

**Shree Manibhai Virani & Smt. Navalben Virani Science College, Rajkot
(Autonomous)**

Affiliated to Saurashtra University, Rajkot

BOARD OF STUDIES – MICROBIOLOGY

12th Meeting of Board of Studies in Microbiology

Program: B.Sc. Microbiology

Date: 12.11.2022

Time: 11.00 am

Mode: Hybrid

Details of Meeting:

Mode of Meeting	Hybrid - Online and Offline
Date	12 th November 2022
Time	11.00am
Platform for online participation	Google Meet
Venue and Link Details with ID, Password etc	12th Board of Studies for Microbiology - Shree M. & N. VSC - Rajkot Saturday, November 12 · 11:00am – 12:00pm Google Meet joining info Video call link: https://meet.google.com/hfn-fvqf-ebk Or dial: (US) +1 513-816-0475 PIN: 343 514 416#
Venue for off-line meeting	Microbiology Department, Shree M. & N. Virani Science College, Rajkot

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BOARD OF STUDIES – MICROBIOLOGY

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Agenda

1. Introductory remarks by the Chairperson
 - Confirmation of MoM & ATR of previous BoS held on 28/04/2022
 - Departmental activities and updates
2. Scheme of Learning and Evaluation for Sem.-4 of B.Sc. Microbiology Programme
3. Syllabi of all Theory & Practical courses including Core elective courses of Sem.-4 of B.Sc. Microbiology Programme
4. Syllabi of Part-II – Discipline Specific Elective (DSE) cluster theory & practical course/s for Sem.-4; offered by the Department.
5. Syllabi & evaluation norms of Part-II: Trans Disciplinary Elective (TDE) course offered by the Department
6. Blue – Print of Question paper pattern for all theory & practical courses of Sem.-4 of B.Sc. Microbiology programme
7. List of paper setters and examiners for all theory & practical courses of B.Sc. Microbiology programme
8. Any other agenda with permission of the Chair

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BoS Members:

S.No.	Name	Designation	Presence/Absence
1.	Dr. Neepa Pandhi	Head of Department, Chairperson	Present
2.	Dr. Datta Madamwar	Subject Expert, VC Nominee	Absent
3.	Dr. Mehul Dave	Subject expert, AC Nominee	Present - Online
4.	Dr. Chitra Bhattacharya	Subject expert, AC Nominee	Present
5.	Dr. Madhavi Joshi-Bagtharia	Industry Representative	Present - Online
6.	Dr. Vasant Jadeja	Faculty Member	Present
7.	(Dr.) Lt. Hemangi Bhatt	Faculty Member	Present
8.	Dr. Hitarth Bhatt	Faculty Member	Absent
9.	(Dr.) Vivek Pattani	Faculty Member	Present
10.	Dr. Rajesh Patel	Meritorious PG Alumni	Present - Online

Minutes of Meeting:

The Board of Studies in Microbiology met as indicated above and discussed on the aforementioned Agenda. Sharing the expertise of all the members and with very proactive inputs, the members unanimously resolved the following:

1. MoM of previous BoS held on 28/04/2022 was confirmed by the esteemed members of the board
2. Scheme of Learning and Evaluation for 4th Sem. of B.Sc. Microbiology programme was **discussed & framed. – (Enclosure – I)**
The above will be effective for students admitted from **AY 2021-22& onwards**
3. Syllabi of all theory & practical courses of 4th Sem. of B.Sc. Microbiology programme were **discussed & framed. – (Enclosure – II)**

New Courses introduced: NA

New Components Introduced:

1. Trans Disciplinary Course – Semester – IV – Microbes in Human Welfare
2. Core Enrichment – 1: Concept to Practice Course – Semester IV
3. Core Enrichment – 2 – Internship 1 – Semester IV

Courses Removed: 19UMBCC302 – Analytical Techniques

Courses Modified: 21UMBCC404- Fermentation Microbiology (Practical)

The above will be effective for students admitted from **AY 2021-22& onwards**

4. Syllabi of Part-II: Discipline Specific Elective Course (DSE) offered by the department were **discussed & framed. - (Enclosure –III)**
Discipline specific Elective – Semester – IV – Pharmaceutical Microbiology
5. Syllabi of Part-II: Trans Disciplinary Elective Course (TDE) offered by the department were **discussed & framed. - (Enclosure –III)**

List of courses where syllabus is modified 20% & more in terms of content:

- a. Fermentation Microbiology (Practical)

List of the courses whose title got changed:

- a. Fermentation Microbiology (Practical)

The detailed syllabi in the new format for adoption of OBE indicating course outcomes with K levels, pedagogical & assessment tools as appended

The above will be effective for students admitted from **AY 2021-22& onwards**

6. List of Paper Setter and Examiner for the 4th Semester courses were discussed and finalized as indicated in **(Enclosure – IV)**
7. Question paper pattern for 4th Semester theory & practical courses were discussed and finalized **(Enclosure – V)**



**SarvodayaKelavaniSamaj Managed
ShreeManibhaiVirani&Smt.NavalbenViraniScienceCollege, Rajkot
(Autonomous)**

Affiliated to SaurashtraUniversity, Rajkot

Reaccredited at the “A” Level (CGPA 3.28) by NAAC

“STAR” College Scheme & Status by MST-DBT

A College with Potential for Excellence – CPE (Phase - II) by UGC

Accredited at the G-AAA Highest Grade ‘A-1’ Level by KCG, Govt. of Gujarat

UGC-DDU KAUSHAL Kendra

GPCB-Government of Gujarat approved Environmental Audit Centre

SCHEME OF LEARNING AND EVALUATION

Of

B. Sc. MICROBIOLOGY

(W.e.f June 2021)

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot
(Autonomous)
Affiliated to Saurashtra University, Rajkot
Department of Microbiology

B. Sc. MICROBIOLOGY
Regulations for Students Admitted from A.Y. 2021-2022 & Onwards

ELIGIBILITY

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

LATERAL ENTRY

Candidates seeking admission directly in third semester of B.Sc. Microbiology must have passed examination of Diploma in Pharmacy or relevant subjects will be eligible for admission. A result of this type of candidate will be declared by considering his/her marks of semester 3 to 6 in aggregate and accordingly class will be awarded.

DURATION OF THE PROGRAMME

The Program

1. Shall extend over a period of three years comprising of six semesters for lateral entrants
2. Comprises of two semesters in one academic year wherein each semester normally will be of minimum 90 teaching days.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses based on their interest. Mainly, each course is worth a certain number of credit points, determined by different criteria including learning outcome, contact hours etc.

The following mechanism is adopted for the purpose of computation of credits earned by the students:

- | | |
|--|------------|
| a) 1 hour instruction of Theory | = 1 Credit |
| b) 2-3 hours instruction of Tutorial | = 1 Credit |
| c) 2-3 hours instructions of Practical | = 1 Credit |

OUTCOME BASED EDUCATION (OBE)

Outcome based education is based on revised Bloom Taxonomy and is a learner-centric teaching and learning methodology in which the course delivery and assessment are planned to achieve stated

objectives and outcomes. It focuses on measuring students performance i.e. outcomes at different levels. OBE method of learning is adopted.

STRUCTURE OF THE PROGRAMME

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

MEDIUM OF INSTRUCTION AND EXAMINATIONS

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

EVALUATION

The evaluation shall generally comprise of Continuous Internal Assessment (CIA) and Semester End Examination (SEE) with percentage weightage as specified below, unless specified otherwise in the Scheme of Learning and Evaluation.

