, Stat. and Comp. Appl. / Lib., Info. & Media Sci. / Comm. & Mgt./Huma., & Social Sci./ Sanskrit etc...	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.3) **Any One from Basket** (As per the expertise and resources available in the college) **(4- Credit Course** including Theory & Practical components)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**
5	**Ability Enhancement Course -1** (AEC-1)	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.4) **English Language:**	**2**	**-**	**2**	**2**	**-**	**25**	**-**	**25**	**-**	**50**
6	**Skill Enhancement Course-1** (SEC-1)	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.5) **Skill based Course-1: Basics of Clinical Laboratory (2- Credit Course** including Theory & Practical components)	**1**	**1**	**2**	**1**	**2**	**-**	**25**	**25**	**-**	**50**
7	**Common Value-Added Course-1-**(C-VAC-1)*** NSS/NCC/ Sports & Fitness/ Ethics and Culture/ Culture and Communication / Ethics and Values in Ancient Indian Traditions/ Human Values and Ethics/IPDC	(As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Clause 3.3.6) VAC based on **IKS:** NSS/NCC/Sports & Fitness/Human Values and Ethics **(2- Credit Course** including Theory & Practical components)	**1**	**1**	**2**	**1**	**2**	**-**	**25**	**25**	**-**	**50**
Total Credits and Marks (Semester-II)			16	06	**22**	16	12	**125**	**150**	**275**	**00**	**550**

***** Any one course from the basket is to be selected as a Minor elective course as per the expertise and resources available in the college. The same course will continue as a Minor in the semester-II as well.

****** Any one course from the basket is to be selected as Multi/Inter disciplinary elective courses (MDC/IDC) as per the expertise and resources available in the college. The same MDC/IDC course will continue in the semester-II as well.

*** Common **Value-Added Elective Courses** (C-VAC-1) common to all is to be selected from University Basket for semester 1**,** as per the expertise and resources available in the college.

Courses Offered by BoS in Microbiology to other FYUGP- B.Sc. Program in Semester-II

SN	Course Category As per GoG- NEP-SOP - July 2023& additional content 28/7/23	Course Title	Credit			Hrs./ Week		Evaluation - Weightage CCE: SEE = 50:50				
			T	P	Total	T	P	CCE Marks		SEE Marks		Total Marks
								T	P	T	P	
1	**Minor (Elective)*-1** (Microbiology) (In addition to courses mentioned in SOP basket)	**Microbiology-1:** Fundamentals of Microbiology **(4- Credit Course** including Theory & Practical components)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**
2	**Multi/Inter-Disciplinary Course -1** (MDC/IDC-1) **(Elective)** (Microbiology) (In addition to courses mentioned in SOP basket)	**Microbiology-2:** Introduction to Microbial Chemistry **(4- Credit Course** including Theory & Practical component)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**

Evaluation Scheme: (As per GoG- NEP-SOP July 2023& additional content 28/7/23 – Chapter-7: Evaluation Reforms)

The evaluation process should be formulated to make a systematic evaluation of students' progress based on UGC guidelines. The evaluation must be designed with learner attributes in mind. These attributes have clear linkages to Programme Education Objectives and Outcomes. The evaluation consists of the following two components:

1. Continuous and Comprehensive Evaluation (CCE)- Formative
2. Semester End Evaluation (SEE)- Summative

CCE carries 50% of the total marks allotted to a subject and the other 50% being assigned to the SEE.

In each course, every credit carries 25 marks, of which 50% marks is assigned for CCE and rest 50% marks for SEE. The 50% marks assigned to the CCE is distributed between the continuous classroom evaluation and mid-term evaluation. The pattern may be as follow:

SN	Evaluation	*T-3 + P-1 = Total 4 credit subjects (Marks)	2 credit subjects (Marks)
1	**CCE (50%)**		
	Classroom & Mid-Term Evaluation	**T-25 + P- 25**	**T/P – 25** (As per the Course)
2	**SEE (50%)**	**50**	**T - 25**
	Total	**100**	**50**

***T = Theory; P= Practical**

Continuous and Comprehensive Evaluation (CCE)

Subject–wise CCE will be undertaken by the concerned faculty member. The mode of evaluation will be decided by the faculty member concerned with the subject. Normally CCE consists of class participation, case analysis and presentation, assignment, tutorials, slip tests (announced/ surprised), quizzes, attendance etc. or any combination of these. The students are expected to submit their answer scripts/ reports of internal evaluation within the stipulated time. Failure to do so may result in the script not being valued. Another part of CCE consists of mid-term written evaluation, which is compulsory for all students. It can be done in a scheduled manner. The duration of the mid-term evaluation shall be one hour.

Semester End Evaluation (SEE)

The SEE carries 50% of the marks assigned to a course. SEE shall be of 2 ½ hours for 3/4 credit course and 2 hours in case of 1/2 credit courses. The controller of the examination will conduct these examinations. Paper setting and evaluation will be done by the external examiners to an extent of 50% of the evaluation process. This examination shall be conducted as per a schedule which shall be notified in advance.

