SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

S.Y.B.Sc. Microbiology

Undergraduate Programme

From

Academic year

2024-25

Vision & Mission

Mission:

- Equip the student with knowledge and skills of their chosen vocation.
- Inculcate values.
- Provide them opportunities for all round growth and prepare them for life.

Vision:

•To equip the students with advanced knowledge and skills in their chosen vocation.

•To provide value-based education and opportunities to students.

•To help them to face challenges in life.

•To nurture a scientific attitude, temperament and culture among the students.

•To continually review, develop and renew the approach to build India of the Founder's dream.

Goals and Objectives:

•To build a strong Academia-Industry bridge.

•To provide flexibility in the courses offered and proactively adapt to the changing needs of students and the society.

•To establish a centre for multidisciplinary activities.

•To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

Board of studies (BoS) in Microbiology

Undergraduate and Post graduate

	Name	Designation	Institute/Industry
1	Dr. Lolly Jain	Chairperson	Head of the Department, K. J. Somaiya College of Science and Commerce, Mumbai
Subject Experts nominated by the Vice-Chancellor			
1	Dr. Pramod Ghogare	Assistant Professor	Head Dept. of Microbiology, SIES College, Sion, Mumbai
Subject experts outside parent University			
1	Dr. Nilima Shivale	Assistant Professor	School of Biotechnology and Bioinformatics D. Y. Patil deemed to be University, Navi Mumbai
2	Dr. Pratibha Shah	Associate Professor	Dept. of Microbiology, K. C. College HSNC University, Mumbai
Other members of the same faculty			
1	Prof. Bela Nabar	Professor	Head. Dept. of Microbiology, C.H.M. College, Ulhasnagar, Thane
2	Prof. Savanta Raut	Professor	Head. Dept. of Microbiology, Bhavans College, Andheri, Mumbai
Representatives from industry/ corporate sector/ allied area			
1	Dr. Vikrant Bhor	Scientist E and Head	Department of Molecular Immunology and Microbiology, ICMR

2	Dr. Dina Saroj	Principal Scientist	Advanced Enzyme Technologies Limited, Mumbai

Meritorious alumnus			
1	Dr. Meenal Dukhande	Associate Professor	Dept. of Microbiology, G. N. Khalsa College, Matunga Mumbai
Faculty of the specialization			
1	Dr.Soniya Shetty	Associate Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
2	Mr. Shabib Khan	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
3	Ms. Versha Peghwal	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
Experts from outside the College whenever special course of studies are to be formulated (Molecular Biology expert)			
1	Dr.Tejas Chirmade	Senior Research Associate III	Bioanalytical Team, US Vitamins, Govandi Mumbai
Invited Members			
1	Ms. Kiran Surve	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce

2	Ms. Poonam Shinde	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
3	Ms. Tarannoom Khan	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
4	Ms. Pooja Nandi	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce
5	Ms. Dhanashree Tambe	Assistant Professor	Dept of Microbiology, K. J. Somaiya College of Science and Commerce

Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K J Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our college.

Autonomous college carries a prestigious image for the students and the teachers, and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the students, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy.

This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

Dr. Pradnya Prabhu
Principal

Acknowledgement

At the outset, I would like to thank our Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Microbiology for the long and arduous work they have put in during the compiling of the restructured syllabus.

Dr. Lolly Jain

Chairperson, Board of Studies in Microbiology

Table of Contents

Preamble

Microbiology, to the common man, is the study of invisible mini wonders that only cause disease. In reality, the vast majority of microorganisms co-exist alongside us without causing any harm. On the contrary, many of them are required for our survival. Microbiology is a study of this microscopic world. It is a research-oriented subject and plays a pivotal role in our daily lives. Microbiology is an indispensable part of our routine life. We are associated with the diverse world of microorganisms and depend on the different products produced by them. Microbiome is essential for the functioning of human development and immunity. Along with this the presence of microorganisms in air, soil and water substantiates their environmental significance. Microbiology is the branch of science which deals with study of microorganisms with emphasis on their morphology, biochemistry and industrial applications in diverse fields. Microbial cell-based technologies enhance our quality of life by providing new solutions to problems in the health, environment and energy sector. The syllabi for the three-year undergraduate programme are designed to enable the students to understand and select an area of their interest to pursue further studies for post-graduation.

Education is one of the most critical yardsticks in any country's development. The new National Education Policy (NEP) 2020 is an essential and comprehensive policy framework that aims to revamp the country's educational system from its foundation and to bring it at par with global standards. The larger aim of this policy is to transform the Indian education system by making it more inclusive, flexible and relevant to the changing needs of the society. Some of the key features of this policy are the

introduction of vocational training, elective courses, emphasis on cultural studies, development of global skill sets and the promotion of multilingualism.

The policy seeks to bring about significant changes in the Higher Education structure, such as introducing a four-year undergraduate degree Programme, establishing multidisciplinary education and research universities, pooled credit bank and creating a National research Foundation to promote and support research activities in various fields. The new education policy enables every student to get quality education irrespective of their socio-economic background, gender or disability. NEP 2020 enables teachers to use a variety of learning techniques and experiments.

In the current fast paced world, simply cascading the knowledge in the classroom is not sufficient especially when the global requirements keep changing. Every learner should be encouraged to exchange ideas and thoughts in a collaborative approach. This leads to develop an environment which is cognitive in nature and not a one-way information flow. Keeping all this in mind, the curriculum under Learning Outcome-based Curriculum Framework (LOCF) is designed.

This Learning Outcome-based Curriculum Framework (LOCF) supports the fundamental principle of providing quality education in India. Our focus is to involve young minds to participate, contribute and add value at each stage in the field of their study. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum in multiple folds.

The LOCF will certainly help teachers to envisage the outcome expected from the learners at the end of the programme. For students, it will be a guide which

shows how this curriculum will help them acquire all the skills and knowledge which are essential in their personal and academic growth. Higher education qualifications such as bachelor's degree Programme are awarded on the basis of demonstrated achievement of outcomes and academic standards; and this is the very essence of this curriculum.

I. Introduction

The B.Sc. Microbiology programme is developed by keeping in mind interest of learners to explore the field of Microbiology. The framework helps to maintain the standard of Microbiology degrees/programmes through periodic programme review within a broad framework of agreed/expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The B.Sc. programme is planned in such a way that it allows flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students' learning levels.

This curriculum framework is developed on the principles of student centric learning pedagogy. The platform intends to empower graduates with the skills required for pursuing Microbiology-related careers, higher education in Microbiology and allied subjects.

Various graduate attributes are emphasised in this framework such as critical thinking, basic psychology, scientific reasoning, moral ethical reasoning, etc. While designing this framework, an important aspect considered was the measurable teaching-learning outcome to ensure employability of the graduates. Implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms are suggested through this framework. The framework also focuses on issues relevant to India and also of the rest of the world.

Every course is designed in such a way that students get decent exposure to each topic by keeping equilibrium between these topics and thus creating

interest to pursue further education in the field of Microbiology. It covers the basic concepts of Microbiology to establish a strong foundation of the subject and helps students to explore the subject more. B.Sc. Microbiology programme offers learners access to fundamental concepts in Microbiology and opens horizons to explore recent trends in the subject. There is substantial scope for interdisciplinary collaborative research with other allied branches of Biology. The programme fosters scientific temperament among the learners and enriches problem solving skills. It is designed to bring out the intellectual potential of the learner and also allow the learner to keep pace with the recent advances in Microbiology.

After introducing the basics of Microbiology in Semester I and Semester II, syllabus progresses to include the topics of Immunology, Genetics, Biochemistry, Virology, Taxonomy, Dairy Microbiology, basic and advanced Instrumentation in Semester III and Semester IV.
Semester V and Semester VI while focusing on the depth and applications of the above topics will also include topics of Population genetics, Emerging infectious diseases, Bioinformatics, Advanced Virology and basic Nanotechnology. As mentioned in the syllabus, all the two courses of theory & practical are compulsory to B.Sc. Microbiology students (Semester I and II).

The practical sessions will help the students to gain sufficient skills in Microbiological analysis of infections, food substances, preparation of media, biochemistry of cell, viral assays, bioassays, etc. Students are also encouraged to improve their scientific writing skills through various assignments. The research-based project work in the curriculum ensures team building attitude within students and utilise every aspect of the team members in the success of any

project. The project evaluation method is designed in such a way that it helps in creating a strong background for the research, skills to generate systematic reports and create effective presentation.

2. Learning Outcome based Curriculum Framework

LOCF focuses on curriculum framework, curriculum aims, learning targets and objectives. The curriculum framework also provides examples of effective learning, teaching and assessment practices. As the curriculum development is a collaborative and an on-going enhancement process, the LOCF instructs periodic reviews and revisions of the curriculum in accordance with the ever-changing needs of students, teachers and society.

The framework describes how students are given exposure towards core knowledge of the subject, specialisation, choice based learning and other skill enhancement courses ensuring development of an integrated personality and employability. The template defines expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness along with specific learning course outcomes at the starting of each course. The Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Microbiology will certainly be a valuable document in the arena of outcome-based curriculum design.