Components	Theory Courses	Practical Courses
Continuous Internal Assessment (CIA)	Varies from 30 percent to 60 percent based on the nature of course.	Varies from 40 percent to 100 percent based on the nature of course.
Semester End Examination (SEE)	Varies from 70 percent to 40 percent based on the nature of course.	Varies from 40 percent to 60 percent based on the nature of course.

COMPLETION OF PROGRAM TO EARN THE DEGREE CERTIFICATE

The University shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval / ratification of the results by the Academic Council, the student will be recommended to Governing Body for the award of the degree provided that the student have earned all the credits towards mandatory course / components as mentioned in Scheme of Learning and Evaluation.

MINIMUM QUALIFICATION FOR APPOINTMENT OF FACULTY MEMBER

As per norms of UGC and./or other related Regulatory body

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**Department of Microbiology
B. Sc. MICROBIOLOGY**

VISION OF THE DEPARTMENT

Our vision is to produce highly qualified and competent microbiologists with expertise in all the relevant areas, to develop and maintain a strong and supportive research programme to complement our national needs while strengthening local relevance and to rise as centre of excellence and knowledge in the subject of Microbiology

MISSION OF THE DEPARTMENT

The Mission of Microbiology Department is to promote good quality education, research and to provide the most rigorous and inspiring training in the discipline of Microbiology with greater significance of application in all relevant areas. The Department strives to educate and mentor students to:

- Acquire practical skills necessary for operation and maintenance of small and medium scale industry and research institute,
- Be aware of the role of microorganisms in various aspects of life processes and understand their importance in agriculture, environment, food, health, and other areas,
- Apply microbiological techniques and technologies to the betterment of human life, environment and national economy,
- Contribute to the pursuit of knowledge by contributing meaningfully in the area of Research in Microbiology

OBJECTIVES OF THE PROGRAMME

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

1. This programme will enable students to understand the basic anatomy, physiology, diversity, and genetics of microorganisms including viruses, bacteria, protozoa, algae and fungi, and exploit their interactions with environment and human beings.
2. The Curriculum is designed to impart to students the skill to operate basic and advanced instruments used for analysis of various biomolecules.
3. This programme will enable students to acquire knowledge on the Microbiology, Cell Biology, Microbiology, Immunology, Bioprocess Technology and Molecular Biology to enable them to understand emerging and advanced concept in modern biology and help them to take their career in this field.
4. After completion of the programme, the students will be able to acquire the necessary theoretical and practical competencies in Microbiology to enable them to undertake higher studies in recognized Institutions of advance learning and engage gainful self-employment.
5. The Programme is intended to help the students to be the innovative and versatile personalities in the field of Life Science with quality education and provide the skilled manpower required by Research and Development, Institutions of Higher Learning and Industry.

GRADUATE ATTRIBUTES

- **Academic excellence:** Ability to identify key questions, research and pursue rigorous evidence-based arguments.
- **Critical Thinking and Effective communications:** Analysis and evaluation of information to form a judgment about a subject or idea and ability to effectively communicate the same in a structured form.
- **Global Citizenship:** Mutual understanding with others from diverse cultures, perspectives and backgrounds
- **Life Long Learning:** Open, curious, willing to investigate, and consider new knowledge and ways of thinking

PROGRAM EDUCATIONS OBJECTIVES (PEOs)

This programme will produce Graduates who will attain following PEOs after few years of graduation	
PEO 1	: Core competency: will develop the competency to pursue higher education, successful professional career, or be an entrepreneur with synergistic combination of the knowledge and skills of Microbiology and allied sciences
PEO 2	: Breadth of knowledge: will show the ability to critically analyse scientific data, drawing objective conclusions from it and apply this knowledge to independently design, and execute small research problems with the help of integrated knowledge of Microbiology and other domains for societal and human welfare.
PEO 3	: Preparedness: will have the potential to take any task or assignment in the capacity of a leader or team member in the chosen occupations or careers and will reflect an aptitude and ability for contribution in academics, entrepreneurship, and research, equipped with good communication skills.
PEO 4	: Professionalism: will possess strong professional ethics and expertise to fulfil moral duties towards their profession, community, society and nation at large.
PEO 5	: Learning environment: will show readiness for lifelong learning necessary to meet the ever evolving professional, social and personal demands through ethical, interpersonal and team skills.

PROGRAM OUTCOMES:

After completion of the B.Sc. Microbiology programme, the Graduate will be able to:		
PO 1	:	Domain knowledge: Demonstrate an understanding of fundamental principles of Microbiology, its applications and scope, along with an ability to identify beneficial and harmful role of microorganisms for the benefit of Science and Society
PO 2	:	Problem analysis: Accurately identify and critically analyse pertinent problems in the field of Applied Microbiology and various domains of Biological sciences.
PO 3	:	Design/development of solutions: Search for and successfully arrive at viable conclusions/solutions pertaining to various aspects of life sciences using right approach and appropriate tools and techniques
PO 4	:	Conduct investigations of complex problems: Ability to investigate any complex problems related to Microbiology and other life science with the use of appropriate experimental tools/techniques/equipment.
PO 5	:	Modern tool usage: Understand standard operating procedures, safety measures and acquire in-depth technical competence to handle the basic laboratory instruments, and develop the skills to locate and retrieve scientific information with modern data search tools.
PO 6	:	The Microbiologist and Society: Demonstrate the ability to understand the role of scientific developments in a changing world from the disciplinary perspective as well as in relation to its professional and everyday use, with an insight into one's role in society and act in an honest and consistent manner based on a strong sense of self and personal values.
PO 7	:	Environment and sustainability: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
PO 8	:	Ethics: Commitment to professional ethics and responsibilities.
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: Communicate effectively in spoken and written forms as well as through digital media with scientific community, society, and fellow mates.
PO 11	:	Project management and finance: Demonstrate knowledge and scientific understanding to design a research project and manage its execution to generate new scientific insights, innovations in Microbiology research and exhibit organizational skills for able management of time and resources.
PO 12	:	Life-long learning: Able to recognize the need to undertake life-long learning and acquire the capacity to build on critical thinking skills for periodic updating of scientific knowledge and its application.

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

After completion of the programme, the Graduate will:	
PSO1	: Acquire knowledge on the fundamentals of Microbiology for sound and solid base which enables them to understand the emerging and advanced concepts in life sciences
PSO2	: To equip the students with knowledge, skill and inspiration to pursue higher education and research in Microbiology and allied fields in reputed institutes at national and international level.
PSO3	: Be able to understand fundamental principles of Microbiology to find innovative solutions for environment, agriculture, and health related issues at local and global level.
PSO4	: Apply the knowledge of Microbiology, preferably with the synergistic application of basic understanding of other allied fields, for finding sustainable ethical solutions to existing global problems in compliance to the SDGs
PSO5	: Become competent and eligible to appear in various competitive exams, getting placement in government and private sectors of academia, research and industries, and become a successful Microbiologist serving the Nation.