The backlog exam will be conducted twice a year just after the result declared of the semester evaluation. Students shall have a second chance to clear their backlog and avoid the burden to carry forward the backlog with the next semester exam.

Appearance in all the evaluations is mandatory and no exemption can be granted except in the following case:

1. In case of inability to attend the exam due to reasons considered genuine by the controller of examination in consultation with the Director/Board.

2. In case of medical emergency, a certificate from the registered medical practitioner must be produced before the commencement of exams. The evaluation board will then take final decision on the recommendation for exemption.

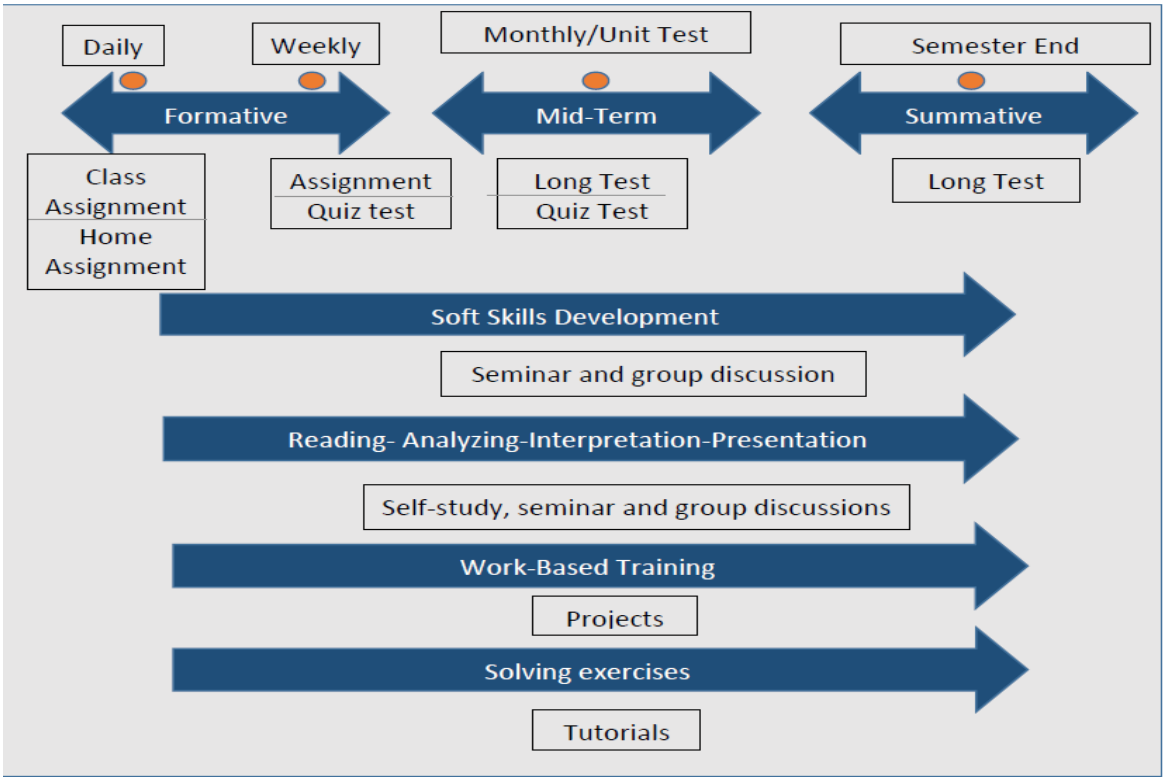
Eligibility Criteria to appear in SEE

To be able to appear for the SEE, a student must comply with the following conditions:

1. Should have at least 75% of attendance in all the courses put together.
2. Should have at least 70% of attendance in each course/subject.
3. Should not have any disciplinary proceedings pending against him/her.
4. Should have no pending due.

Continuum of Evaluation

Evaluation must be continuous which may include both formative and summative components in a timely manner for continuous feedback as follow:



Mode of Evaluation

A wide range of modes of evaluation for evaluating students is available for the teachers/ institutions to use. A suitable compendium of such a mode needs to be carefully chosen for a particular program depending on its nature, objectives, and available resources. The mode of evaluation can be as below:

Written Mode	Oral Mode	Practical Mode	Integrated Mode
Semester Exam Class Test Open book exam/test Open note exam/test Self-test/Online test Essay/Article writing Quizzes/Objective test Class assignment Home assignment Reports writing Research/Dissertation Class Studies	Viva/Oral exam Group Discussion Role Play Authentic Problem Solving Quiz Interview	Lab work Computer simulation/virtual labs Craft work Co-curricular work	Paper presentation/Seminar Field Assignment Poster Presentation

