ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)
U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISHTI LANGUAGE UNIVERSITY,
LUCKNOW, U.P. (India)

B.Sc. – Microbiology

Ordinance/Regulations, Course, Curriculum Structure and Syllabus (As per NEP 2020)

First, Second & Third Years

(I, II, III, IV, V & VI Semesters)

Effective from Session 2022-23

Department of Microbiology

Faculty of Science

Khwaja Moinuddin Chishti Language University Lucknow, U.P. (India)

Ordinance/Regulations

Bachelor of Science in Microbiology Programme

1. Applicability

These regulations shall apply to the programme of Bachelor of Science in Microbiology from the session 2022-23.

2. Minimum Eligibility for Admission

An Intermediate degree under the 10+2 system with Biology group from a recognized Board/Institution, with 45% marks in aggregate for General/OBC and 40% for SC/ST candidates shall constitute the minimum requirement for admission to the programme.

3. Programme Objectives

- Bachelor course in microbiology offers the synergism of concepts of microbiology along with basic concepts of biology, chemistry, biochemistry, physiology, molecular biology, immunology, recombinant DNA technology, genomics & proteomics with technological applications.
- The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies, entrepreneurship or research and development in the various health, agricultural and industrial areas.
- Develop proficiency in application of current aspects of Microbiology like biochemistry, molecular biology, immunology, recombinant DNA technology, genomics & proteomics.
- Students will be able to use state of the art techniques relevant to academia and industry, generic skills and global competencies including knowledge and skills that enable the students to undertake further studies in the field of biochemistry, immunology, molecular biology, genetic engineering, genomics & proteomics, microbiology or any other related field.
- Imparting an education that includes communication skills, the ability to work in a team with leadership quality, devoted to societal problems with an ethical attitude.

4. Programme Outcomes

- **PO1-** Prepares the students for immediate entry to the workplace with sound theoretical, experimental knowledge in the area of health and pharmaceuticals, biochemicals, biofuels, environment related, food and dairy, cosmetics, biopolymers and related multidisciplinary fields.
- **PO2-** Overall, the course offers basic foundation in microbiology which enables the students to understand the concepts in microbiology, biochemistry, molecular biology, genetic engineering and related industrial technology.
- **PO3-** Students will be able to design, execute, record and analyse the results of experiments in field of microbiology, molecular biology, genomics, Recombinant DNA technology, biochemistry and genetic engineering.
- **PO4-** Students will be able to work effectively in a group in the classroom, laboratory, industries and field based situations.
- **PO5-** Become efficient in using standard operating procedures and will be well versed with the regulations for safe handling and use of chemicals as well as IPR and biosafety issues related to experiments in field of biochemistry, microbiology and genetic engineering.

5. Specific Programme Outcomes

- **SPO1-** Critical Thinking- Students will demonstrate an understanding of major concepts in all disciplines of biology, microbiology, biochemistry, biotechnology and bioinformatics. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
- **SPO2-** Effective Communication- Development of various communication skills such as reading, listening, speaking in expressing ideas and views clearly and effectively.
- **SPO3-** Social Interaction and Ethics- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life besides following ethics
- **SPO4-** Environment and Sustainability- Understand the issues of environmental contexts and sustainable development.
- **SPO5-** Competitive Skill- Demonstrate an ability to appear for National level examination to pursue higher studies.
- **SPO6-** Career opportunities- Demonstrate an ability to identify careers in microbiology domain like Healthcare Diagnostics, Pharmaceutical, Food Industry etc, and skills required to work in a microbiology laboratory or manufacturing facility. Beside this, industries also employ microbiological professionals in their marketing divisions to boost up business in sectors where their products would be required.
- **SPO7-** Entrepreneurship ventures- such as consultancy and training centers can be opened.

Abbreviations:

S. No.	Abbreviation	Full form
1	C	Credits
2	L	No. of Lectures/ periods (One hour Lecture for theory & two hours lab for practicals)
3	CIE	Continuous Internal Evaluation
4	UE	University Exam.
5	Th.	Theory paper
6	Prac.	Practical paper
7	UG	Under Graduation
8	PG	Post-Graduation
9	MM	Maximum marks
10	POs	Programme Outcomes
11	PSOs	Programme Specific Outcomes
12	COs	Course Outcome

1. **Number of subjects:**

- Three subjects in first year.
- Three subjects in second year.
- Two Subjects in third year.