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Department of Microbiology

B. Sc. MICROBIOLOGY

SCHEME OF LEARNING AND EVALUATION

For the students admitted from the A.Y. 2021-22 & onwards

Semester-I									
Course Code	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
Part-I									
21ULCEN101	English-I – Development of Functional English	3	-	-	3	40	60	100	3
	Part-I Total	3	0	0		40	60	100	3
Part-II									
21UMBCC101	Core1: Fundamentals of Microbiology (F1)	4	-	-	3	30	70	100	4
21UMBCC102	Core2: Microbial Growth and Control (F2)	4	-	-	3	30	70	100	4
21UMBID101	IDC-1: Zoology-1 Systematics and Anatomy	3	-	-	3	30	70	100	3
21UMBCC103	Core Practical-1 Basic Microbial Techniques	-	-	6	6#	40	60	100	4
21UMBID102	IDC- Practical - 1: Zoology-1: Systematics and Anatomy	-	-	6	3	40	60	100	2
	Core Enrichment – 1: Concept to Practice Course		1	-	-	(20)	Evaluation at the end of Semester - IV		
	Part-II Total	11	1	12		170	330	500	17
Part-III: Ability Enhancement Courses									
21AESD101	AECC I : Introduction to SDG (online course)	-	-	-	-		-	Remarks	Audit course
	AECC II: Environmental Conservation and Sustainable Development	1	-	-	-		Evaluation at the end of 2 nd Semester		-

	AECC III: Human Values for Holistic Living	1	2*	-	-	Evaluation at the end of 2 nd Semester			-
	FS 3: Career Acceleration Programme	2*							
	Part-III Total	2	-	-		100	0	0	0
	Total (Part-I to Part-III)	16	1	12	-	210	390	600	20
		29				600			

3hrs on day1 and 3 hrson day 2;

* Beyond Academic hours

() Final evaluation for 100 marks be made at the end of Semester IV, which include 20 marks CIA in Semesters I, II, and III each, and of 40 marks in Semester IV.

Semester-II									
CourseCode	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
Part-I									
21ULCEN2	English II – Functional English	3	-	-	3	40	60	100	3
	Part-I Total	3	0	0		40	60	100	3
Part-II									
21UMBCC201	Core3: Microbial Taxonomy and diversity (F)	4	-	-	3	30	70	100	4
21UMBCC202	Core4: Basic Biochemistry (F)	4	-	-	3	30	70	100	4
21UMBCC203	Core 5: Cell Structure and Organization (F)	4	-	-	3	30	70	100	4
21UMBID201	IDC-2: Botany – Medicinal Botany	3	-		3	30	70	100	3
21UMBCC204	Core Practical - 2 Microbial Diversity and Biochemistry	-	-	6	6#	40	60	100	2
21UMBID202	IDC-2: Practical: Botany	-	-	6	3	40	60	100	2
	Core Enrichment – 2: Concept to Practice Course		1		-	(20)	Evaluation at the end of Semester - IV		
	Part-II Total	15	1	12		200	400	600	19
Part-III: Ability Enhancement Courses									
21xxx	AECC II: Environmental Conservation and Sustainable Development	1	-	-	-	Remarks			2
21xxxx	AECC III: Human Values for Holistic Living	1	2*	-	-	Remarks			3
	FS 3: Career Acceleration Programme	2*							
	Part-III Total	2	-	-		0	0	0	5
	Total (Part-I to Part-III)	20	1	12	-	240	460	700	27
		33				700			

3hrs on day1 and 3 hrs on day 2;

* Beyond Academic hours

(Final evaluation for 100 marks be made at the end of Semester IV, which include 20 marks CIA in Semesters I, II, and III each, and of 40 marks in Semester IV.)

Minimum one-month internship pertaining to learning for concept to practice/prototype or product development for start-up/mini and final semester project/skilling in the summer vacation/combination of semester break and summer vacation in industry/premier research institute/NGO, etc.

Semester–III									
CourseCode	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
Part – I									
21ULCEN3	English III – Advanced English and Correspondance	3	-	-	3	40	60	100	3
	Part-I Total	3	0	0		40	60	100	3
Part–II									
21UMBCC301	Core6: Applied and Environmental Microbiology	4	-	-	3	30	70	100	4
21UMBCC302	Core7: Agricultural Microbiology	4	-	-	3	30	70	100	4
21UMBCC303	Core8: Bioinstrumentation Techniques	4	-	-	3	30	70	100	4
21UMBDC301	DSE 1: Sustainability and Conservation (Zoology-2)	3	-	-	3	30	70	100	3
21UMBCC304	Core practical – 3 – Applied and Analytical Microbiology	-	-	6	6	40	60	100	2
21UMBDC302	DSE 1: Practical Sustainability and Conservation (Zoology-2)	-	-	6	3	40	60	100	2
<No course code>	Core Enrichment – 1: Concept to Practice Course		1	-	-	20	Evaluation at the end of Semester - IV		
	Core Enrichment 2: Internship 1	-	-	-		100		100	1
	Part-II Total	15	1	12		300	400	700	20
Part-III: Ability Enhancement Courses									
	FS 3:Career Acceleration Programme (CAP)	-	2	-					Audit course
	Part-III Total	-	2	-		0	0	0	
	Total (Part-I to Part-III)	18	3	12	-	340	460	800	23
		33				800			

Semester– IV									
Course Code	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
Part – I									
21ULCEN4	English IV –	3	-	-	3	40	60	100	3
	Part-I Total	3	0	0		40	60	100	3
Part–II									
21UMBCC401	Core 9: (Ad) Bacterial Metabolism	4	-	-	3	30	70	100	4
21UMBCC402	Core10: (Ap) Industrial Microbiology	4	-		3	30	70	100	4
21UMBCE401/ 21UMBCE402	Core Elective:1 Quality Assurance and Quality Control / Mycology and Virology	4	-		3	30	70	100	4
	TDE 1:	2	-	-	3	Total Internal Evaluation			2
	DSE:	3	-	-	3	30	70	100	3
21UMBCC403	Core Practical – 4 – Fermentation Microbiology			6	6	40	60	100	3
21UMBCE403/ 21UMBCE404	Core Elective Practical: Quality Assurance and Quality control / Mycology and Virology			4	3	40	60	100	2
	DSE: Practical:			6	3	40	60	100	2
	Core Enrichment – 1: Concept to Practice Course		1	-	-	40	-	100	-
	Core Enrichment 2: Internship 2	-	-	-		100		100	1
	Part-II Total	17	1	18		270	530	800	24
Part-III: Ability Enhancement Courses									
<no subject code>	FS 3: Career Acceleration Programme (CAP)	-	2	-					Audit course
	Part-III Total	0	2	0					
	Total (Part-I to Part-III)	20	3	18	-	310	590	900	27
		37				900			

Minimum one-month internship pertaining to learning for concept to practice/prototype or product development for start-up/mini and final semester project/skilling in the summer vacation/combination of semester break and summer vacation in industry/premier research institute/NGO etc.