Written Mode		
Evaluation Type	**Nature**	**Objective**
Semester Exam	Traditionally essay type, with objective / short answer questions to evaluate Lower Order Thinking (LOT) OBE skills	For depth and planned preparation
Class test	Traditionally essay type	Fixed date forces students to learn
Open book test	Allowed choice of reference book	Measures what students can do with resources, less stress on memory
Open note test	To get used to the system	Encourage good note taking
Self-test	For subjective and objective items	Mastery learning occurs with proper feedback
Article/essay writing	Individual long written assignment	Individual expression and creativity
Quizzes/Objective test	Short duration structured test	Excellent validity as greater syllabus coverage
Class assignment	With defined time	Student's performance to make decision
Home assignment	With undefined time	Reinforce learning and facilitate mastery of specific skills
Reports Writing	On activities performed or event observed	Develop a key transferable skill
Research/Dissertation	Detailed research-based report	To judge creativity and research skills
Case Studies	Analyse a given case (real or fictional)	To assess thinking, value, and attitude

Oral Mode		
Evaluation Type	**Nature**	**Objective**
Viva/Oral exam	Individually or in small group	Practical experience towards job interview situation
Group discussion	Small group of 2-5 members work on a joint task	Encourage teamwork
Role Play	Small group of 2-5 members work on a joint task	Develop personality
Authenticate problem solving	Small group of 2-5 members work on a joint task	Communication of ideas
Quiz	Small group of 2-5 members work on a joint task	Assess memory power
Interview	Individually	Judge the personal confidence level

Practical Mode		
Evaluation Type	**Nature**	**Objective**
Lab work	Component of working with one's hand	Keep the students on the task
Computer simulation/virtual labs	Component of working with one's hand	To understand the practical exposure
Craft work	Component of working with one's hand	Encourage application of concepts learnt
Co-curricular work	Component of working with one's hand	For immediate feedback

Integrated Mode		
Evaluation Type	**Nature**	**Objective**
Paper presentation/Seminar	Group or individual work	Learn from others presentation
Field Assignment	Field visit with report	Develop observation and recording skills
Poster presentation	Group or individual work	Develop research, creativity, and discussion skills
Paper presentation/Seminar	Group or individual work	Learn from others presentation

Models of Evaluation

Based on the types of evaluation, various models of evaluation implementation are suggested for theory, practical, self-study and work-based learning. The focus of these models is to encourage the students to improve on skills and performance.

Evaluation Norms & Question Paper Pattern for Theory & Practical Courses: Please refer General Guidelines for Implementation of **Four Year Under Graduate Programmes** for Saurashtra University (16 pages) published in August 2023.

Model for 4 Credit Course (Theory-3 + Practical-1)		
CCE-50% (50 Marks) SEE-50% (50 Marks)		
Exam Pattern		**Marks**
Continuous and Comprehensive Evaluation (CCE) – Theory + Practical		**50**
Components of CCE & Weightage – Theory – 25 marks		
1	Class Test / Open Book Test	**10**
2	Assignment (One)	**05**
3	Attendance	**05**
4	Quiz / Presentation / Field visit report	**05**
Components of CCE & Weightage – Practical – 25 marks		
1	Performance / Experiments	**15**
2	Viva voce and Certified journal / Lab quiz	**10**
Semester-End Evaluation (SEE) - THEORY		**50**

Model for 2 Credit Skill Enhancement Course (Theory-1 + Practical -1)		
CCE-50% (25 Marks) SEE-50% (25 Marks)		
Exam Pattern		**Marks**
Continuous and Comprehensive Evaluation (CCE) – Practical – 25 Marks		
1	Performance / Experiments or Project based Assessment	15
2	Viva voce and Certified journal / Lab quiz	10
Semester-End Evaluation – 25 Marks		**25**

Saurashtra University, Rajkot

Question Paper Pattern - 4 Credit Course (Theory) FYUGP-B.Sc. Microbiology Semester – II

Time: 2 hrs. **Max. Marks: 50**

Ques.1 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.1 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.2 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.2 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.3 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.3 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.4 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.4 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.1 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.1 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Saurashtra University, Rajkot

Question Paper Pattern - 2 Credit Course (Theory) FYUGP-B.Sc. Microbiology Semester – II

Time: 1 hrs. **Max. Marks: 25**

Ques.1 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.1 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.2 A. Descriptive **05**

B. Descriptive **05**

OR

Ques.2 A. Objective: **(3x1 = 03)**

a.

b.

c.

B. Descriptive **07**

Ques.3 A. Descriptive **05**

OR

Ques.3 B. Descriptive **05**

Practical Question Paper Pattern

Semester End Examination (SEE)

Instructions:

- Certified journal is compulsory for appearing for semester end practical examination.
- Student should have at least 75% attendance in practical sessions during the semester.
- Time duration: **2** Hours.