2.1 Nature and extent of B.Sc. Microbiology

Degree programme in Microbiology is designed to include cutting edge core topics from Genetics, Immunology, Molecular Biology, Biochemistry and Industrial Microbiology in a perfect balance. The scope of individual topics varies with the nature of specific Microbiology branches. In our endeavour to improve the employability of graduates of Microbiology programme, the curriculum offers courses on Dairy Microbiology, Antimicrobial Chemotherapy and Agricultural Microbiology. The B.Sc. Microbiology programme is of three years duration. Each year is divided into two semesters. The total number of semesters are six/eight. The teaching and learning in the B.Sc. Microbiology programme will involve theory classes (lectures) and practical.

The curriculum will be taught through formal lectures with the aid of Power-point presentations, audio and video tools and other teaching aids can be used as and when required. Wherever possible RBPT (Research based pedagogical tool) approach will be adopted to make the process of learning more learner centric. ICT-based teaching-learning tools will be incorporated through which even the mundane aspects could be made more interesting and relevant.

2.2 Programme Education Objectives (PEOs)

The overall aims of bachelor's degree programme in Microbiology are to:

1. Present elementary information about different aspects of Microbiology to learners.
2. Enable the learners to use this information in Microbiology for creating a better society.
3. Create an enriching learning environment for the learners to inculcate a deep interest in applying Microbiology concepts to solve real-life problems.
4. Facilitate choice-based student-centric learning systems.

5. Empower the learners by developing their ability to use their knowledge and skills to handle the specific theoretical and applied problems in Microbiology.
6. Encourage the learners to pursue advanced studies related to Microbiology by creating a concrete base of the fundamental concepts.
7. Provide the learners with a sense of interconnectedness among the various domains of Microbiology.
8. Enhance the analytical skills of the learners and enable them to think, analyze and develop a research-oriented perspective.
9. Assist the learners to develop an array of generic skills which are helpful in creating employment and business opportunities.

3. Graduate Attributes in Microbiology

Attributes expected from the graduates of B.Sc. Microbiology Programme are:

GA-1. Disciplinary knowledge: Comprehensive knowledge of the fundamentals of Microbiology with emphasis on the knowledge of recent developments in the various fields of Microbiology.

GA-2. Scientific reasoning: Ability to analyze, interpret the quantitative/qualitative data, while performing bacteriological techniques

GA-3. Analytical reasoning: Draw valid conclusions from the experimental data.

GA-4. Research-related skills: Awareness about research planning and ethical considerations in all the allied fields of Microbiology.

GA-5. Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

GA-6. Communication Skills: Expertise in communication skills: personal, scientific and professional.

GA-7. Leadership readiness/qualities: Gained life skills such as teamwork, leadership, patience as a result of group project participation.

4. Qualification descriptors

Undergraduate degree programmes of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

- A 'UG certificate' is awarded to students who opt to exit after completing 1 year (2 semesters) of study in the chosen fields of study with having secured 44 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
- A 'UG diploma' is awarded to students who opt to exit after 2 years (4 semesters) of study with having secured 88 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
- A Bachelor's degree is awarded after a 3-year (6 semesters) programme of study in major discipline with having secured 132 credits and minimum credit requirements as follows

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	48
2	Minor Stream Course	20
3	Discipline Specific Elective Course	06
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04

7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	20
10	Open Elective Course	10
Total		132

- After completing the requirements of a three-year Bachelor's degree, candidates who meet the minimum CGPA of 7.5 shall be allowed to continue studies in the fourth year of undergraduate program to pursue and complete Bachelor's degree with honours/research (subject to change).
- A 4-year Bachelor's degree (honours) is awarded after eight semesters programme of study with having secured 176 credits and minimum credit requirements as follows:

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	76
2	Minor Stream Course	24
3	Discipline Specific Elective Course	14
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	24
10	Open Elective Course	10

Total	176

- They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree with Research.

  The 4-year bachelor's degree programme is considered a preferred option since it would provide the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

  Upon successful completion of the programme, students receive B.Sc. degree in Microbiology. B.Sc. Microbiology graduates of this department are expected to demonstrate the extensive knowledge of various concepts of Microbiology and its application thus contributing in research, development, teaching, government and public sectors. This programme will establish a foundation for students to further pursue higher studies in Microbiology. The list below provides a synoptic overview of possible employment areas provided by an undergraduate training in Microbiology.

The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Microbiology:

1. Academics
2. Research
3. QC and QA departments in pharmaceutical industries
4. Government or Private Food and Water Testing Laboratories
5. Medical Laboratory Technology

6. Food Packaging and Dairy Microbiology firms
7. Cosmetic industry
8. Fermentation Industries
9. Agrochemical Industry
10. Forensic science department
11. Agricultural industry
12. Clinical analyst and medical coding

Job Roles for B.Sc. Microbiology graduate:

After graduation one can seek a professional career as:

1. A technician in an Instrumentation Laboratory

2. An officer in a Research Laboratory, Hospitals, Blood Banks and Public Health Sector

3. QC and QA manager in Pharmaceutical, Cosmetics, Fermentation and other industries as a technician in Food, Dairy, Water testing and Pathology Laboratory

4. Project fellow

5. Entrepreneur

6. Civil services

7. Competitive exams

Higher Education options for B.Sc. Microbiology graduate:

1. M.Sc. Microbiology by Papers or M.Sc. Microbiology by Research

2. M.Sc. in a specialized branch of biological sciences (Life Sciences, Environmental Science, Biochemistry, Biotechnology)

3. Ph.D. in Microbiology

4. MBA, PG Diploma in Medical Laboratory Technology (PGDMLT) or any other relevant PG Diploma.

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's degree in Microbiology.

5. Programme Specific Outcomes (PSOs)

After the successful completion of B.Sc. Microbiology programme, the learner will be able to:

PSO I: Implement the principles of Microbiology in day-to-day life.

PSO II: Apply the basic knowledge of Microbiology to diverse areas such as Genetics, Medical Microbiology, Immunology, Biochemistry, Molecular Biology, Cell-biology, Food and Industrial Microbiology and analytical techniques.

PSO III: Demonstrate competency in Microbiological practical skills.

PSO IV: Evaluate problems involving Microbiology and undertake remedial measures to solve them.

PSO V: Express his/her views on Microbiology related topics effectively through oral and written communication.

PSO VI: Plan a professional career to provide innovative solutions to challenging societal problems, along with peers.

PSO VII: Analyse, interpret and draw conclusions from data.

5.1 Course Mapping

Semester	PSO	I	II	III	IV	V	VI	VII
	Course							
III	MJ I	✓	✓	✓	✓	✓	✓	✓
	MJ II	✓	✓	✓	✓	✓	✓	✓
	SEC	✓	✓	✓	✓	✓	✓	✓
	VSC	✓	✓	✓	✓	✓	✓	✓
	AEC							
	CC:NCC:SP:FP							
	OE							
	IKS	✓			✓	✓	✓	✓
IV	MJ I	✓	✓	✓	✓	✓	✓	✓
	MJ II	✓	✓	✓	✓	✓	✓	✓
	SEC	✓	✓	✓	✓	✓	✓	✓
	VSC	✓	✓	✓	✓	✓	✓	✓
	AEC							
	CC:NCC:SP:FP							

	OE							

6. Structure of B.Sc. Microbiology programme

The curriculum framework is designed around the choice-based credit system (CBCS). The programme consists of three years UG having six semesters (two semesters per year) or four years UG (Honours) having eight semesters (two semesters per year). Credit Distribution for Eight Semester is as follows:

Semester	MJ	DSE	SEC	VSC	MN	AEC	VEC	IKS	CC	FP	INT / APT	OE	Total
I	6	-	-	-	6	4	2	-	2	-	-	2	22
II	6	-	-	-	6	3	2	1	2	-	-	2	22
III	6	-	3	2	4	1	-	1	2	-	-	3	22
IV	6	-	3	2	4	-	-	-	2	2	-	3	22
V	12	-	-	-	-	-	-	-	-	2	8	-	22
VI	12	6	-	4	-	-	-	-	-	-	-	-	22

BSc with Honours – 22 credits in Sem VII and VIII

BSc with Research – 22 credits in Sem VII and VIII

To acquire a degree in B.Sc. Microbiology a learner must study

1. **Major Core Courses (MJ):**

   a) A course which is required to be opted by a candidate as a major core course. The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular subject or discipline.

b) Students may be allowed to change major within the broad discipline at the end of the second semester by giving him/her sufficient time to explore interdisciplinary courses during the first year.

c) There are twenty-four Major Core courses (MJ), two each, in semesters I to IV; and four each in semesters V to VIII.

d) Each Major Core Course is compulsory.

e) Each Major Core Course from semester I to VI is comprised of 2 credits for theory i.e. 30 hours; 2 lectures of each 1 hour per week and 1 credit for practical of two hours per week in every semester.

f) Each Major Core Course from semester VII and VIII is comprised of 2 credits for theory i.e. 30 hours: 2 lectures of each 1 hour per week and 1.5 credits for practical of three hours per week in every semester.

g) The purpose of fixing major core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standards with other universities/institutions.