Trans-Disciplinary Elective & Discipline Specific Elective offered by Department to the Cluster for SEM-4 Students

Course Type	Course Code	Course title	Credit
Trans-Disciplinary Elective	21UMBTD401	Microbes in Human Welfare	2
Discipline Specific Elective	21UMBDE405/406	Pharmaceutical Microbiology – Theory/Practical	3/2

Semester– V										
Course Code	Course	Contact Hrs/wk.			SEE Duration hrs	Maximum Marks			Credits	
		T	Tu	P		CIA	SEE	Total		
Part–II										
21UMBCC501	Core11:	4	-	-	3	30	70	100	4	
21UMBCC502	Core12:	4	-	-	3	30	70	100	4	
21UMBCC503	Core 13: (Self-study) –	1	-	-	3	30	70	100	4	
21UMBCC504	Core 14: Concept Recapitulation Test (CRT) for Core Courses of Semester I to V				2	100	-	100	1	
	Core elective 2: <1><2>	4	-		3	30	70	100	4	
	TDE 2:	2	-	-	3	30	70	100	2	
21UMBCC505	Core Practical – 5 -			9	6	40	60	100	3	
	Core Elective Practical			4	3	40	60	100	2	
	Core Enrichment 3: Internship 2	-	-	-		100		100	1	
	Core Enrichment 4: Mini Project /Skill Enhancement	-	2	4	-	100	-	100	4	
	Part-II Total	15	2	17		530	470	1000	29	
Part-III: Ability Enhancement Courses										
<no subject code>	FS-3 Career Acceleration Programme (CAP)	-	2	-		Remarks			Audit course	
	Part-III Total	0	2	-		0	0	0		
	Total (Part-II to Part-III)	15	4	17	-	530	470	1000	29	
		34				1000				

Semester–VI

Course Code	Course	Contact Hrs/wk.			SEED uratio nhrs	Maximum Marks			Credits
		T	Tu	P		CIA	SEE	Total	
Part-II(Project + a Compulsory course/ Advanced Courses + a Compulsory course)									
	Core15: (Compulsory course)	5	-	-	3	30	70	100	5
	Core16:	5	-	-	3	30	70	100	5
	Core – 17:	5	-	-	3	30	70	100	5
	Core Practical – 6 – Skill Training / Start up	-	-	9	6	40	60	100	4
	Core Enrichment 5: Project / Dissertation	-	-	20				300	14
		24/25						400	19
	Part-II Total							400	19
Total Marks:400									

It is expected that student should spend *4hrs eachdayfor6 days

Formation of Part-III

Course Code	Semester	Course / Component	Contact Hrs	No. of Courses	Credit/ Course	Total Credits
A. Ability Enhancement Course (AEC)						
(i) Ability Enhancement Compulsory Course (AECC)						
	I	AECCI: Introduction to SDG (online course)	-	1	Remarks	Audit Course
	I & II	AECC II: Environmental Conservation and Sustainable Development	1 Hr / Week / Semester	1	1+1	2
	I & II	AECC III: Human Values for Holistic Living	1 T + 2 Tu /Week /Semester	1	1+1+1	3
					Sub Total	5 + Audit course
(ii) Skill Enhancement Course (SEC)						
As per common list	Any Semester between II –V/VII	SEC-I *Value Added Courses	40 Hrs	1	1	1
	Any Semester between III – V/VII	SEC-II **Co- Curricular Course	80 to 120 Hrs	1	2	2
					Sub Total	3
B. Finishing School						
FS I to FS IV Compulsory to Earn Degree.						
	I	FS I: Student Induction Program	3 weeks Phase 1, Phase 2, Phase 3	-	Remark	Audit course
	Across I & II Semester s	FS II: Fundamentals of Design Thinking (Online/Offline)	40 to 60 Hrs	1	Remark	Audit course
	Semester	FS III:	2 Hrs /	As per	Remarks	Audit

	s I to V / VII	Career Acceleration Programme – CAP (Placement Training)	Week /Semester	syllabus		course
	Semester V (3 yrs program) Semester VI (4 yrs program)	FS IV: Community Engagement	Twice a month	1	Remarks	Audit course
FS V to FS VIII Options for Advanced Learners						
	Any semester from II to V/VII	FS V: Indian & Foreign Languages	-	Any number of courses	Remarks	Audit course
	Any semester from II to V/VII	FS VI: Any number of Online course(s) from select MOOC platforms	-	Any number of courses	Remarks	Credit as per provider/ audit course
	Any semester from III to V/VII	FS VII: Advanced Design Thinking	-	1	Remarks	Audit course
	Any semester from I to VI/VIII	FS VIII: #Extra Credit Course Any number of courses from any UG program across the College	Self-study	Any number of courses	As per course offered	As per credit(s) earned across all courses opted

***Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by any department across the Institution.

****Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by any department across the Institution.

Student may opt for any course of the odd/even prevailing semester from any UG program across the Institution with the following guidelines:

- a. Attending class not mandatory.
- b. May be mentored by the course teacher.

- c. Preparation through self-study.
- d. CIA not mandatory; evaluated for total marks at the end of the semester.
- e. Indicates options to appear for the course through examination application and payment of examination fees of that course.
- f. Credits earned through each course indicated in the consolidated mark sheet as extra credits; not included for CGPA, percentage marks and classification.

TOTAL MARKS & CREDIT DISTRIBUTION TO EARN THE DEGREE

S. No	PART	Total Marks	Total Credits
1.	PART I: Language Course	400	12
2.	PART II: Core, IDC, DSE, TDE	4000	128
3.	PART III: AECC-I, II & III SEC- I & II FS I, II, III & IV	Remarks	08 + Credit audit
TOTAL		4400	148

VALUE ADDED COURSES (VAC) COURSES OFFERED BY THE DEPARTMENT

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBVA01	Mushroom Cultivation	40 Hrs	1

CO-CURRICULAR COURSE (COC) COURSES OFFERED BY THE DEPARTMENT

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBCCO1	Biofertilizer	80 Hrs	1

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE) OFFERED BY THE DEPARTMENT (SEM-4)

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBDE405	Pharmaceutical Microbiology – Theory	50 hrs	3
2	21UMBDE406	Pharmaceutical Microbiology – Practical	6hr/week	2

TRANS DISCIPLINARY ELECTIVE (TDE) OFFERED BY THE DEPARTMENT

Sr. No.	Course Code	Course Title	Course Duration	Credits
1	21UMBTDE1	Microbes in Human Welfare	40 hrs	2

Syllabus – Semester – IV

Department: **Microbiology**Programme: **B.Sc. Microbiology**

Course Code	Course Title (AD)	Credits
21UMBCC401	Core 9: Bacterial Metabolism	4 Credits

Course Description:

Metabolism is the sum total of all the synthetic and breakdown reactions that take place within a living cell. These reactions are at the core of the sustenance, vitality, and all the physiological functions of the cell and a multi cellular living organisms. This course explains metabolism of different biomolecules, especially in a bacterial cell. Metabolism of some special microorganisms is also discussed to stress upon the vast diversity in metabolic reactions. A comparative study of these reactions in prokaryotes and eukaryotes is also discussed and the learner will be able to comprehend the mechanism, importance and diversity of metabolism in living world. The course is divided into five units, each discussing the cellular metabolism from its basics to the advanced level

Course objectives:

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

1. Understand the central metabolic reactions in a cell and an organism
2. Understand the mechanism of energy generation and its utilization during cellular activities
3. Explain the fundamentals of catabolism of different biomolecules, its mechanism and its importance
4. Identify the metabolic differences among various categories of bacteria.
5. Understand the process and mechanism of transport of molecules across the membrane for metabolic reactions

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO ₁	Understand the central metabolic reactions in a cell and an organism	K3
CO ₂	Understand the mechanism of energy generation and its utilization during cellular activities	K3& K4