Ex. No.	Detail of Exercise	Marks
1	Perform any one from the given list of exercises as per the instruction of the examiner.	15
2	Viva-voce and certified journal	10
	TOTAL	**25**

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – Certificate in Microbiology)

Semester I

Course Category	**Major-1**
Title of the Course	**Fundamentals of Microbiology**
Course Credit	**03 Theory + 01 Practical**
Teaching Hours per Semester	**45 + 30 = 75**
Total Marks	**CCE – 50 + SEE - 50**

Course Outcomes– Cos

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

1. Identify the pioneers of the subject and interpret their contributions that laid the groundwork for modern microbiology.
2. Demonstrate and relate the characteristic features of prokaryotic and eukaryotic cells and major groups of microorganisms and diversity of microbial world with the cultivation and preservation methods of microorganisms.
3. To relate and describe the flow of structural and functional differences among all the microbes and their nutritional requirements for the microbial growth.
4. Identify the influence of microbiology and 21st century challenges and opportunities that arise from our changing relationship with and understanding of microbes.
5. Relate the science of microbes and the social issues and concerns relevant to the field of microbiology.

1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિત થયેલ છે કે નહિ?					Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?					No
3	Major		Yes	Minor		No
	Skill Enhancement Courses		No	Ability Enhancement Courses		No
	Value Added Courses		No	Exit/ Vocational Courses		No
4	Holistic Education	No	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબ નો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મ પર ના MOOC વિષય પર આધારિત આ વિષય છે ?					Yes
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
Unit-I	**Scope and History of Microbiology** • Microbiology as a field of Biology • Mile stones of Microbiology • The Place of Microorganisms in the living world; Distribution of Microorganisms in Nature • Applied areas of Microbiology	**9**	**15**
Unit-II	**Major Groups of Microorganisms** • Difference between Eukaryotes, Prokaryotes and Archaea • Major groups of Microorganisms: Structure and types of Prokaryotic microbes • Eukaryotic Microorganisms: Structure and types of Fungi, Algae, Protozoa • Akaryotic microbe: Structure and types of Viruses	**9**	**15**
Unit-III	**Microscopy** • Microscopy: Introduction and Types • Principle, and working of: Bright field Microscopy, Dark field Microscopy • Principle, and working of: Fluorescent Microscopy, Phase Contrast Microscopy • Electron Microscopy – Types, working and Limitations	**9**	**15**
Unit-IV	**Staining** • Stains and staining solutions • Types of Stains: Natural, Acidic & Basic Stains • Chromophore & Auxochrome groups, Leuco compounds • Types of Staining	**9**	**15**
Unit-V	**Morphology of Microorganisms** • 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, Cytoplasm, Cytoplasmic inclusions, Endospores, Cyst and Nuclear Material.	**9**	**15**

Reference Books:

- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (2003). Microbiology 5th Edition, Tata McGraw-Hill Publication Company
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology 5th edition, New York: WCB Mc Graw Hill publication
- Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
- Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.

- Modi, H.A. Elementary Microbiology - Vol –I & II, Akta Prakashan, Nadiad.
- Atlas. R.M., Principles of Microbiology- 2nd Edition
- Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications,
  Delhi.

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

Suggested reading / E-resources

1. https://www.youtube.com/watch?v=qCn92mbWxd4
2. https://www.youtube.com/watch?v=AZS2wb7pMo4

Suggested MOOCs

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

Sr. No.	Experiments
1	Principles, working, and uses of the following laboratory instruments: a) Microscope b) Incubator c) pH meter d) Refrigerator e) Colorimeter f) Colony counter
2	Principles, working, and uses of the following sterilizers: a) Autoclave b)Hot air oven c) Steam sterilizer d) Inspissator e) Bacteriological filters.
3	Preparation of glassware for sterilization and disposal of laboratory media and cultures.
4	Preparation of Stains and Staining Reagents.
5	Study of Permanent Slides of Bacteria, Fungi, Algae, and Protozoa.
6	Study of bacterial motility by hanging drop method.(Demonstration)
7	Monochrome Staining: a) Negative Staining b) Positive Staining

8	Differential Staining: Gram's Staining
9	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

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. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi
4. Konika Sharma, Manual of Microbiology – Tools and Techniques, Ane books, Delhi

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video

Suggested reading / E-resources

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7757301/
- https://biochemden.com/download-biochemistry-protocols/
- https://www.youtube.com/watch?v=1iYAC6KlSMk
- https://www.youtube.com/watch?v=YO244P1e9QM

Suggested MOOCs

1. https://www.my-mooc.com/en/mooc/biochemistry-biomolecules-methods-and-mechanisms/
2. https://www.edx.org/course/biochemistry-biomolecules-methods-and-mechanisms

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – Certificate in Microbiology)

Semester I

Course Category	**Major-2**
Title of the Course	**Introduction to Microbial Chemistry**
Course Credit	**03 Theory + 01 Practical**
Teaching Hours per Semester	**45 + 30 = 75**
Total Marks	**CCE – 50 + SEE - 50**