2. **Number of papers:**

In first two years, in each subject there shall be 6 credits in each semester with:

- Either one theory paper of 6 credits.
- Or one theory paper of 4 credits and one practical paper of 2 credits.
- Or one practical paper of 4 credits and one theory paper of 2 credits.

In the third year in each subject there shall be 10 credits in each semester with:

- Either two theory papers of 5 credits each.
- Or two theory papers of 4 credits each and one practical paper of 2 credits.
- Or two practical papers of 4 credits each and a theory paper of 2 credits.

2.1 Core Compulsory Papers

In first two years, there shall be compulsory core papers of 12 credits in each semester with:

- One theory paper of 4 credits and one practical paper of 2 credits.

In the third year there shall be compulsory core papers of 10 credits in each semester with:

- 2 theory papers of 4 credit each and one practical paper of 2 credits.

2.2 Minor Elective:

A course of 4 Credits can also be opted as an elective (Optional) course by the students in one year like Ist year and IInd year in any even or odd semester who do not have this subject as major (main) subject but other subjects.

- Minor Elective Course Paper will be any subject (4 credits) and not the full subject
- Minor Elective Paper will be taken by the student from other subject/any Faculty (Own Faculty or Other Faculty). No pre-requisite will be required for this.
- It will be mandatory for the student to take a minor elective subject (one minor paper per year) in the first, second year (undergraduate). The university/college may allot the minor subject paper on the basis of available seats. Minor / Elective paper will not be compulsory in 5th and 6th semester.
- Students can choose the available minor elective paper in even or odd semesters at their convenience.
- Minor elective paper will be selected from the subjects offered in the institute. The classes for the selected minor paper will be held at the same time as the classes of the same course conducted in the Faculty and examination will also be held at the same time.

a. Vocational/Skill Development Courses

- Every student at the undergraduate level will be required to undertake a skill development course of 3 credits in each semester of the first two years (four semesters) (four courses totaling 3x4 12 credits).

b. Co-Curricular Courses(Qualifying)

- It will be mandatory for every graduate student to do one co-course in each semester of three years (six semesters).
- The student has to pass all these co-courses with 40 percent marks. Grades will be marked on the

grade sheet of the student based on their marks, but they will not be included in the calculation of CGPA.

c. Research Project /Industrial Training

- Graduation / Post Graduation / PGDR level, every semester (fifth to eleventh) up to the semester). The student will have to do a small research project in the third year and a major research project in the fourth and fifth year. The nature of the research project in PGDR will be decided by the university as per Pre-Ph.D. course work
- A research project related to one of the two main subjects of the third year chosen by the student and the main subject of the fourth, fifth, sixth year will have to be done. This research project can also be interdisciplinary. This research project can also be in the form of industrial training / internship / survey work etc.
- The research project will be done under the direction of one teacher supervisor; co-supervisor can be taken from any industry/company/technical institute/research institute.
- At the end of the year, the student will submit a joint report of the research project done in both the semesters, which will be evaluated jointly by the supervisor and external examiner nominated by the university out of 100marks at the end of the year.
- Grades will be marked on the grade sheet of based on research project of the students at graduation PGDR level and will be included in calculation of CGPA.
- Undergraduate (including research) and postgraduate students will be required to undertake a four- credit research project in each semester. The grades will be marked based on the project scores and they will be included in the calculation of CGPA.

2. **Credit and credit determination**

- One credit paper of theory will carry one hour/week of teaching assignments; means 15 hours of teaching assignments in 15 weeks of a semester will be done.
- One credit paper of Practical / Internship / Field Work etc. will consist of two hours / per week teaching assignments i.e. 30 hours of practical / internship / field work etc. in 15 weeks of a semester. In computing the workload of the teacher, the workload of one hour of theory will be

equal to the workload of two hours of practical / internship / field work etc.