CO ₃	Comprehend the fundamentals of catabolism of different biomolecules, its mechanism and its importance	K3
CO ₄	Identify the metabolic differences among various categories of bacteria.	K3
CO ₅	Understand the process and mechanism of transport of molecules across the membrane for metabolic reactions	K3 & K4

Course Content	Hours
Unit 1: Introduction to Metabolism, Bioenergetics and Enzyme Kinetics	12hrs
<ul style="list-style-type: none"> • General Overview of Metabolism, primary and Secondary Metabolism and their significance • Thermodynamics –First law of thermodynamics, second law of thermodynamics • Bioenergetics: The concept of free energy, Determination of ΔG & Energy rich compounds • Energy metabolism: Introduction to metabolism, Role of ATP in metabolism, Role of reducing power in metabolism, Role of precursor metabolites in metabolism • Kinetics of a single-substrate enzyme catalysed reaction, Michaelis-Menten Equation, K_m, V_{max}, Lineweaver–Burk plot, Turnover number, K_{cat}; Kinetics of Enzyme Inhibition; Kinetics Allosteric enzymes 	
Unit 2: Catabolism of Carbohydrates	12hrs
<ul style="list-style-type: none"> • General overview of various metabolic pathways, regulations and their significance • Glycolysis and its regulation • Pentose phosphate pathway • Entner-Doudroff pathway • Citric acid cycle and its regulation, Glyoxylate cycle 	
Unit 3: Metabolism of amino acids, Nucleic acids and Lipids	12hrs
<ul style="list-style-type: none"> • Biodegradation of amino acids – deamination, transamination, decarboxylation; Stickland Reactions • Urea cycle including its regulation • Biosynthesis of amino acids • Biologically active amines Recycling of Purine and Pyrimidine nucleotides by salvage pathways • Oxidation of Fatty Acids, Beta-Oxidation of Fatty Acids 	

Unit 4: Bioenergetics and Membrane Transport	12hrs
<ul style="list-style-type: none"> • Different modes of ATP generation and comparative study of ATP (energy budget) • Electron transport chain: Introduction, Components of ETC and energy yield, Anaerobic Respiration • Bacterial photosynthesis; Biosynthesis of Peptidoglycan • Transport of small molecules across membrane: Active and Passive transport • Specific Transport Systems: Mechanosensitive channels, ATP-binding cassette Transport family, Chemiosmotic-driven transport, Establishing Ion gradients, Iron transport, The phospho-transferase system 	
Unit 5: Some selected aspects of metabolism in specific microbial systems	12hrs
<ul style="list-style-type: none"> • Chemo-autotrophs: Nitrifying Bacteria, Sulfur Oxidizers, The Iron bacteria, The Hydrogen bacteria • The lactic acid bacteria: Patterns of carbohydrate fermentation in lactic acid bacteria • The Enteric group and related Eubacteria: Fermentative patterns of Gram negative Eubacteria • Archaeobacteria: Energy metabolism and Carbon - Assimilation in Methanogens, Photophosphorylation in <i>Halobacterium</i> • Quorum sensing 	

Text Books:

1. D.White 2nd Edition. The physiology and Biochemistry of Prokaryotes (UNIT 1 – 5)
2. Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.

Reference Books:

1. Nelson, D.L., Cox, M.M. (2013). Lehninger Principles of Biochemistry. W.H. Freeman publication.
2. Moat, A.G., Foster. J.W., Spector, M.P. (2009). Microbial Physiology, 4th Ed: Wiley India Pvt Ltd.
3. Principles of Biochemistry By Lehninger
4. Conn E. E. and Stumpf P. K. Outlines of biochemistry by Lehninger 4th Ed.
5. Powar and Dagainawala General Microbiology by Vol-1

Pedagogic tools:

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

Suggested reading / E-resources

<https://www.youtube.com/watch?v=NYMTeqpr6JI>

<https://www.youtube.com/watch?v=C8wfypp-4F8>

Suggested MOOCs

- **Microbial Physiology and metabolism - Course**
(https://onlinecourses.swavam2.ac.in/cec21_bt17/preview)

Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st & 2 nd Units	1 ^{1/2} hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 th week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 nd CIA	20	05
Grand Total					30

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (AP)	Credits
19UMBCC402	Core 10: Industrial Microbiology	4 Credits

Course Description:

Industrial Microbiology is the application of microbial technology for the production of economically and socially useful products, at industrial level. This includes antibiotics, organic acids, amino acids, alcohol, vitamins, dairy products, pharmaceutical drugs, Single cell protein, etc. The course is distributed in to five units which discusses the fundamental properties of microorganisms that make them suitable for production of these products, the actual process, the process parameters, measures for quality assurance and control, product purification, standardization and marketing.

Course Objectives:

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

1. Understand the role of microorganisms in various product formation by microbial processes
2. Comprehend the mechanism of action of different groups of industrially important microorganisms in production of variety of products
3. Analyse the effect of different physical and chemical conditions on the microbial process for product formation.
4. Understand the process of product separation and purification using various techniques.
5. Apply the knowledge of strain improvement, parameter optimization and mechanism of microbial action to produce novel products with enhanced values.
6. Get an excellent position in any fermentation industry as process/ product incharge or QAQC officer

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	Understand the role of microorganisms in various product formation by microbial processes	K2
CO2	Comprehend the mechanism of action of different groups of industrially important microorganisms in production of variety of products	K3
CO3	Analyse the effect of different physical and chemical conditions on the microbial process for product formation.	K4
CO4	Understand the process of product separation and purification using various techniques.	K3
CO5	Apply the knowledge of strain improvement, parameter optimization and mechanism of microbial action to produce novel products with enhanced values.	K4

Course Content	Hours
Unit 1: Fermentation Technology & Industrially Important Microorganisms	12 hrs.
<ul style="list-style-type: none"> • Basic concept: Industrial Microbiology • Range of Fermentation Processes; Component parts a fermentation process • Fermentation Economics; GLP and GMP • Screening of industrially important microorganisms: Use of enrichment techniques in isolation methods; Primary & Secondary Screening; Culture Collection Centres in India and abroad • Improvement of industrially important microbes: Application of Mutation, protoplast fusion and recombinant DNA technology 	
Unit 2: Formulation of Fermentation Media	12 hrs.
<ul style="list-style-type: none"> • Introduction, Types of Media and Medium formulation • Raw materials: Crude Carbon and Nitrogen sources • Minerals, Precursors, Growth Regulators, Buffers, Antifoam agents • Media Optimization • Inoculum Medium 	

Unit 3: Design and aseptic operation	12 hrs.
<ul style="list-style-type: none"> • Introduction and basic functions of fermenter • Types of bioreactors: Continuous stirred tank bioreactor, air lift fermenter, tower fermenter, immobilized enzyme bioreactors • Aeration and Agitation • Fermentation process: Batch Fermentation, Continuous fermentation and their comparative advantages and disadvantages • Sterilization process in fermentation industries: Fermenter sterilization; Medium sterilization; Sterilization of air and feed, Aseptic operation and Containment 	
Unit 4: Overview of Downstream Processes	12 hrs.
<ul style="list-style-type: none"> • Methods of Cell separation: Broth conditioning, Precipitation, Sedimentation, Centrifugation, Filtration • Techniques of Cell Disruption: Mechanical and Non mechanical methods • Product Recovery: Liquid-Liquid extraction, Solvent recovery, Two Phase aqueous extraction, Super critical fluid extraction; Chromatography, Drying and crystallization • Physical, Chemical and Biological assay of fermentation products 	
Unit 5: Studies of selective fermentation processes	12 hrs.
<ul style="list-style-type: none"> • Production of organic solvents: Ethyl alcohol • Production of enzymes and Vitamins: Amylases and Riboflavin • Production of antibiotics: Penicillin • Production of amino acids and organic acids: Lysine and Citric acid • Introduction to methods to immobilize whole cell and/ or enzymes; Applications 	

Text books:

1. Stanbury, P.F., Whittaker, A. (1984). Principles of Fermentation Technology, 2nd Edition. Pergamon Press. (UNIT – 1-5)
2. Patel, A.H. (2011). Industrial Microbiology, 2nd Edition: Laxmi publication.