Course Outcomes– Cos

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

1. Understand the basics of structure of cellular matter, various types of reactions, pH scale and the special properties of water
2. Understand and differentiate the structure and properties of fundamental biomolecules – Carbohydrate and its types
3. To relate and describe the flow of structural and functional differences among all the amino acids and proteins as found in the microbial systems
4. Identify the structure and basic function of nucleotides. Understand structure of different classes of lipids and their roles in biological systems
5. Outline the chemical and physical properties of enzymes, mechanism of enzyme actions, factors affecting enzyme activity and enzyme synthesis.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?					Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?					No
3	Major		Yes	Minor		No
	Skill Enhancement Courses		No	Ability Enhancement Courses		No
	Value Added Courses		No	Exit/ Vocational Courses		No
4	Holistic Education	No	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબ નો વિષય છે?					No
7	Swayam પ્લેટફોર્મ પર ના MOOC વિષય પર આધારિત આ વિષય છે ?					Yes
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
Unit-I	**Basic Biochemistry** • Introduction to Atoms, Elements & Molecules • Major Chemical bonds found in biological system: Ionic Bonds, Covalent Bonds, Hydrogen Bonds, Van der Waals interactions, Hydrophobic interactions • Major Chemical reactions: Acid Base, Redox, Condensation-Hydrolysis Reactions • Water and pH - important properties	**9**	**15**
Unit-II	**Carbohydrates** • Definition and Classification of Carbohydrates • Structure and properties of Monosaccharide • Types and importance of Disaccharides • Types of importance of Polysaccharides	**9**	**15**
Unit-III	**Proteins** • Definition and Functions of Proteins • Amino acids: Classification • Physical & Chemical Properties of Amino acids • Structure of Proteins: Primary, Secondary, Tertiary & Quaternary Levels	**9**	**15**
Unit-IV	**Lipids and Nucleic acids** • Definition, Functions and Classification of Lipids • Introduction and significance of Fatty acids, Triacylglycerol, Phospholipids and Steroid • Introduction to Nitrogen Base, Nucleosides & Nucleotides, Structure of Deoxyribonucleic acid: A-DNA, B-DNA, Z-DNA • Introduction to RNA & its types	**9**	**15**
Unit-V	**Enzymes** • Definition of Enzymes, Apo- enzyme, Core Enzyme, Holo enzyme, Coenzyme, Cofactors, Prosthetic Groups, and Classification • Mechanism of enzyme action – Active Sites, Activation Energy, Lock & Key Model, Induced Fit model • Factors affecting enzyme activity • Enzyme inhibition	**9**	**15**

Reference Books:

- Atlas, R.M., Bartha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
- Powar, C.B., Daginawala, J.F. (2010). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.
- Conn E.E., Stumpf P.K. (1989). Outlines of Biochemistry, Wiley publication.

- Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.
- Nelson, D.L., Cox, M.M. (2013). Lehninger: Principles of Biochemistry. W.H. Freeman publication.
- Satyanarayan, U. (2008). Biotechnology. Kolkata, West Bengal: Books and allied (P) Ltd

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

Suggested reading / E-resources

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7757301/
- https://biochemden.com/download-biochemistry-protocols/
- https://www.youtube.com/watch?v=1iYAC6KlSMk
- https://www.youtube.com/watch?v=YO244P1e9QM

Suggested MOOCs

- https://www.my-mooc.com/en/mooc/biochemistry-biomolecules-methods-and-mechanisms/
- https://www.edx.org/course/biochemistry-biomolecules-methods-and-mechanisms

Sr. No.	Experiment
1	Measurement and adjustment of pH of various solutions
2	Estimation of Protein by Foiln-Lowry's Method.
3	Estimation of Sugar by Cole's Method.
4	Estimation of Reducing sugar by DNSA method
5	Estimation of DNA by DPA Method.
6	Qualitative Analysis of Carbohydrates.
7	Qualitative Analysis of Proteins & Amino acids.
8	Determination of alpha amylase activity by iodometric method.

Reference Books:

1. Jayaraman, J. (2011). Laboratory Manual in Biochemistry: New Age International Private Limited. India

2. Sawhney S.K., Singh, R. (2005). Introductory Practical Biochemistry: Alpha Science International.
3. Cappuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4th edition: Benjamin Cummings publications

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video

Suggested reading / E-resources

- https://www.classcentral.com/course/edx-biochemistry-biomolecules-methods-and-mechanisms-12585
- https://onlinecourses.nptel.ac.in/noc20_cy10/preview

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – Certificate in Microbiology)

Semester I

Course Category	**Skill Enhancement course-1 (SEC-1)**
Title of the Course	**Basics of Clinical Laboratory**
Course Credit	**01 Theory + 01 Practical**
Teaching Hours per Semester	**15 + 30 = 45**
Total Marks	**CCE – 25 + SEE - 25**