2. Minor Stream Course (MN):

a) A course is chosen by a candidate from the interdisciplinary stream as a minor course. Minor Stream courses help a student to gain a broader understanding beyond the major discipline.

b) Students who take a sufficient number of courses in an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline.

c) Students may declare the choice of the minor stream course at the end of the second semester after exploring various courses.

d) There are two each Minor stream course (MN), in semesters I and II. This Minor stream is comprised of 2 credits for theory i.e. 30 hours; 2

lectures of each 1 hour per week and 1 credit of practical of two hours per week in every semester.

e) There is one each Minor stream course (MN) in semester III and IV. This Minor stream is comprised of 2 credits for theory i.e. 30 hours; 2 lectures of each 1 hour per week and 2 credits for practical of four hours per week in every semester.

f) Each Minor stream Course is compulsory.

3. Ability Enhancement Courses (AEC)

a) The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.

b) Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills.

c) There are five AEC courses spread over three semesters (I to III).

d) Each student is supposed to take two AE in semester I - English language and Modern Indian language of 2 credits each.

e) There are two AEC in semester 2 - English language of two credits and Modern Indian language of 1 credit.

f) There is one AE in semester 3 - Modern Indian language of 1 credit.

4. Value Education Courses (VEC)

a) The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, sustainable development and living.

b) The VEC courses offered are:

VEC I- Environmental Science I (2 credits) (Semester I),

VEC II- Environmental Science II (2 credits) (Semester II).

5. Co-Curricular courses (CC):

a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.

b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.

c) There are two CC each in semester I to III – NCC (compulsory 1 credit course) and Other one from Music/Sports training program/Yoga/ Study Circle

d) There are three CC each in semester IV – NCC (compulsory 1 credit course), second one from Music/Sports training program/Yoga/ Study Circle of 1 credit and third one is Field project of 2 credits.

e) There are two CC in semester V – Internship/ Apprenticeship (8 credit) and Field project (2 credit)

6. Open Elective (OE)

a) They are designed to provide multidisciplinary education.

b) Students can opt for one interdisciplinary Open Elective Course (OE) in each of semester I and II of two credits each.

c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of semester III and IV of three credits each.

d) Open courses are offered in cognate disciplines by different departments in the college.

7. **Indian Knowledge System (IKS)**

a) They are designed to recognize the rich heritage of ancient and eternal Indian knowledge and thought as a guiding principle.

b) Students can opt for one General IKS in semester II – Indian cultural Heritage of one credit.

c) There is one IKS based on major subject in semester III of 1 credit.

8. **Skill Enhancement Course (SEC):**

a) They are designed to provide skill-based knowledge pertaining to the Major course to the learner.

b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.

c) There are two skill enhancement courses offered. Each student is supposed to take one SEC in each semester III and IV of 3 credit each (2 credit theory and 1 credit practical).

9. **Discipline Specific Elective Courses (DSE):**

a) Elective courses are offered under the major course subject of study.

b) There are two discipline specific elective courses (DSE), offered in semesters VI of 2 credits theory and 1 credit practical.

c) There is one discipline specific elective course (DSE), offered in semesters VII and VIII each of 2 credits theory and 2 credit practical.

d) There is one advanced level disciplinary course – Research Methodology of 4 credits offered in semester VII.

10. Vocational Skill Course (VSC)

a) Vocational courses are designed to provide practical, hands-on training, competencies, and proficiency to students, ultimately enhancing their skills and employability.

b) These courses are tailored to prepare individuals for specific careers and industries.

c) There are two VSC offered, one each in semester III and IV, each one is of two credits.

d) There is one VSC offered in semester VI of 4 credits.

11. On Job Training (OJT)

a) On Job training of 4 credits is offered in semester VIII to enhance the specific skills and competencies required for a particular job

b) OJT bridges the gap between theory and practical application, promoting a deeper understanding of concepts.

12. Internship/ Apprenticeship

a) Internship/ Apprenticeship have a prominent role in linking higher education with the requirements of industry and the world of work. Students are offered internship/ apprenticeship embedded degree program to fulfil the objective of improving employability and forming robust industry academia linkage.

b) Internship/Apprenticeship of 8 credits is offered in semester V.

c) Field based learning /project should provide opportunities for students to understand the different socio-economic contexts. It aims at giving the students exposure to development related issues in rural and urban settings.

d) Two field projects each 2 credits are offered one in each semester IV and V.

6.1 Content

Sr. No	Semester	Course number	Course Code	Course title
1	III	MJ I	24US3MBMJIVAT	Virology and Taxonomy
2		MJ II	24US3MBMJ2BIM	Biomolecules
3		MJ P	24US3MBMJP	Based on MJ I and MJ II
4		MN		Course form Chemistry
5		MN P		Based on Minor selected
6		SEC	24US3MBSECHMI	Host Microbe Interactions
7		SEC P	24US3MBSECP	Based on SEC
8		VSC	24US3MBVSCP	Dairy Microbiology
9		AEC I		Modern Indian Language Level I (Hindi/Marathi)
10		CC	24US3CCEMI	Emotional Intelligence
11		IKS	24US3MBIKSVSM	Vedic Sukshmjeevanushastra
12		OE	24US3OEFHR / 24US3OEIFM / 24US3OESCW	Fundamentals of Human Rights / Introduction to Financial Market /Scientific Writing

Sr. No	Semester	Course number	Course Code	Course title
13	IV	MJ I	24US4MBMJICBC	Concepts in Biochemistry
14		MJ II	24US4MBMJ2IMI	Industrial Microbiology
15		MJ P	24US4MBMJP	Based on MJ I and MJ II
16		MN		Course from Chemistry
17		MN P		Based on Minor Selected
18		SEC	22US4MBSECIMM	Introduction to Immunology
19		SEC P	24US4MBSECP	Based on SEC
20		VSC	24US4MBVSCP	Soil and Agriculture microbiology
21		FP	24S4MBFP	Field Project
22		CC I	24US4CCSOL	Science of Life
23		CC II	24US4CCSPT	Sports Training Program
24		OE	24US4OEIWC / 24US4OEEGI / 24US4OEISS	Basic Of Investment And Wealth Creation / Emerging Gender Issues in India / Introduction to Soft Skills

6.2 Credit distribution for S.Y.B.Sc. Microbiology

Semester	Course number	Course title	Credits		
III			Theory	Practical	Total
	MJ I	Virology and Taxonomy	2	1	3
	MJ II	Biomolecules	2	1	3
	MN		2	1	3
	MN P		-	1	1
	SEC	Host Microbe Interactions	2	1	3
	VSC	Dairy Microbiology	-	2	2
	IKS	Vedic Sukshmjeevanushastra	1	-	1
	AEC I		1	-	1
	CC:NCC, SP:FP		2	-	2
	OE		3	-	3
	Total				**22**
IV	MJ I	Concepts in Biochemistry	2	1	3
	MJ II	Industrial Microbiology	2	1	3
	MN		2	1	3

	MN P		-	1	1
	SEC	Introduction to Immunology	2	1	3
	VSC	Soil and Agriculture microbiology	-	2	2
	IKS		-	-	-
	AEC		-	-	-
	CC:NCC, SP:FP		2 + 2FP	-	4
	OE		3	-	3
	Total				**22**

6.3 Semester Schedule

Semester	Major Core Courses (MJ)	Minor Stream Courses (MN)	Ability Enhancement Courses (AE)	Value Added Course (VA)	Indian Knowledge System (IK)	Co-Curricular Course (CC)	Open Elective (OE)
III	I] MJ I Virology and Taxonomy 2] MJ II Biomolecules 3] MJ SEC Host Microbe Interactions 4) MJ VSC Dairy Microbiology	1) MN Chemistry 2) MN P (Practical's) Chemistry	Modern Indian Language		MJ IKS Vedic Sukshmjeevanushastra		
IV	I] MJ I Concepts in Biochemistry 2] MJ II Industrial Microbiol	I) MN Chemistry 2) MN P (Practical's) Chemistry				2 +2FP	

	ogy 3] MJ SEC Introduction to Immunology 4) MJ VSC Soil and Agriculture microbiology						

6.4 Course Learning Objectives

The three-year undergraduate Microbiology programme is designed to familiarize students with significant developments in Microbiology. The objective of structured syllabus in Microbiology is to make the concepts and basics of Microbiology clear and interesting to students and also to ensure the development of vertical growth in the subject. The idea behind this is to enable students to develop analytical skills and critical thinking.

It is our attempt that students achieve this objective through systematic reading and class lectures and through feedback on their written work-assignments, project/research papers, presentations, discussions, debates, etc. Our intention is to enable students to formulate cogent arguments, presenting the necessary evidence to establish these, based on training in Microbiology.