Reference Books:

1. Casida, L.E. (1968). Industrial Microbiology. New Delhi: New Age International Pub. (P) Limited.
2. Joshi, V.K., Pandey, A. (1999). Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2. Emakulam: Educational Publishers & Distributors.
3. Prescott, S.C., Dunn, C.G., Reed, G. (1982). Prescott & Dunn's Industrial Microbiology. Westport: AVI Publication.

4. Crueger, W., Crueger, A. (1990). A text book of Industrial Microbiology, 2nd edition: Sunderland, Mass.: Sinauer Associates

Pedagogic tools:

- Chalk and Board
- PPT and Videos.
- Assignment
- Class Activity: Class Test

Suggested reading / E-resources

- <https://www.youtube.com/watch?v=V0BzQQCCwgo>
- <https://www.youtube.com/watch?v=pQnfileQNwI>

Suggested MOOCs

- <https://online-learning.tudelft.nl/courses/industrial-biotechnology/>
- https://onlinecourses.nptel.ac.in/noc19_bt20/preview

Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st & 2 nd Units	1 ^{1/2} hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 th week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 nd CIA	20	05
Grand Total					30

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (AD)	Credits
21UMBCE401	CE 1: Quality Assurance and Quality Control	4 Credits

Course Description:

Quality is a very important factor in the industrial application and production by any technology, and microbial technology is not an exception. All the materials, protocols, procedures, and the products have to pass through and abide to stringent quality regulations. This course will make student aware of the importance of quality assurance and quality control in any pharmaceutical, food, or other industries that involve microorganisms. Total Quality Management, its role and the importance is also emphasized. This course will make the learner familiar with the industrial process and procedures related to TQM.

Course Objectives:

The course is designed

1. For better perception in industrial microbiology standards
2. To understand industrial requirement of microbial technology
3. To get better opportunities in pharmaceutical industry/laboratories/ Research institutes
4. To be equipped with standard operating procedures as per regulatory authorities
5. To make the learner able to apply the norms of the quality regulation in the industry and various laws governing the same.

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	To get a better perception in industrial microbiology standards	K2
CO2	To understand industrial requirement of microbial technology	K2

CO3	To get better opportunities in pharmaceutical industry/laboratories/ Research institutes	K3
CO4	To be equipped with standard operating procedures as per regulatory authorities	K3
CO5	To make the learner able to apply the norms of the quality regulation in the industry and various laws governing the same.	K3

Course Content	Hours
Unit 1: Total Quality Management System	12hrs
<ul style="list-style-type: none"> • Basic concept of Total Quality Management • Importance of quality • Components of TQM • Advantages of quality 	
Unit 2: Quality Assurance	12hrs
<ul style="list-style-type: none"> • Hazard and risk analysis in pharmaceutical products • Personnel's in Quality assurance • Functions of quality assurance • Organizational setup in QA 	
Unit 3: Quality Control	12hrs
<ul style="list-style-type: none"> • Definition: Quality Control and its types in various industries • Principles of quality control • Methods of quality control in food industry, Pharma industry • Corrective and Preventive actions 	
Unit 4: Quality Audits and Inspections	12hrs
<ul style="list-style-type: none"> • Self-inspections and internal assessments • Audits: Purpose audits and its types • Regulatory Compliance • Government regulations governing the Quality Audits 	
Unit 5: Regulatory Guidelines on Quality Systems in Industry	10hrs
<ul style="list-style-type: none"> • Regulatory bodies in industries • FDA, USFDA, FSSAI and ISO • Quality Standards in India: ISI, AGMARKS • Commodity based standards 	

Text Book

- Vyas S. P., Dixit V. (2007) Pharmaceutical Biotechnology, CBS Publishers & Distributors
- R. Bhatia, (2000). Quality Assurance in Microbiology. CBS publishers & distributors, New Delhi.
- S. H. Willing, M.M. Tuckerman, W. S. Hitchings IV.(2007). Good manufacturing practices for Pharmaceuticals. 2nd edition. MerceL Dekker NC New York

Reference Book

- Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) Hugo & Russell Pharmaceutical Microbiology 8th Ed. Wiley-Blackwell Publishing house
- John S. Wolfson and David C. Hooper, (1989) Quinolone antimicrobial agents. American Society for Microbiology, Washington.
- Cooper M. S. (1972) Quality control in the Pharmaceutical Industry Vol.2 Academic Press Inc

Pedagogic tools:

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

Suggested reading / E-resources

- <https://tabraizullah.files.wordpress.com/2020/02/basic-concepts-of-quality-assuramnce-quality-control.pdf>
- <http://www.cdb.gov.bt/uploads/downloads/1.%20Quality%20Assurance%20and%20Quality%20Control.pdf>
- <https://asq.org/quality-resources/quality-assurance-vs-control>

Suggested MOOCs

- <https://www.youtube.com/watch?v=Q9lZwMXourk>
- https://www.youtube.com/watch?v=0hZqHwuli_I

Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st & 2 nd Units	1 ^{1/2} hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 th week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 nd CIA	20	05
Grand Total					30

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (F)	Credits
21UMBCE402	CE 2: Mycology and Virology	4 Credits

Course Description:

Mycology is the branch of biological science dealing with the study of Fungi while Virology is the study of viruses. This course will discuss the general features and distinguishing characteristics of both fungi and viruses. A brief discussion about different classes of fungi, their mode of nutrition, reproduction and propagation is also a major component of the course. Techniques for cultivation and enumeration of viruses and their importance in the production of vaccines is also stressed upon. Economic importance of both fungi and viruses is also included in the course.

Course Objectives:

This course is designed to provide Instruction about

1. General features and characteristics of fungi
2. Different classes of fungi
3. Mode of fungal nutrition, reproduction and propagation
4. General features, characteristics, and classification of viruses
5. Cultivation and enumeration techniques for viruses.