Course Outcomes– Cos

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

1. Work as a technician / helper in a clinical laboratory
2. Decide his academic progression and can plan to take up a degree or diploma course in Laboratory technician
3. Analyze and appreciate the financial and administrative efforts and the expertise required to put in for setting up a clinical laboratory
4. Plan his career in Clinical diagnosis field with more clarity and understanding
5. Self employed after fulfilling the basic educational eligibility.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?					Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?					No
3	Major		No	Minor		No
	Skill Enhancement Courses		Yes	Ability Enhancement Courses		No
	Value Added Courses		No	Exit/ Vocational Courses		No
4	Holistic Education	No	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબ નો વિષય છે?					No
7	Swayam પ્લેટફોર્મ પર ના MOOC વિષય પર આધારિત આ વિષય છે ?					Yes
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					No

Course Content	Hours
UNIT – 1: Laboratory Set-up and Instrumentation	**10hrs**

• Laboratory – types, departments of laboratory and Laboratory set-up
• Laboratory safety – Universal safety precaution (hand hygiene, PPE, biomedical waste management, sterilization, disinfection.), Biohazard, chemical hazard, blood spillage management.
• Different type of equipments/instruments/Glassware and their Principle, procedure, and operation/use., Automation – Hematology, biochemistry, microbiology & serology
• Sterilization and Disinfection:
  • Physical agents- Sunlight, Temperature, steam at atmospheric pressure and steam under pressure, irradiation, filtration.
  • Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide	

UNIT –2: Pre and Post Analytical procedures	**10hrs**
• Types of specimens, their collection, transportation, preservation, and important instructions. • Turn Around Time, Registration process, proper and safe disposal of different categories of bio-medical waste • Diagnostic methods – principle, procedures and reagents, Different types of Laboratory tests • Laboratory Information System, Interpretation of laboratory findings, biological reference value and Reporting of results	
UNIT –3: Quality control & Documentation	**10hrs**
• Quality control (internal & external), LJ Chart, Westgard rules. • Standard Operating Procedures, work desk instructions, formats, registers and Data maintenance. • Accreditation / Certification • Visit to a laboratory and 5-days training.	

Practical:

1. Study of Principle, construction and operation of various instruments used in Clinical laboratory
2. Microscopic analysis of clinical samples by staining procedures
3. Isolation of Pathogens from the clinical samples

Reference Books:

- Text book of medical laboratory technology, Praful Godkar; Bhalani Bhalani Publishing House.
- A Hand Book of D.M.L.T. (Diploma in Medical Laboratory Technology), Payal Soan, Gitesh Amrohit), Vardhan Publishers & Distributors
- Textbook of Medical Laboratory Technology Ramnik Sood Jaypee Brothers Medical Publishers

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment

- Class Activity: Think-Pair-Share / Class Test

Suggested reading / E-resources

- https://www.ncbi.nlm.nih.gov/books/NBK535358/
- https://www.academia.edu/35543991/Basic_Clinical_Laboratory_Techniques_6th
- https://www.youtube.com/watch?v=1iYAC6KlSMk
- https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/medicallabtechnology.pdf

Suggested MOOCs

- https://www.edapp.com/course-collection/free-online-medical-laboratory-courses/
- https://www.edx.org/course/biochemistry-biomolecules-methods-and-mechanisms

Courses Offered by BoS in Microbiology to other FYUGP- B.Sc. Program in Semester-II													
SN	**Course Category** As per GoG- NEP-SOP - July 2023& additional content 28/7/23	**Course Title**	**Credit**			**Hrs./ Week**		**Evaluation - Weightage CCE: SEE = 50:50**					
			T	**P**	**Total**	**T**	**P**	**CCE** Marks		**SEE** Marks		**Total** Marks	
								T	**P**	**T**	**P**		
1	**Minor (Elective)*-1** (Microbiology) (In addition to courses mentioned in SOP basket)	**Microbiology-1:** Fundamentals of Microbiology **(4- Credit Course** including Theory & Practical components)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**	
2	**Multi/Inter-Disciplinary Course -1** (MDC/IDC-1) **(Elective)** (Microbiology) (In addition to courses mentioned in SOP basket)	**Microbiology-2:** Introduction to Microbial Chemistry **(4- Credit Course** including Theory & Practical component)	**3**	**1**	**4**	**3**	**2**	**25**	**25**	**50**	**-**	**100**	

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – Certificate in Microbiology)

Courses Offered by BoS in Microbiology to other FYUGP- B.Sc. Program in Semester-I

Course Category	**Minor Course-1** (In addition to courses mentioned in SOP basket)
Title of the Course	**Fundamentals of Microbiology**
Course Credit	**03 Theory + 01 practical**
Teaching Hours per Semester	**45 + 30 = 75**
Total Marks	**CEE – 50 + SEE - 50**

Course Outcomes– Cos

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

1. Identify the pioneers of the subject and interpret their contributions that laid the groundwork for modern microbiology.
2. Demonstrate and relate the characteristic features of prokaryotic and eukaryotic cells and major groups of microorganisms and diversity of microbial world with the cultivation and preservation methods of microorganisms.
3. To relate and describe the flow of structural and functional differences among all the microbes and their nutritional requirements for the microbial growth.
4. Identify the influence of microbiology and 21st century challenges and opportunities that arise from our changing relationship with and understanding of microbes.
5. Relate the science of microbes and the social issues and concerns relevant to the field of microbiology.