7. Detailed B.Sc. Micobiology Syllabus

S. Y. B.Sc. Syllabus with effect from the Academic year 2024–2025

Syllabus – S. Y. B.Sc. Microbiology

Course No.	Course Title	Course Code	Credits	Periods (1 Hr)	Module	Lectures per module (1 hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER III									
Major Core courses THEORY									
I	Virology and Taxonomy	24US3MBMJIVAT	2	30	2	15	20	30	50
II	Biomolecules	24US3MBMJ2BIM	2	30	2	15	20	30	50
SEC	Host Microbe Interactions	24US3MBSECHMI	2	30	2	15	20	30	50
IKS	Vedic Sukshmjeevanushastra	24US3MBIKSVSM	1	15	1	15	25		25
Core courses PRACTICAL									
		24US3MBMJP	2	60			50		50

		24US3MBSECP	1	30			25		25
VSC		24US3MBVSCP	2	60			50		50
SEMESTER IV									
Major Core courses THEORY									
I	Concepts in Biochemistry	24US4MBMJICBC	2	30	2	15	20	30	50
II	Industrial Microbiology	24US4MBMJ2IMI	2	30	2	15	20	30	50
SEC	Introduction to Immunology	24US4MBSECIMM	2	30	2	15	20	30	50
Core courses PRACTICAL									
		24US4MBMJP	2	60			50	50	60
		24US4MBSECP	1	30			25	25	30
VSC		24US4MBVSCP	2	60			50	50	60

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - I

COURSE TITLE: Virology and Taxonomy

COURSE CODE: 24US3MBMJIVAT [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the course, the learner will be able to: 1. Describe the structure, classification, replication and life cycle of different viruses and their major features. 2. Evaluate the different methods employed in bacterial taxonomy.		
Module 1	Basics of Virology	[15L]
Learning Objectives: 1. To discuss the basic concepts of viral architecture. 2. To introduce the basis of viral classification. 3. To describe the replication of different types of viruses.		
Learning Outcomes: After the successful completion of the module, the learner will be able to: 1. Describe the structure of different types of viruses with one example each. 2. List the criteria for viral classification. 3. Describe the replication of different viruses and compare major features.		
1.1	**Viral architecture**- Virus structure and morphology of plant (TMV) and animal viruses (Influenza virus, HIV)	[3]
1.2	**Viral classification**: Baltimore, ICTV	[3]
1.3	**General introduction to viral replication** - Attachment, penetration and un-coating, types of viral genome, their replication (genome replication of DNA and RNA viruses)	[3]

	assembly, maturation, and release.	
1.4	**Life cycle of the following plant and animal viruses:** Plant virus - Tobacco Mosaic virus Animal virus - Influenza and HIV	[5]
1.5	**Introduction to the features of Viroids and Virusoids**	[1]

References:

- Shor's T. (2009). Understanding Viruses.1st edition Massachusetts: Jones and Bartlett Publisher.
- Carter J.(2007). Virology-Principles and Applications: John Wiley & Sons, Ltd.
- Madigan, Martinko, Stahl, and Clark. (2020). Brock: Biology of Microorganisms. 13th edition. Pearson.
- Prescott, Harley, and Klein. (2008). Microbiology. 7th edition. McGraw Hill international edition.

Module 2	Taxonomy	[15L]

Learning Objectives:

1. To explain the basic concepts under taxonomy.
2. To discuss the phylogenetic and classical approaches employed in bacterial taxonomy.

Learning Outcomes:
After the successful completion of the course, the learner will be able to:

1. Explain the rules of binomial nomenclature.
2. Apply the concepts of phylogenetic and classical approaches of taxonomy.
3. Evaluate the newer methods of bacterial taxonomy.

2.1	Taxonomic ranks and Binomial Nomenclature	[2]
2.2	Phylogenetic approach and Classical approach to taxonomy	[1]
2.3	Numerical taxonomy	[4]
2.4	Newer methods to Bacterial Taxonomy: a) DNA base composition and Tm b) Nucleic acid Hybridisation c) DNA Sequencing-Sanger's method d) RNA Fingerprinting and Sequencing. e) Ribotyping f) Fatty acid analysis g) Automated analysis: VITEK and API	[7]
2.4	Introduction to Bergey's Manual	[1]

References:

- Stanier. R.Y., Ingraham, J.L., Wheelis, M.L., Painter, R.R, (1987). General Microbiology, 5th edition. The Macmillan press Ltd.
- Frobisher, M. (1974) Fundamentals of Microbiology.9th Edition. W. B. Saunders Company.
- Madigan, Martinko, Stahl, and Clark. (2020). Brock: Biology of Microorganisms. 13th edition. Pearson.
- Prescott, Harley, and Klein. (2008). Microbiology. 7th edition. McGraw Hill international edition.

Question paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - I

COURSE TITLE: Virology and Taxonomy

COURSE CODE: 24US3MBMJIVAT [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5		25
II	5	5	5	5	5		25
Total marks per question	10	10	10	10	10		50
% Weightage	20%	20%	20%	20%	20%		100

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - II

COURSE TITLE: Biomolecules

COURSE CODE: 24US3MBMJ2BIM [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the course, the learner will be able to: 1. Describe the structure and role of biomolecules. 2. Explain structural aspects of ds-DNA and prokaryotic chromosomes and features of the Genetic code.		
Module 1	Introduction to Microbiology and Chemical basis of life	[15L]
Learning Objectives:		

1. To familiarise the learner with the structure of biomolecules. 2. To describe the role of biomolecules in a living cell.		
Learning Outcomes: **After the successful completion of the module, the learner will be able to:** 1. List the different types of chemical bonds in biomolecules. 2. Describe the role of biomolecules in a living cell.		
1.1	**Chemical basis of life:** Revision of basic chemical structure of an atom Types of chemical bonds and their relevance in biomolecules: Ionic, Covalent and Hydrogen	[1]
1.2	**Structure and Role of water:** Polar nature of water and its four characteristics	[1]
1.3	**Carbohydrates:** Description of structure and functions of: i. Monosaccharides (Hexoses and pentose) ii. Disaccharides (Lactose, Maltose and Sucrose) iii. Polysaccharides (Function of: Glycogen, Cellulose, Dextran, Chitin and Starch) **Significance of sugar derivatives:** Inulin, Pectin, Mannitol, Inositol and Gluconic acid	[4]
1.4	**Amino acids and Proteins:** i. 20 standard amino acids and their classification. ii. Basic stereochemistry : Peptide bond and its features iii. Levels of structure of proteins: Brief description of- Primary structure, Secondary structure, Tertiary structure and Quaternary structure	[5]
1.5	**Lipids:** Structure and function of: i. Simple lipids ii. Complex lipids	[4]

References:

- Microbiology-An Introduction. (1998) 6th Edition. Tortora Funke and Case. Addison Wesley Longman Inc.
- Microbiology. (2001), 5th Edition. Lansing M. Prescott, Harley and Klein. McGraw Hill Higher Education, New York.
- Madigan, M., Martinko, J., Parkar, J., (2009), Brock Biology of microorganisms, 12th edition. Pearson Education International.

Module 2	Informational macromolecules	15L

Learning Objectives:

1. To familiarize the learner with the central dogma of the cell.
2. To discuss the structural aspects of RNA, ds DNA and prokaryotic chromosomes.
3. To explain the features of the Genetic code.

Learning Outcomes:
After the successful completion of the module, the learner will be able to:
1. List the contributions of prominent scientists in elucidating the structure of the double helix.
2. Explain the structural features of double stranded DNA.
3. Describe the organization of DNA in a prokaryotic chromosome.
4. Differentiate between A, B and Z forms of DNA.
5. List the different types of RNAs and their functions.
6. Describe features of Genetic code and variations of the code.
7. Analyse reasons for degeneracy of the genetic code.

2.1	**Central dogma of the cell** i. Informational macromolecules ii. Basics of exons and introns iii. Introduction to special types of RNA- snRNA, siRNA, snoRNA, miRNA and stRNA (Only definitions)	[4]
2.2	**Organization of DNA in prokaryotic chromosomes** Structure of double helix DNA: i. Features	[6]

	ii. Discovery iii. A, B and Z forms of DNA iv. Important features of DNA structure-Palindrome structures Circularity, Supercoiling of prokaryotic chromosome and role of Topoisomerases	
2.3	**Genetic Code** i. Historical perspective ii. Features of the genetic code iii. Wobble hypothesis iv. Variations to the genetic code	[5]

References:

- Russell P. J. (2006), —I Genetics-A molecular approach, 3rd edition. New York: Pearson Education International.
- Madigan, M., Martinko, J., Parkar, J., (2009), Brock Biology of microorganisms, 12th edition. Pearson Education International.
- Nelson, D. and Cox, M. (2008). Lehninger Principles of Biochemistry. 5th edition. New York: W H Freeman and Company.

Question paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - II

COURSE TITLE: Biomolecules
COURSE CODE: 24US3MBMJ2BIM [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	2	5	3		25
II		10		10	5		25
Total marks per	5	20	2	15	8		50

question							
% Weightage	10%	40%	4%	30%	16%		100

S.Y.B.Sc. (Microbiology)

Semester III - Practical

Course: I and II

Course Code: 24US3MBMJP [Credits: 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Enrich and enumerate bacteriophages in a processed lysate. 2. Evaluate different methods of identifying and classifying microorganisms. 3. Detects the presence of biomolecules in varied samples.
Learning Objectives: 1. To implement techniques to enrich and cultivate bacteriophages in a given processed lysate. 2. To acquire the skills to identify and classify microorganisms. 3. To assess the presence of biomolecules in varied samples.
Learning Outcomes: After the successful completion of the practical, the learner will be able to: 1. Determine the titre of bacteriophages in a processed lysate. 2. Apply different techniques of identifying and classifying microorganisms.