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	To get a better perception on General features and characteristics of fungi	K2
CO2	To understand the general features and properties of different classes of fungi	K2
CO3	To understand the basic difference in the mode of nutrition, reproduction and propagation in different classes of fungi	K3
CO4	To comprehend the basics of general features, characteristics, and classification of viruses	K3

CO5	To learn and apply Cultivation and enumeration techniques for viruses	K3
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Course Content	Hours
Unit 1: General characteristics of Fungi	12hrs
<ul style="list-style-type: none"> History, Definition and place in the living world Morphological features of fungi Special structural modifications Fungal nutrition and growth Fungal associations 	
Unit 2: Fungal classification and reproduction	12hrs
<ul style="list-style-type: none"> Types of classification: Natural and Artificial Fungal Classification: Four Class Classification of Fungi, Nine class Classification of Fungi Asexual reproduction Sexual reproduction Parasexual cycle 	
Unit 3: Introduction to Bacterial viruses	12hrs
<ul style="list-style-type: none"> General morphology, occurrence and types LHT Classification system Viral Nomenclature system Lytic Cycle: T4 Bacteriaophage Lysogenic Cycle: Lambda phage, Mu Phage 	
Unit 4: Introduction to Animal and Plant viruses	12hrs
<ul style="list-style-type: none"> General morphology, occurrence and types Animal virus classification and multiplication- Pox virus Viruses and Cancer Classification and Multiplication of Plant Viruses.- TMV Viroids and Prions 	
Unit 5: Cultivation & Enumeration of viruses	10hrs
<ul style="list-style-type: none"> Animal virus cultivation: Direct Animal, Use of Organised Tissues, Animal tissue culture Plant virus cultivation: Plant tissue culture, Direct inoculation Bacterial virus Cultivation: Plaque method Enumeration of Viruses: Latex droplet method, Plaque assay, Acid end-point determination assay, Haemagglutination assay, Particle count and infectivity Cytopathic effects 	

Text Books:

1. An Introduction to Fungi- (2nd revised edition) H.C.Dubey, Vikas publishing House Pvt. Ltd (UNIT-1,2)
2. Introductory Mycology - 4rdedition ,C.J.Alexopoulos, C.W.Mims, 2007. Wiley Eastern limited (UNIT-1-2)
3. Powar and Dagainawala 2012 General Microbiology –Vol. 2, Himalaya Publishing House (UNIT-3,4)
4. S.B. Biswas & Amita Biswas An Introduction to Viruses – 4th revised edition, *Vikas Publishing House (P) Ltd.*, 2006. ISBN 10: 0706982207 / ISBN 13: 9780706982206. (UNIT-5)

Reference Book:

1. Microbiology – Fundamentals and Applications - 7th edition - S.S.Purohit, Agrobios India Publishers
2. L.M. Prescott & Harley, Klein McGraw Hill 2015 *Microbiology - 7th Edition* International Edition
3. Microbiology (international student edition) - Michael Pelczar JR, E.C.S. Chan , Noel R. Krieg, McGraw-Hill publication

Pedagogic tools:

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

Suggested reading / E-resources

- <https://www.microrao.com/micronotes/mycology.pdf>
- <https://www.austincc.edu/ddingley/MLAB1331/LectureGuide/Mycology.pdf>
- https://www.jfmed.uniba.sk/fileadmin/jlf/Pracoviska/ustav-mikrobiologie-a-imunologie/distanca_vyuka/ang_12_lect_viruses.pdf

Suggested MOOCs

<https://www.mooc-list.com/tags/mycology>

<https://www.mooc-list.com/course/virology-i-how-viruses-work-coursera>

Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st & 2 nd Units	1 ^{1/2} hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 th week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 nd CIA	20	05
Grand Total					30

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title	Credits
21UMBCC403	Core Practical - 4: Fermentation Microbiology	6 hrs/week - 3 Credits

Course objectives:

The course will impart basic and advanced skill and hands on practice for;

1. Fermentative production of selected microbial products in the laboratory
2. Methods for product isolation, purification and estimation
3. Enzyme kinetic study

List of Practical:

1. Determination of V_{max} and K_m for amylase enzyme by performing substrate curve with line weaver Burk plot.
2. Primary screening of industrially important microorganisms capable of producing: Antibiotics, Organic acids, amylases
3. Bioassay of Penicillin/Streptomycin using *B. subtilis/E.coli*
4. Laboratory fermentation of Ethyl Alcohol by *Saccharomyces cerevisiae* & its Estimation
5. Laboratory fermentation of amylase by *B. subtilis* & its estimation
6. Sterility testing of fermentation products (Demo) – Use of Sterile products for testing Microbial contamination
7. Immobilization of yeast cells by Ca-alginate entrapment method & determination of viability of immobilized cells by invertase activity / Gluconic acid formation.

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. Cuppuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4th edition: Benjamin Cummings publications.
4. Baker, F.J., Breach, M.R. (1967). Handbook of Bacteriological Technique: Butterworth & Co Publishers Ltd.

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title	Credits
21UMBCE403	CE 1 Practical: Quality Assurance and Quality Control	4hrs/week 2 Credits

Course Objectives:

The student shall be able to:

1. Acquire skills Quality management system
2. Understand the role of quality in human life and its role in betterment of society
3. Identify different domains of industry in quality systems like food, pharma etc.

List of Practicals

1. To check the quality of packed food products as per standard protocol of microbiology.
2. Testing for microbial contamination and sterility of the food products in packed food and packaged drinking water
3. Check regulatory guidelines on packaging materials and codes for assurance in quality
4. Study of various pharmaceutical packaged products

Reference Books

1. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal punjani. CBS publishers & distributors, New Delhi.

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title (F)	Credits
21UMBCE404	CE 2 Practical: Mycology and Virology	4 hrs/week 2 Credits

Course Objectives:

The course is designed to develop below mentioned skill in the student:

1. Identify various fungi on the basis of morphological characters
2. Distinguish different parts of fungal thallus
3. Cultivation techniques of fungi from various samples
4. Cultivation techniques for Coliphage

List of Practical

1. Microscopic observation of permanent slides of various fungi
2. Isolation and Cultivation of fungi from soil
3. Isolation of fungi from natural deteriorated samples
4. Study of antimicrobial effect of fungi on laboratory bacteria by plate method
5. Isolation of Bacteriophage of *E.coli*

Syllabus – Semester – IV

Department: **Microbiology**Programme: **B.Sc. Microbiology**

Course Code	Course Title (AD)	Credits
21UMBDE405	DE -: Pharmaceutical Microbiology	3 Credits

Course Description:

Pharmaceutical industry depends largely on the microorganisms and microbial technology. It is a sector that requires active participation of a microbiologist, a chemist, a biochemist and a skilled technician to carryout production activity at large scale. This course is designed to give an insight into the operation of a pharmaceutical unit and the role of microorganism as well as a microbiologist in its smooth operation.

Course Objectives:

The course is designed with the objectives to give students

1. A better perception about the importance of pharmaceutical microbiology standards
2. Basic understanding about the role of microbial technology in industries
3. Skills necessary in pharmaceutical industry/laboratories/ Research institutes
4. An understanding about the standard operating procedures as per Pharmaceutical regulatory authorities

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	To get a better perception about the importance of pharmaceutical microbiology standards	K2
CO2	To have a basic understanding about the role of microbial technology in industries	K2
CO3	To acquire skills necessary in pharmaceutical industry/laboratories/ Research institutes	K3
CO4	To learn and apply the standard operating procedures as per Pharmaceutical regulatory authorities	K3