1	Employability/Entrepreneurship/Skill Development પરકેન્દ્રિત થયેલ છે કે નહિ?					Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?					No
3	Major		Yes	Minor		No
	Skill Enhancement Courses		No	Ability Enhancement Courses		No
	Value Added Courses		No	Exit/ Vocational Courses		No
4	Holistic Education	No	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગમાટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબ નો વિષય છે?					Yes
7	Swayam પ્લેટફોર્મ પર ના MOOC વિષય પર આધારિત આ વિષય છે ?					Yes
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
Unit-I	**Scope and History of Microbiology** • Microbiology as a field of Biology • Mile stones of Microbiology • The Place of Microorganisms in the living world; Distribution of Microorganisms in Nature • Applied areas of Microbiology	**9**	**15**
Unit-II	**Major Groups of Microorganisms** • Difference between Eukaryotes, Prokaryotes and Archaea • Major groups of Microorganisms: Structure and types of Prokaryotic microbes • Eukaryotic Microorganisms: Structure and types of Fungi, Algae, Protozoa • Akaryotic microbe: Structure and types of Viruses	**9**	**15**
Unit-III	**Microscopy** • Microscopy: Introduction and Types • Principle, and working of: Bright field Microscopy, Dark field Microscopy • Principle, and working of: Fluorescent Microscopy, Phase Contrast Microscopy • Electron Microscopy – Types, working and Limitations	**9**	**15**
Unit-IV	**Staining** • Stains and staining solutions • Types of Stains: Natural, Acidic & Basic Stains • Chromophore & Auxochrome groups, Leuco compounds • Types of Staining	**9**	**15**
Unit-V	**Morphology of Microorganisms** • 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, Cytoplasm, Cytoplasmic inclusions, Endospores, Cyst and Nuclear Material.	**9**	**15**

Reference Books:

- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (2003). Microbiology 5th Edition, Tata McGraw-Hill Publication Company
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology 5th edition, New York: WCB Mc Graw Hill publication
- Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
- Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.

- Modi, H.A. Elementary Microbiology - Vol –I & II, Akta Prakashan, Nadiad.
- Atlas. R.M., Principles of Microbiology- 2nd Edition
- Purohit, S.S., Microbiology-Fundamentals and Applications-6th Edition, Agrobios Publications,
  Delhi.

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

Suggested reading / E-resources

1. https://www.youtube.com/watch?v=qCn92mbWxd4
2. https://www.youtube.com/watch?v=AZS2wb7pMo4

Suggested MOOCs

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

Sr. No.	Experiments
1	Principles, working, and uses of the following laboratory instruments: a) Microscope b) Incubator c) pH meter d) Refrigerator e) Colorimeter f) Colony counter
2	Principles, working, and uses of the following sterilizers: a) Autoclave b)Hot air oven c) Steam sterilizer d) Inspissator e) Bacteriological filters.
3	Preparation of glassware for sterilization and disposal of laboratory media and cultures.
4	Preparation of Stains and Staining Reagents.
5	Study of Permanent Slides of Bacteria, Fungi, Algae, and Protozoa.
6	Study of bacterial motility by hanging drop method.(Demonstration)
7	Monochrome Staining: a) Negative Staining

	b) Positive Staining
8	Differential Staining: Gram's Staining
9	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

Reference Books:

4. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
5. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
6. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand& Company Ltd., New Delhi

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

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video

Suggested reading / E-resources

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7757301/
- https://biochemden.com/download-biochemistry-protocols/
- https://www.youtube.com/watch?v=1iYAC6KlSMk
- https://www.youtube.com/watch?v=YO244P1e9QM

Suggested MOOCs

3. https://www.my-mooc.com/en/mooc/biochemistry-biomolecules-methods-and-mechanisms/

   https://www.edx.org/course/biochemistry-biomolecules-methods-and-mechanisms

B.Sc. Honours/ Honours with Research in Microbiology

(NCrF Level- 4.5 First Year – Certificate in Microbiology)

Courses Offered by BoS in Microbiology to other FYUGP- B.Sc. Program in Semester-I

Course Category	**Multi Disciplinary Course-1 (MDC)** (In addition to courses mentioned in SOP basket)
Title of the Course	**Introduction to Microbial Chemistry**
Course Credit	**03 Theory + 01 Practical**
Teaching Hours per Semester	**45 + 30 = 75**
Total Marks	**CEE – 50 + SEE - 50**

Course Outcomes– Cos

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

1. Understand the basics of structure of cellular matter, various types of reactions, pH scale and the special properties of water
2. Understand and differentiate the structure and properties of fundamental biomolecules – Carbohydrate and its types
3. To relate and describe the flow of structural and functional differences among all the amino acids and proteins as found in the microbial systems
4. Identify the structure and basic function of nucleotides. Understand structure of different classes of lipids and their roles in biological systems
5. Outline the chemical and physical properties of enzymes, mechanism of enzyme actions, factors affecting enzyme activity and enzyme synthesis.