3.	Detects the presence of biomolecules in varied samples.
4.	Detects purity of a DNA sample using spectroscopy.

Major Core Course I		Virology and Taxonomy (30Hrs)
1.	Enrichment of phage's and their detection in the prepared lysate.	[5]
2.	Enumeration of phage's by plaque assay.	[2]
3.	Identification of a bacterial isolate using Bergey's manual	[18]
4.	Visit to study VITEK and API techniques.	[3]
5.	Identification of Viruses based on morphological characteristics. (Assignment)	[2]

Major Core Course II		Biomolecules (30Hrs)
1.	Qualitative test for carbohydrates - Molisch test.	[2]
2.	Detection of reducing sugars- DNSA and Benedict tests.	[5]
3.	Qualitative test for proteins and amino acids- Biuret and Ninhydrin test.	[5]
4.	Qualitative tests for Nucleic acids: DNA and RNA.	[5]
5.	Extraction of DNA from bacteria and onion. i.Estimation of DNA by UV Spectroscopy. i.Determination of purity of DNA by Spectroscopy.	[13]

References:

- Sadasivam S. (2018). *Biochemical methods*. New Age International Publishers
- Gunasekaran P. (1995) *Laboratory Manual in Microbiology*. New Age International Publishers

- Bergey's manual of Determinative Bacteriology, 8th Edition.
- Bergey's manual of Systematic Bacteriology, 2nd Edition.

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - SEC

COURSE TITLE: Host Microbe Interactions: A Medical Perspective

COURSE CODE: 24US3MBSECHMI [CREDITS - 02]

Course learning outcomes		
After the successful completion of the course, the learner will be able to: 1. Comprehend the normal flora of human microbiota and sterile body fluids. 2. Explain and analyse the concept of host microorganism interaction.		
Module 1	Normal human microbiota and sterile body fluids	[15L]
Learning objectives: 1. To comprehend the role of resident microbiota in the human body. 2. To discuss various techniques for collecting specimens from sterile body sites.		
Learning Outcomes: After the successful completion of the module, the learner will be able to 1. Evaluate the role of normal microbiota in the human body. 2. Differentiate between various types of specimens for diagnostic purposes. 3. Apply laboratory diagnostic procedures with respect to specimen collection and processing.		

1.1	**Role of resident Microbiota:** i. Skin ii. Mouth and Upper respiratory tract iii. Mouth microbiota and upper respiratory tract iv. Dental Plaques and Caries v. Intestinal tract vi. Urethra vii. Vagina viii. Conjunctiva	[8L]
1.2	**Specimen from sterile body sites** i. Body fluids: Fluids: Pleural fluid, peritoneal fluid, peritoneal dialysis fluid, pericardial fluid, joint fluid ii. Bone: Bone marrow aspiration, bone biopsy, solid tissues iii. Immunologically privileged sites	[4L]
1.3	**Laboratory diagnostic procedures** i. Specimen collection and transport: fluids and aspirates, bone, and tissue ii. Specimen processing, Direct examination, and culture: Fluid and aspirates, Bone and Solid tissue	[3L]

References:

- Forbes, B. A., Sahm, D. F., Weissfeld, A. S. (2016). Study Guide for Bailey and Scott's Diagnostic Microbiology .12th Edition- E-Book. United States: Elsevier Health Sciences.
- Carroll, K. C., Mietzner, T. A., Hobden, J. A., Miller, S., Morse, S. A., Mitchell, T. G., Sakanari, J. A., McKerrow, J. H., Detrick, B. (2016). Jawetz, Melnick & Adelberg's Medical Microbiology. 28th Edition .Singapore: McGraw-Hill Education.

Module 2	Host Microorganism interactions	[15L]

Learning Objectives:

1. To illustrate the host-microorganism interactions.
2. To describe the entry, invasion, and dissemination of microorganisms in the human host.

3. To acquire the knowledge of genetics of virulence.		
Learning Outcomes: **After the successful completion of the module, the learner will be able to:** 1. Explain the significance of host microbe interactions. 2. Discuss the factors contributing to specific and nonspecific host defence systems. 3. Describe the colonization process by microorganisms.		
2.1	**The encounter between host and microorganism:** **The human host's Perspective:** i. Microbial reservoirs and transmission ii. Human as Microbial Reservoirs iii. Animals as Microbial Reservoirs iv. Birds as Microbial Reservoirs v. Insect as vectors vi. The environment as Microbial Reservoir **The Microorganism's perspective**	[2L]
2.2	**Microorganism colonization of host surfaces:** **The host's Perspective:** a) Skin and Skin structures b) Mucous membranes- general and specific protective characteristics **The Microorganism's perspective:** a) Microbial colonization	[3L]
2.3	**Microorganism entry, invasion, and dissemination:** **The host's Perspective-** I. Disruption of surface barriers II. Response to microbial invasion of deeper tissues III. Nonspecific responses- phagocytes and inflammation IV. Specific responses- The immune system V. Components of Immune system	[8L]

	VI. Two arms of the immune system: Antibody mediated immunity and cell mediated immunity **The Microorganism's perspective**: I. Colonization and infection II. Pathogen and virulence III. Microbial Virulence factors **Virulence factors**: Coagulase, Hemolysin, Streptokinase, lecithin, Kinases, Hyaluronidase, collagenase and IgA protease **Toxins**: Endotoxin and Exotoxin	
2.4	**Genetics of virulence: Pathogenicity islands**	[IL]
2.5	**Outcome and prevention of infectious diseases:** I. Acute infection II. Chronic infection III. Immunization	[IL]

References:

- Tortora, G. J., Funke, B. R., Case, C. L. (2004). Microbiology: an introduction.8th edition. United Kingdom: Benjamin Cummings.
- Microbiology. (2001), 5th Edition. Lansing M. Prescott, Harley, and Klein. McGraw Hill Higher Education, New York.
- Madigan, M. T., Brock, T. D. (2012). Brock Biology of Microorganisms.15th edition Germany: Pearson.

Question Paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER III

Core course - SEC

COURSE TITLE: Host Microbe Interactions: A Medical Perspective

COURSE CODE: **24US3MBSECHMI** [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5		25
II	5	5	5	5	5		25
Total marks per question	10	10	10	10	10		50
% Weightage	20%	20%	20%	20%	20%		100

S.Y.B.Sc. (Microbiology)

Semester III – Practical

Course: SEC

Course Code: 24US3MBSECP [Credits: 01]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Analyse and compare normal flora compositions from different body sites. 2. Detects the production of virulence factors- coagulase, haemolysin, and lecithinase. 3. Understand the role of Virulence enzymes in microbial pathogenesis.
Learning Objectives: 1. To comprehend the role of virulence factors in microbial pathogenesis. 2. To demonstrate proficiency in various diagnostic techniques for microbial identification.
Learning Outcomes: After the successful completion of the practical, the learner will be able to: 1. Discuss the significance of virulence enzymes in disease development. 2. Cultivate bacterial strains and detect the production of coagulase, haemolysin, and lecithinase. 3. Compare and contrast the microbial composition of skin, throat, and GI tract flora.

SEC		Virology and Taxonomy (30Hrs)
1.	Study of virulence factor (enzymes): Coagulase,	[10]

	Haemolysin, and Lecithinase.	
2.	Identification of Human Staphylococcal pathogens using DNase test.	[5]
3.	Study of Normal flora from human skin, throat and GI tract samples.	[10]
4.	Microflora of the mouth: Determination of susceptibility to dental caries.	[5]

References:

- Tille, P. M., & Forbes, B. A. (2014). Bailey & Scott's diagnostic microbiology (Thirteenth edition.). St. Louis, Missouri: Elsevier.
- Cappuccino J.G. and Sherman N. 2008. Microbiology: A Laboratory Manual, 8th ed. Pearson Benjamin Cummings, San Francisco, CA, USA.
- Benson's Microbiological Application, Laboratory Manual in General Microbiology.

S.Y.B.Sc. (MICROBIOLOGY)

SEMESTER III- VSC

COURSE TITLE: Dairy Microbiology

COURSE CODE: 24US3MBVSCP [CREDITS - 02]

Course Learning Outcomes
After the successful completion of the course, the learner will be able to: 1. Evaluate the microbiological quality of milk. 2. Comprehend the various National and International food laws
Learning Objectives: 1. To apply culture-based methods to enumerate different types of microorganisms in milk. 2. To evaluate the significance of sterilization of milk.

Learning Outcomes:
After the successful completion of the module, the learner will be able to:
1. Recommend suitable culture-based methods for detection of different types of microbes in milk.
2. Grade the quality of milk by using different rapid platform tests.