Course Content	Hours
Unit 1: Introduction to Pharmaceutical Industry	10 hrs
<ul style="list-style-type: none"> • Role of a microbiology in a pharmaceutical industry • Good Laboratory Practices (GLP) in pharmaceutical industry. • Microbiology Laboratory and standards in industry • Regulatory practices and policies: FDA and NGCMA. 	
Unit 2: Processes in Pharmaceutical Industry	10 hrs
<ul style="list-style-type: none"> • Good manufacturing practices and Good microbiology laboratory practices. • QA and QC in industry • Concepts of pharmaceuticals, biologics and biopharmaceuticals • Types of pharmaceutical microbiology laboratories: Sterile & Nonsterile • SOP, clean room, zones, microbial filters, media 	
Unit 3: Quality control: Microbiology Laboratory	10 hrs
<ul style="list-style-type: none"> • Microscopic techniques for particulate matter • Antimicrobial testing of pharmaceutical products • Microbial Limit test, Water analysis • Bacterial Endotoxin Testing (BET) • Environmental Monitoring 	
Unit 4: Microbial control in pharmaceutical industries	10 hrs
<ul style="list-style-type: none"> • Disinfection: Classification, mode of action, factors influencing disinfectants • Sterilization: Introduction, significance • Microbiological assessment of various pharmaceutical products • Fumigation, Growth Promotion test, Biological indicators, Chemical Indicators 	
Unit 5: Role of microbes in pharmaceutical formulations	10hrs
<ul style="list-style-type: none"> • Pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase). • Drug formulations, Carriers and delivery systems, targeted drug delivery, • Application of microbial enzymes in pharmaceutical industry • Microbial production and spoilage of pharmaceutical products 	

Text Book

- S. P., Vyas, V. Dixit (2007) Pharmaceutical Biotechnology, CBS Publishers & Distributors New Delhi
- R. Bhatia, (2000). Quality Assurance in Microbiology. CBS publishers & distributors, New Delhi.

- S. H. Willing, M.M. Tuckerman, W. S. Hitchings IV.(2007). Good manufacturing practices for Pharmaceuticals. 2nd edition. MerceL Dekker NC New York

Reference Book

- Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) Hugo & Russell Pharmaceutical Microbiology 8th Ed. Wiley-Blackwell Publishing house
- John S. Wolfson and David C. Hooper, (1989) Quinolone antimicrobial agents. American Society for Microbiology, Washington.
- Cooper M. S. (1972) Quality control in the Pharmaceutical Industry Vol.2 Academic Press Inc

Pedagogic tools:

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

Suggested reading / E-resources

- https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf

Suggested MOOCs

- <https://www.mooc-list.com/tags/microbiology>
- <https://www.classcentral.com/tag/microbiology>

Methods of assessing the course outcomes

Components of CIA: 30 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st & 2 nd Units	1 ^{1/2} hours	30	05
	Test 2	Units 3,4,5	3 hours	70	15
B	Assignment-1	Any topic from the syllabus	By the end of 8 th week	20	05
C	Assignment-2	Any topic from the syllabus	Before 2 nd CIA	20	05
Grand Total					30

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title	Credits
21UMBDE406	DE -Practical: Pharmaceutical Microbiology	6hrs/week 2 Credits

Course Objectives:

The student shall be able to:

1. Acquire skills to examine microbial load of pharmaceutical products
2. Understand the role of microbes in drugs
3. Identify different microbes associated with products, enumerate them and understand their role
4. Evaluate different parameters affecting pharmaceutical product quality.

List of Practicals

1. Sterility testing by using *B. sterothermophilus* / *B. subtilis*.
2. Testing for microbial contamination. Microbial loads from syrups and suspensions
3. Determination of antimicrobial activity of chemical compounds (like phenol, resorcinol and formaldehydes) Comparison with standard products.
4. Microscopic analysis of sterile injectables and tablets
5. Quality assessment of pharmaceutical products with special reference to regulatory affairs

Reference Books

- R. Bhatia, (2000). Quality Assurance in Microbiology. CBS publishers & distributors, New Delhi.
- S. H. Willing, M.M. Tuckerman, W. S. Hitchings IV.(2007). Good manufacturing practices for Pharmaceuticals. 2ndedition. Merceel Dekker NC New York

Syllabus – Semester – IV

Department: **Microbiology**

Programme: **B.Sc. Microbiology**

Course Code	Course Title	Credits
21UMBTD401	TDE - 1: Microbes in Human welfare	4 Credits

Course Description:

Mycology is the branch of biological science dealing with the study of Fungi while Virology is the study of viruses. This course will discuss the general features and distinguishing characteristics of both fungi and viruses. A brief discussion about different classes of fungi, their mode of nutrition, reproduction and propagation is also a major component of the course. Techniques for cultivation and enumeration of viruses and their importance in the production of vaccines is also stressed upon. Economic importance of both fungi and viruses is also included in the course.

Course Objectives:

This course is designed to provide Instruction about

The Course is designed:

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

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K1 to K4)
CO1	To get a better perception on General features and characteristics of fungi	K2
CO2	To understand the general features and properties of different classes of fungi	K2
CO3	To understand the basic difference in the mode of nutrition, reproduction and propagation in different classes of fungi	K3
CO4	To comprehend the basics of general features,	K3

	characteristics, and classification of viruses	
CO5	To learn and apply Cultivation and enumeration techniques for viruses	K3

Course Content	Hours
Unit 1: Introduction to Microorganisms	8 hrs
<ul style="list-style-type: none"> • Definition, Brief History and scope of Microbiology, • Groups of Microorganisms. • Nutrition and Cultivation of microorganisms • Isolation, purification and preservation of Microbes • Place of microbes in the living world 	
Unit 2: Microbes in Agriculture and Environment	8 hrs
<ul style="list-style-type: none"> • Plant Microbe interaction – PGPR and Plant pathogens • Biofertilizer & Biopesticide • Biodegradation & Bioremediation • Bioleaching • Waste water treatment, Biohazards & Microbial pollution 	
Unit 3: Microbes in Industry	8 hrs
<ul style="list-style-type: none"> • Acid Production • Alcohol and alcoholic beverages production • Enzyme Production • Antibiotics, Vaccine, interferon, antibodies. • Single Cell Protein 	
Unit 4: Microbes in Health and Hygiene	8 hrs
<ul style="list-style-type: none"> • Normal flora and pathogens, Importance of personal hygiene • Water and food borne infections • Air borne infections • Infections of direct contact • Microbes as savior – Vaccine 	
Unit 5: Microbes in and as food	8 hrs
<ul style="list-style-type: none"> • Microbes in food preparation • Probiotics and functional foods • Microbes as food • Microbial spoilage of food and dairy products • Microbes in preparation of Beverages 	

Text Books

- Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
- Modi, H.A. Elementary Microbiology - Vol -I, Akta Prakashan, Nadiyad.
- Modi, H.A. Elementary Microbiology – Vol-II, Akta Prakashan, Nadiyad.
- Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.

Reference books

- Stanier, R.Y., Ingraham, J.L., Wheelies, M.L., Painter, R.K. General Microbiology, 5 Edition. MacMillan Press Ltd., London
- Salle, S.J. (1974). Fundamental Principals of Bacteriology, Tata McGraw Hill Publication Co. Ltd. New Delhi
- Kaul T N 2001. Biology and conservation of mushrooms. Oxford and IBHpublishing companyNew Delhi
- Frobisher M., Hinsdill, Crabtree and Goodherat Fundamentals of Microbiology, 9 Edition. W.B Saunders Co. USA.

Pedagogic tools:

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

Suggested reading / E-resources

- <https://www.pmfias.com/microbes-in-human-welfare-useful-microbes/>
- https://www.youtube.com/watch?v=65sh_0kBuM8

Suggested MOOCs

- <https://ncert.nic.in/textbook/pdf/lebo110.pdf>

Methods of assessing the course outcomes

Components of CIA: 30 marks

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