1	Employability/Entrepreneurship/Skill Development પર કેન્દ્રિત થયેલ છે કે નહિ?					Yes
2	Value added Courses Imparting Transferable and Life Skills ના ગુણો ધરાવે છે?					No
3	Major		Yes	Minor		No
	Skill Enhancement Courses		No	Ability Enhancement Courses		No
	Value Added Courses		No	Exit/ Vocational Courses		No
4	Holistic Education	No	Multidisciplinary	No	Interdisciplinary	No
5	દિવ્યાંગ માટે વિષય અંતર્ગત આનુસાંગિક જોગવાઈ કરાયેલ છે ?					Yes
6	New India Literacy Programme (NILP) મુજબ નો વિષય છે?					No
7	Swayam પ્લેટફોર્મપરના MOOC વિષયપરઆધારિતઆવિષયછે ?					Yes
8	ઇન્ડીયન નોલેજ સીસ્ટમ (IKS) પર આધારિત વિષય છે ?					No

Unit No.	Topics	Hours	Marks
Unit-I	**Basic Biochemistry** • Introduction to Atoms, Elements & Molecules • Major Chemical bonds found in biological system: Ionic Bonds, Covalent Bonds, Hydrogen Bonds, Van der Waals interactions, Hydrophobic interactions • Major Chemical reactions: Acid Base, Redox, Condensation-Hydrolysis Reactions • Water and pH - important properties	**9**	**15**
Unit-II	**Carbohydrates** • Definition and Classification of Carbohydrates • Structure and properties of Monosaccharide • Types and importance of Disaccharides • Types of importance of Polysaccharides	**9**	**15**
Unit-III	**Proteins** • Definition and Functions of Proteins • Amino acids: Classification • Physical & Chemical Properties of Amino acids • Structure of Proteins: Primary, Secondary, Tertiary & Quaternary Levels	**9**	**15**
Unit-IV	**Lipids and Nucleic acids** • Definition, Functions and Classification of Lipids • Introduction and significance of Fatty acids, Triacylglycerol, Phospholipids and Steroid • Introduction to Nitrogen Base, Nucleosides & Nucleotides, Structure of Deoxyribonucleic acid: A-DNA, B-DNA, Z-DNA • Introduction to RNA & its types	**9**	**15**
Unit-V	**Enzymes** • Definition of Enzymes, Apo- enzyme, Core Enzyme, Holo enzyme, Coenzyme, Cofactors, Prosthetic Groups, and Classification • Mechanism of enzyme action – Active Sites, Activation Energy, Lock & Key Model, Induced Fit model • Factors affecting enzyme activity • Enzyme inhibition	**9**	**15**

Reference Books:

- Atlas, R.M., Bartha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
- Powar, C.B., Daginawala, J.F. (2010). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.
- Conn E.E., Stumpf P.K. (1989). Outlines of Biochemistry. Wiley publication.
- Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.
- Nelson, D.L., Cox, M.M. (2013). Lehninger: Principles of Biochemistry. W.H. Freeman publication.

- Satyanarayan, U. (2008). Biotechnology. Kolkata, West Bengal: Books and allied (P) Ltd

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Think-Pair-Share / Class Test

Suggested reading / E-resources

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7757301/
- https://biochemden.com/download-biochemistry-protocols/
- https://www.youtube.com/watch?v=1iYAC6KlSMk
- https://www.youtube.com/watch?v=YO244P1e9QM

Suggested MOOCs

- https://www.my-mooc.com/en/mooc/biochemistry-biomolecules-methods-and-mechanisms/
- https://www.edx.org/course/biochemistry-biomolecules-methods-and-mechanisms

Sr. No.	Experiment
1	Measurement and adjustment of pH of various solutions
2	Estimation of Protein by Foiln-Lowry's Method.
3	Estimation of Sugar by Cole's Method.
4	Estimation of Reducing sugar by DNSA method
5	Estimation of DNA by DPA Method.
6	Qualitative Analysis of Carbohydrates.
7	Qualitative Analysis of Proteins & Amino acids.
8	Determination of alpha amylase activity by iodometric method.

Reference Books:

1. Jayaraman, J. (2011). Laboratory Manual in Biochemistry: New Age International Private Limited. India
2. Sawhney S.K., Singh, R. (2005). Introductory Practical Biochemistry: Alpha Science International.
3. Cappuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4th edition: Benjamin Cummings publications

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Video

Suggested reading / E-resources

- https://www.classcentral.com/course/edx-biochemistry-biomolecules-methods-and-mechanisms-12585
- https://onlinecourses.nptel.ac.in/noc20_cy10/preview