Sr. No.	Experiment	No. of Hours (60)
1.	Organoleptic tests a) Colour, extraneous matter, Flavour test b) For acceptance of milk - Total acidity	[2]
2.	Methods for microbiological grading of milk- Platform test: COB Test Methylene blue reduction test Microbiological analysis of milk by Direct Microscopic Count test	[8]
3.	Enumeration of aerobic bacteria using SPC, psychotropic, thermoduric, and thermophilic bacteria in milk	[15]
4.	Detection and enumeration of coliforms in milk. Enumeration of coliforms in milk by using VRBA media. Determination of coliforms in milk by most probable number method (presumptive coliform test)	[15]
5.	Tests for fermentative changes in milk by bacteria	[5]
6.	Detection and Quantification of Starch in Milk	[2]
7.	Tests for the detection of mastitis in milk (Qualitative)	[3]
8.	Detection of antibiotic residues in milk	[4]

9.	Test for sterilized milk	[2]
10.	Phosphatase test	[2]
11.	Food laws: National and International(Assignment)	[1]
12.	Case study/ Assignment on A1 and A2 milk.	[1]

References:

- Sukumar De, Outlines of Dairy technology, 1980, Oxford University Press.
- Richard K. Robinson, Dairy microbiology handbook third edition, 2002 by John Wiley and Sons, inc., New York.
- Elmer H. Marth-James L. Steele Applied Dairy Microbiology, 2nd Edition, 2001 by CRC Press.
- Eckles, C., Combs W. and Macy, H. Milk and milk products, 4th edition. New Delhi: TMH.
- Methods of test for dairy industry, PART I Rapid examination of milk : https://law.resource.org/pub/in/bis/S06/is.1479.1.1960.pdf
- Methods of test for dairy industry, PART II Chemical analysis of milk: https://law.resource.org/pub/in/bis/S06/is.1479.2.1961.pdf

S.Y.B. Sc. (MICROBIOLOGY) SEMESTER III

Indian Knowledge System

COURSE TITLE: Vedic Sukshmjeevanushastra

COURSE CODE: 24US3MBIKSVSM
[CREDITS - 01]

Course Learning Outcomes		
After successful completion of the course, learner should be able to: 1. Investigate the microbiological aspects of Vedic rituals. 2. Analyze ancient Vedic texts related to microorganisms and their significance.		
Learning Objectives: 1. To comprehend the classification of germs in ancient Microbiology. 2. To apply different vedic remedies in health care.		
Learning Outcomes: **After the successful completion of the module, the learner will be able to:** 1. Classify the germs in ancient Vedas. 2. Discuss potential applications of ancient Vedic in health care.		
Module 1	**Vedic Sukshmjeevanushastra**	**[15L]**
1.1	**Introduction to Vedic Microbiology** : a. Origin and parts of the Vedas b. Father of Microbiology : Scientific explanation c. Microbial diseases described during Vedic period	[3 L]
1.2	**Name and Classification of germs (Krmis)** a. Knowledge of invisible organisms through logic b. Observing the Microbes through the divine eyes c. Name of Krmis in Vedas d. Name and colors of Krmis as described by Charaka e. Major groups of Krmis in Vedas	[4L]

1.3	**Origin and Prevalence of Germs:** a. Microbial diversity b. Occurrence and prevalence of Krmis in water, milk, whey and foods	[2L]
1.4	**Human Health and Pathogenic Germs**	[2L]
1.5	**Prevention from infections** a. Pandemic /Epidemic diseases during vedic period b. Precautions for spread of infectious microorganisms	[3L]
1.6	**Eradication of Pathogens by Medicinal plants.**	[1L]

References:

- Dr R.C Dubey, Vedic Microbiology: A Scientific approach, Motilal Banarisdass International Delhi, 1st edition,2021.
- B. Mahadevan, Introduction to Indian Knowledge System: Concepts and Applications,2023 by PHI learning private limited, Delhi.
- The Microbiome in Health and Disease from the Perspective of Modern Medicine and Ayurveda 1805-Article Text-4978-1-10-20180714.pdf

S. Y. B. Sc. (MICROBIOLOGY)

SEMESTER III - Practical

COURSE CODE: 24US3MBIKSP

Course Learning Outcomes

After the successful completion of the Course, the learner will be able to:

1. Apply the concept of traditional practices of Ayurveda in disease

treatment.

Learning Objectives:

1. To determine the effect of chanting different mantras on microbial load.
2. To assess whether the traditional practice of homa/havan affects microbial load.

Learning Outcomes:

After the successful completion of the practical, the learner will be able to:

1. Illustrate the importance of Homa and Gayatri Mantra in controlling the microbial load.

IKS		Vedic Sukshmjeevanushastra (10hrs)
1	Effect of different Mantras on Microbial Load.	5
2	Effect of homa /havan on Microbial Load.	5

References:

- Abhang, Pranay and Manasi, Patil and Pramod, Moghe, Beneficial Effects of Agnihotra on Environment and Agriculture (2015). International Journal of Agricultural Science and Research (IJASR), 2015, Available at SSRN: https://ssrn.com/abstract=2743254
- Abhang, D. P., & Pathade, G. (2017). Agnihotra technology in the perspectives of modern science-A review. *Indian Journal of Traditional Knowledge*, *16*(3), 454-462.
- Rastogi, V., Krishnanand, S., Panwar, R. B., Chacko, K. M., Prem, R., Vijay, C., & Agiwal, V. (2022). Quality analysis, Anti-bacterial activity and Chemical Characterization of Ethnobotanical (Hawan) Medicinal Fumes. *Interdisciplinary Journal of Yagya Research*, *5*(1), 01-19.

Evaluation Pattern:
Internal Evaluation: 20M

Pattern of evaluation	Marks/Paper	Credits
Objective- MCQ, Short answer test, Assignments, Internal Evaluation Google form Moodle Objective-MCQ Short answer test	20	2

External evaluation:

	Total Marks	Credit
Paper I	50	2
Paper II	50	2
SEC	50	2

Evaluation Pattern: Practical's

	Total Marks	Credit	Minimum Passing Marks
Practical I (P I& II)	50	2	20
Practical 2 (SEC)	25	1	10
Practical 3 (VSC)	50	2	20

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course I

COURSE TITLE: Concepts in Biochemistry

COURSE CODE: 24US4MBMJICBC [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the course, the learner will be able to: 1. Explain the principles of thermodynamics with respect to a living cell. 2. Describe the role of enzymes and different metabolic pathways in the functioning of a living cell.		
Module 1	**Thermodynamics**	**[15L]**
Learning Objectives: 1. To familiarize the student with basic concepts of thermodynamics from a biological perspective. 2. To introduce various common ATP yielding mechanisms in a cell.		
Learning Outcomes: **After the successful completion of the module, the learner will be able to** 1. Define terms related to Thermodynamics. 2. Differentiate between ΔG and ΔG'°. 3. Explain the relation of K'eq and ΔG. 4. Describe structure and significance of ATP. 5. Explain role of high energy compounds. 6. Identify and compare energy yielding mechanisms.		
1.1	i. **Scope of thermodynamics**: First and second laws of thermodynamics system, universe, enthalpy and entropy. ii. **Concepts:** Gibbs free energy, free energy change, exergonic and endergonic reactions, relation between Keq and ΔG, ΔG and ΔG'° Keq and K'eq.	[5L]
1.2	i. **ATP**: Structure and properties of ATP, Free energy	[4L]

	change for hydrolysis of ATP and other high-energy compounds viz. 1,3-diphosphoglyceric acid and phosphoenolpyruvate ii. **Biological oxidation reduction reactions, role of pyridine nucleotides in metabolism**	
1.3	**i. Types of ATP generating reactions**: Substrate level phosphorylation, oxidative phosphorylation and photophosphorylation **ii. Energy yielding metabolic mechanisms:** a. Fermentation: alcoholic and lactic acid b. Respiration; aerobic and anaerobic c. Photosynthesis	[6L]

References:

- Nelson, D. and Cox, M. (2005). Lehninger Principles of Biochemistry. 5th edition. New York: W H Freeman and Company.
- Tortora Funke and Case. (1998). Microbiology and Introduction. 6th edition Addison Wesley Longman Inc.

Module 2	Enzymology and Metabolism	15L

Learning Objectives:

1. To describe the purification and separation of enzymes.
2. To evaluate the effect of different parameters on enzyme activity.
3. To explain concepts in enzyme kinetics.
4. To describe the types of metabolic pathways.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Describe the mechanism of enzyme action.
2. Explain the different metabolic pathways in a living cell.

2.1	i. **Basic concepts:** Apoenzyme, Holoenzyme, Co-factors, Coenzymes, Prosthetic groups and the mechanism of enzyme action. ii. **Coenzymes:** Table showing coenzyme and vitamins chemical group transferred and dietary precursor.	[2L]
2.2	**Concepts of enzyme purification:** Objectives and strategy in enzyme purification Methods of homogenization and extraction Methods of separation based on: i. **Size or mass:** Centrifugation, Dialysis ii. **Solubility:** Salting-in, salting-out, Solvent extraction iii. **Definitions of Enzyme Unit**: Specific activity, Katal and International Unit	[4L]
2.3	**Classification of enzymes:** i. Six classes of enzymes and their mode of action ii. Enzyme Nomenclature as per IUBMB	[1L]
2.4	**Enzyme kinetics** a) Michaelis- Menten equation and plot b) Line-weaver Burk equation and plot c) Km and Vmax	[3L]
2.5	**Effect of following parameters on enzyme activity:** Enzyme concentration, substrate concentration, pH and temperature	[2L]
2.6	**Metabolism**- Catabolism, anabolism, link between catabolism and anabolism viz. ATP, reducing power and precursors (list of 12 precursors)	[2L]
2.7	**Types of biochemical pathways**- linear, branched and cyclic with one example each.	[1L]
References: • Nelson, D. and Cox, M. (2005). Lehninger Principles of Biochemistry. 5th edition. New York: W H Freeman and Company.		

- Tortora Funke and Case. (1998). Microbiology and Introduction. 6th edition Addison Wesley Longman Inc.
- Conn P., Stumpf, G., Bruening and Doi R. (1995). Outlines in Biochemistry. 5th edition. New York: John Wiley and Sons.

Question paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course I

COURSE TITLE: Concepts in Biochemistry

COURSE CODE: 24US4MBMJ1CBC [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	-	5	5	10	5	-	25
II	5	5	3	2	5	-	25
Total marks per question	5	10	8	12	10	-	50
% Weightage	10%	20%	16%	24%	20%	-	100

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course II

COURSE TITLE: Industrial Microbiology

COURSE CODE: 24US4MBMJ2IMI [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the three courses, the learner should be able to: 1. Describe the basic concepts of Industrial Microbiology. 2. Formulate a fermentation media. 3. Evaluate the different modes of fermentation. 4. Illustrate the sterilization methods used in industrial fermentation processes.		
Module 1	**Basic Concepts of Industrial Microbiology**	**[15L]**
Learning Objectives : 1. To describe different microbial industrial. 2. To illustrate the steps of primary and secondary screening. 3. To sketch the basic design of a fermenter. 4. To apply the principles underlying Inoculum development. 5. To familiarize with the different types of fermentation media components.		
Learning Outcomes : **After the successful completion of the module, the learner will be able to** : 1. State the significance of industrial processes and the different microbial Industries based on products. 2. Recall the steps of primary and secondary screening. 3. Illustrate the components of a fermenter and their function. 4. Plan an inoculum development for a given production. 5. Formulate the media for a given industrial production.		
1.1	**Types of microbial products** (Primary and secondary metabolites) **Industries based on Microbial products**: (Medical, agriculture, chemicals, food and beverages etc.)	[1L]
1.2	**Prerequisites of an Industrial microbiological process**: Microorganism, Medium and Product	[1L]
1.3	**Parts of a typical fermentation Process**: Upstream processing,	[1L]

	Fermentation Proper and Downstream Processing	
1.4	**Screening**: Primary and secondary screening	[2L]
1.5	**Basic Fermenter design:** i. Criteria for designing the fermenter. ii. Fabrication materials for fermenters iii. Components of a fermenter and their uses	[2L]
1.6	**Inoculum development:** Definition, Principles, and various aspects of inoculum development with examples	[2L]
1.7	**Fermentation Media**: i. **Concept of defined and undefined media** ii. **Medium formulation** -Water - Cellular yield coefficient -Energy and carbon sources, nitrogen sources, minerals, chelators, growth factors, buffers, precursors, inhibitors, inducers, steering agents and antifoam agents **Animal Cell Culture Media** :(Serum, serum-free media supplements, protein free media, trace elements, osmolality, pH and non-nutritional media supplements)	[6L]

References:

- Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 3rd edition, Elsevier Science Ltd.
- Patel A.H. (1996). Industrial Microbiology. Ist edition, Macmillan India Limited
- Casida LE. (1991). Industrial Microbiology. Ist edition. Wiley Eastern Limited.

Module 2	Types of Fermentation and Sterilization	15L

Learning Objectives:

1. To analyze the choice of appropriate mode of fermentation.
2. To evaluate the methods of sterilization.
3. To illustrate filtration as an effective method of sterilization of media, air and exhaust air.

Learning Outcomes:

After the successful completion of the module, the learner will be able to:

1. Distinguish between the different modes of fermentation.
2. Assess the advantages and disadvantages of batch and continuous sterilization methods.
3. Differentiate between Depth and Absolute filters.
4. Establish the process steps for filter sterilization of media.

2.1	**Types of Fermentation:** **Principle, Concept, advantages and limitations of:** -Batch, Continuous and fed-batch -Aerobic, Anaerobic, Surface, Submerged and Solid-Substrate	[5L]
2.2	**Sterilization:** i. **Consequences of invasion in fermentation by a foreign organism, Sterilization criterion, Definition, and significance.** ii. **Methods of sterilization**: Batch and Continuous sterilization. iii. **Filter sterilization**: a) Mechanisms of filtration and b) Depth and Absolute filters iv. **Sterilization of fermentation media, air, and fermenter exhaust air**	[2L] [3L] [2L] [3L]

References:

- Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 3rd edition, Elsevier Science Ltd.
- Fermentation Technology (Vol: I and II Set) H A Modi, Published by Pointer, Jaipur, 2009
- Patel A.H. (1996). Industrial Microbiology. Ist edition, Macmillan India Limited
- Casida LE. (1991). Industrial Microbiology. Ist edition. Wiley Eastern Limited.

Question paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

COURSE TITLE: Industrial Microbiology

COURSE CODE: 24US4MBMJ2IMI [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	5	5	-	-	25
II	5	5	5	5	5	-	25
Total marks per question	10	15	10	10	5		50
% Weightage	20%	30%	20%	20%	10%	-	100

S. Y. B. Sc. (MICROBIOLOGY)

SEMESTER IV - Practical

COURSE CODE: 24US4MBMJP
[CREDITS - 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Produce and purify extracellular enzymes using basic techniques. 2. Perform an enzyme assay and plot kinetic graphs for the same. 3. Apply Primary screening to isolate significant microorganisms. 4. Compare different modes of fermentation.
Learning Objectives: 1. To produce and purify microbial enzymes 2. To determine the effect of different parameters on enzyme activity. 3. To isolate antibiotic producers using Primary screening method. 4. To evaluate the producing ability of microorganisms using different modes of fermentation.
Learning Outcomes: After the successful completion of the practical, the learner will be able to: 1. Purify microbial enzymes. 2. Evaluate the effect of different parameters on enzyme activity. 3. Isolate significant microorganisms from natural sources using primary screening methods. 4. Compare microbial productivity using different modes of fermentation.

Major Core Course I		Basic Concepts of Industrial Microbiology (30Hrs)
1.	Production of Invertase from yeast	[5]

	Crude enzyme preparation by ammonium sulphate precipitation Purification by dialysis	
2.	a) Effect of parameters - enzyme concentration, substrate concentration, pH and temperature on activity of yeast Invertase b) Michaelis-Menten and Lineweaver Burk plot Determination of Km and Vmax	[20]
3.	Problems on Bioenergetics	[5]
Major Core Course II	**Types of Fermentation and Sterilization (30Hrs)**	
1.	Isolation of antibiotic producers by crowded plate technique and Wilkins agar overlay.	[10]
2.	Fermentation of bread dough by yeast in the laboratory.	[5]
3.	Study of fermenter parts and demonstration of its working.	[5]
4.	Comparative study of solid state and submerged. Fermentation. (Amylase production)	[5]
5.	Demonstration of Animal Cell Culture: Visit to Industry	[5]

References:

- Nelson, D. and Cox, M. (2005). Lehninger Principles of Biochemistry. 5th edition. New York: W H Freeman and Company.
- Conn P., Stumpf, G., Bruening and Doi R. (1995). Outlines in Biochemistry. 5th edition. New York: John Wiley and Sons.
- Fermentation Technology (Vol: I and II Set) H A Modi, Published by Pointer, Jaipur, 2009
- Patel A.H. (1996). Industrial Microbiology. Ist edition, Macmillan India Limited

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course - SEC

COURSE TITLE: Introduction to Immunology

COURSE CODE: 24US4MBSECIMM [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the three courses, the learner should be able to: 1. Elaborate the different types of immunity and its response against infections. 2. Compare the types of antigen antibody reactions.		
Module 1	The Immune System	[15L]
Learning Objectives: 1. To differentiate between innate and adaptive immunity and their roles in the immune system. 2. To identify the different types of adaptive immunity, including humoral and cell-mediated immunity. 3. To analyze the properties of adaptive Immune responses. 4. To comprehend the cellular components and tissues of the Immune system.		
Learning Outcomes: After the successful completion of the module, the learner will be able to: 1. Explain the fundamental differences between innate and adaptive immunity. 2. Differentiate between humoral and cell-mediated immunity. 3. Characterize the major cell types involved in the immune system. 4. Describe the organization and function of peripheral lymphoid organs.		

1.1	**Innate or Native immunity:** i. Factors affecting innate immunity ii. Mechanisms of Innate immunity	[1L]
1.2	**Acquired or Adaptive Immunity:** i. Active immunity ii. Passive immunity	[2 L]
1.3	**Organization of Immune system:** i. Primary Lymphoid Organs: Thymus and Bone Marrow ii. Secondary Lymphoid Organs: Lymph nodes and Spleen	[4 L]
1.4	**Cells of the Immune System:** i. T-lymphocytes ii. B-lymphocytes iii. Null cells	[5 L]
1.5	**Major Histocompatibility Complex**: Types and functions	[2 L]
1.6	**Immune dysfunction and its consequences**	[1 L]

References:

- David L. Baker. 4th edition. (2014). Basic immunology. Elsevier.
- Janis Kuby. 6th edition. (2006). Immunology. W.H Freeman.
- Ivan M. Roitt & Peter J. Delves. 10th edition. (2007). Essential Immunology. Blackwell Science.
- Williams E. Paul. 7th edition. (2013). Fundamental Immunology. Wolters Kluwer.
- Richard Goering. 6th edition. (2018). MIMS Medical Microbiology and Immunology. Elsevier Health Science.

Module 2	Antigen-Antibody Interactions	15L

Learning Objectives: 1. To describe the strength of antigen-antibody Interactions. 2. To explore immunological reactions and techniques. 3. To analyze advanced immunological techniques.		
Learning Outcomes: **After the successful completion of the module, the learner will be able to:** 1. Define and differentiate between antibody affinity and antibody avidity. 2. Apply the immunological concepts for evaluating antigen-antibody interactions.		
2.1	**Strength of Antigen-Antibody Interactions:** i. Antibody affinity ii. Antibody avidity iii. Avidity Index	[1L]
2.2	**Cross-Reactivity**	[1L]
2.3	**Precipitin Reactions:** i. **Precipitin Reactions in fluids** ii. **Precipitin Reactions in gels**: Radial Immunodiffusion, Double Immunodiffusion, Immunoelectrophoresis, Rocket electrophoresis and Two-dimensional immunoelectrophoresis	[4L]
2.4	**Agglutination Reactions :** i. Hemagglutination ii. Bacterial Agglutination iii. Passive Agglutination iv. Agglutination Inhibition	[3L]
2.5	**Complement fixation test**	[1L]
2.6	**Neutralization test**	[1L]
2.7	**Radioimmunoassay**	[1L]

2.8	**Enzyme-Linked Immunosorbent Assay** i. Indirect ii. Sandwich iii. Competitive	[2L]
2.9	**Western Blotting**	[1L]

References:

- David L. Baker. 4th edition. (2014). Basic immunology. Elsevier.
- Janis Kuby. 6th edition. (2006). Immunology. W.H Freeman.
- Ivan M. Roitt & Peter J. Delves. 10th edition. (2007). Essential Immunology. Blackwell Science.
- Williams E. Paul. 7th edition. (2013). Fundamental Immunology. Wolters Kluwer.
- Richard Goering. 6th edition. (2018). MIMS Medical Microbiology and Immunology. Elsevier Health Science.

Question paper Template

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course - SEC

COURSE TITLE: Introduction to Immunology

COURSE CODE: 24US4MBSECIMM [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5	-	25
II	5	5	5	5	5	-	25
Total marks per question	10	10	10	10	10	-	50

% Weightage	20%	20%	20%	20%	20%	-	100

S.Y.B.Sc. (MICROBIOLOGY) SEMESTER IV

Course - SEC

COURSE CODE: 24US4MBSECP

[CREDITS - 01]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Perform tests required for a blood transfusion and detection of Rh incompatibility
Learning Objectives: 1. To explain the techniques and principles of basic tests based on agglutination reactions viz blood grouping, isoagglutination and Coomb's tests. 2. To observe and identify different types of blood cells.
Learning Outcomes: After the successful completion of the practical, the learner will be able to: 1. Explain principles of Complement fixation test. 2. Determine blood group of a sample. 3. Perform compatibility tests, isoagglutination tests and comment on feasibility of blood transfusions. 4. Perform direct and Indirect Coomb's tests. 5. Identify different types of blood cells after blood staining.

SEC	Introduction to Immunology (30Hrs)	
1.	Complement fixation test	[5]
2.	ABO grouping	[5]
3.	Coombs test	[5]
4.	Determination of isoagglutinin titres	[5]
5.	Major minor compatibility test	[5]
6.	Blood Staining and Permanent slides of blood cells	[5]

References:

- Janis Kuby. 6th edition. (2006). Immunology. W.H Freeman.
- Ivan M. Roitt & Peter J. Delves. 10th edition. (2007). Essential Immunology. Blackwell Science.
- Williams E. Paul. 7th edition. (2013). Fundamental Immunology. Wolters Kluwer.
- Richard Goering. 6th edition. (2018). MIMS Medical Microbiology and Immunology. Elsevier Health Science.

S.Y.B.Sc. (MICROBIOLOGY)

SEMESTER IV: VSC

COURSE TITLE: Soil and Agriculture Microbiology
COURSE CODE: 24US4MBVSCP [CREDITS - 02]

Course Learning Outcomes
After the successful completion of the course, the learner should be able to: 1. Differentiate between beneficial and harmful microorganisms of relevance to agriculture. 2. Apply the knowledge of complex interactions between agriculture systems and micro-organisms in the production of value-added products.
Learning Objectives: 1. To describe the process of biofertilizer manufacturing. 2. To demonstrate the efficacy of the produced fertilizer using pot trials with different plants.
Learning Outcomes: **After the successful completion of the module, the learner will be able to:** 1. Produce biofertilizer and biopesticide using organic materials. 2. Explore biofertilizer manufacturing start-up.

Sr.No	Experiments	No of Hours
1.	Cultivation of *Azolla*	[10]

2.	Isolation of nitrogen fixers, phosphate solubilizers and potassium solubilizers from agricultural soils.	[10]
3.	Production of biofertilizers using *Azotobacter spps* and checking its efficacy on growth of plants.	[7]
4.	Production of biopesticides- Dashparni and checking its efficacy.	[3]
5.	Visit to the Vermicomposting production unit.	[10]
6.	Visit to Agricultural fields	[10]
7.	Study of plant growth characteristics.	[10]

References:

- Natarajan Amaresan et al. (eds.), Practical Handbook on Agricultural Microbiology, Springer Protocols Handbooks, https://doi.org/10.1007/978-1-0716-1724-3_1.
- Roy, D. C., Pakhira, M. C., & Bera, S. (2016). A review on biology, cultivation, and utilization of Azolla. *Advances in Life Sciences*, *5*(1), 11-15.
- 3.https://agrostar.in/article/easy-preparation-of-dashparni-extract-for-organic-farming/5c1cd9b897c501e2904fdf6a?language=mr
- Rangaswami, G., & Bagyaraj, D. J. (2010). *Agricultural Microbiology*. PHI Learning Private Limited.

Evaluation Pattern:
Internal Evaluation: 20M

Pattern of evaluation	Marks/Paper	Credits
Objective- MCQ, Short answer test, Assignments, Internal Evaluation Google form Moodle Objective-MCQ Short answer test	20	2

External evaluation:

	Total Marks	Credit
Paper I	50	2
Paper II	50	2
SEC	50	2

Evaluation Pattern: Practical's

	Total Marks	Credit	Minimum Passing Marks
Practical (P I& II)	50	2	20
Practical (SEC)	25	1	10
Practical (VSC)	50	2	20

8. Teaching learning process

The pedagogic methods adopted, involve direct lectures, tutorial discussions, as well as technology- supported presentations. We believe that education is interactive and all sessions between students and teachers are based upon reciprocity and respect.

I) The lectures (of 1 hr duration) delivered to one whole class at a time systematically deal with the themes of the syllabus. This constitutes the core of the teaching- learning process. The students are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.

2) Wherever needed, teachers use audio-video based technology devices (e. g. power point, YouTube videos) to make their presentations more effective. Some courses require that students see a documentary or feature film and course themes are structured so that discussions of these will further nuance the critical engagement of students with ideas introduced in their textual materials.

3) Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics. Bridge courses facilitate to develop a concrete basis for the topics to be learnt in the coming academic year.

.

9. Assessment Methods

- Assessments are divided into two parts: Continuous Internal Examination (CIE) and End Semester Examination (ESE).
- The Continuous Internal Examination shall be conducted by the Department for each semester for 20 M.
- The End Semester Examination shall be conducted by the College at the end of each semester. (30M) Duration: 1 hours
- End Semester Examination Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	5 M x 5 Q = 25 M	5 M x 3 Q = 15 M
2	II	5 M x 5 Q = 25 M	5 M x 3 Q = 15 M

Each question will have six sub questions a, b, c, d, e, f and out of which any three should be answered.

Evaluation pattern: Practical

- Continuous Assessment: a) 50 Marks for Practical 1 and Practical 3 b) 25 Marks for Practical 2 throughout the entire semester.
- Evaluation as per the following rubrics

Major Core Course	CIE/ Journal/ Spots/Quiz	Total	Minimum passing marks
Practical (PI	50M	50 M	20M

& PII)			
Practical (SEC)	25M	25 M	10M
Practical (VSC)	50M	50M	20M

10. Programme and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (23- year of implementation is 2023-24)
2. Third letter 'U' designates an undergraduate.
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S1 – 1st Semester)
4. Letter 'MB' is for Microbiology discipline (MB-Microbiology). This forms the programme code 23USMB. For the further course codes programme code is amended as follows
5. To represent Major Core Course (MJ) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
6. To represent Minor Stream Course (MN) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
7. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'EVS'-Environmental science are used.
8. For Value Added course code, (VA) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'EVS'-Environmental science are used.
9. For Indian Knowledge System course code, (IK) alphabets followed by a digit (1/2) followed by 'ICH'- Indian Cultural Heritage is used.

10. For Co-curricular course code, (CC) alphabets followed by a digit (1/2).

11. For Open Elective course code, (OE) alphabets followed by a digit (1/2).

12. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.