- All credit related work will be done through "State Level Academic Bank of Credit", the guidelines of which will be issued separately.
- A student can obtain a one-year certificate with a minimum of 46 credits, a two-year diploma with a minimum of 92 credits, and a three-year bachelor's degree with a minimum of 132 credits. Beyond this, students can pursue a four-year bachelor's (including research) degree with a minimum of 184 credits, a master's degree with a minimum of 232 credits, and a PGDR with a minimum of 248 credits can take. Once the credits are used, the student will not be able to use the credits for those papers again. For example, if a student obtains a certificate after one year using 46 credits, then his credits will be treated as expenses. If he wants to take Diploma after some years, he will either surrender his original certificate to the University and re-credit 45 credits to the account or re-credit new 46 credits and on the basis of which the second year (actual third year can earn 92 (46+46) credits and can take diploma. Similar arrangement will be there for the coming years also. If the student studies continuously and does not take certificate/diploma, then he can take the degree on the basis of 132 credits. You can get a degree.
- If a competent student will obtain the required credits for the degree in less time, then there will be a facility of gap on obtaining minimum credits, but the degree will be granted only after three years. During the interval he will be free to do any work.
- Earned credit will be in the form of certificate. In case of change of faculty or subject in second year. Category and not a diploma, because in order to obtain a diploma, he must obtain the necessary credits in the same subject.
- In the same faculty in which the student will obtain at least 60 percent credit in three years. He will be given a degree and according to the rules in the university, the facility of admission in postgraduate will be given.
- If the student is not able to obtain at least 60 percent of the total credits of the three major subjects in three years in any one of the faculty major, then he will be awarded the degree of Bachelor of Liberal Education and he will be awarded the degree of Bachelor of Liberal Education. in which the prerequisite of any subject at the graduation level will not be required.

- If any eligible student can re-credit his/her credit by taking certificate/diploma and he/she fails in the next examination, he/she can get the certificate/diploma again by using the credits re-credited.

3. Credit system:

- A 4 credit theory course/paper will have four Lectures/periods (of one hour) in a week. In onefull semester the course will be covered in 60 Lectures.
- Similarly, a six credit theory course/paper will have six Lectures/periods (of one hour) in aweek. In one full semester the course will be covered in 90 Lectures.
- A Two credit practical course/paper will have two Lab periods (of two hours each) in a week. In one full semester the course will be covered in 30 Lab periods (60 hours).
- Similarly, a four credit practical course/paper will have four Lab periods (of two hours each) in a week. In one full semester the course will be covered in 60 Lab periods (120 hours).

4. **Attendance and credit determination**

- It will be necessary to take the exam for credit validation. Credits will be incomplete without the exam.
- In order to take the examination, 75 percent attendance will be mandatory as per the earlier rules.
- If a student qualifies for the examination on the basis of attendance in the class, but is unable to take the examination due to any reason, he/she can take the qualifying examination at a later date. He will not need to take classes again.

5. **Continuous Internal Evaluation (CIE):**

- Continuous internal evaluation will be performed by the teacher concerned.
- It is proposed that CIE be kept at present, at 25% of total assessment in a Theory paper. It can be increased in steps up to 50% over a period of time.
- The practical papers in all semesters will have 25% CIE and 75% UE, conducted at the end of the semester by one internal examiner and one external examiner appointed by the University.

6. **Marking system:**

- All papers will be of total Maximum Marks 100, including both CIE and UE.
- Maximum marks 25 will be allotted to CIE and 75 to UE in a theory paper and Research project.
- The practical papers in all semesters will have Maximum Marks 25 CIE and Max. Marks 75 in UE, conducted at the end of the semester by one internal examiner and one external examiner appointed by the University, including a viva voce of 25 marks.

Course Structure

The course structure of the Microbiology programme shall be as follows-

SEMESTER-WISE TITLES OF THE PAPERS IN U.G PROGRAMME B. Sc. (Microbiology)

Year	Sem	Subject	Course Code	Paper Title	Theory	Practical	Total Credits
1	I	Core Compulsory 1	B080101T	General Microbiology	4		6 (4+2)
		Core Compulsory 2	B080102P	Experiments in Basic Microbiology		2	
		GE 1/Minor Elective	B080103T	Basic Microbiology	6		6
		SEC1/Vocational Course	B080104T	Single Cell Proteins and Mushrooms cultivation	3		3
		AECC 1/Co-curricular course	Z010101T	First Aid and Basic Health	2		2
1	II	Core Compulsory 3	B080201T	Agriculture and Environmental Microbiology	4		6
		Core Compulsory 4	B080202P	Experiments in Agriculture and Environmental Microbiology		2	
		GE 1/Minor Elective	B080103T	Basic Microbiology	6		6
		SEC2/Vocational Course	B080204T	Microbial production of Foods and Beverages	3		3
		AECC 2/Co-curricular course	Z020201	Human Values and Environment Studies	2		2
2	III	Core Compulsory 5	B080301T	Basic Biochemistry and Microbial Physiology	4		6
		Core Compulsory 6	B080302P	Experiments Basic Biochemistry and Microbial Physiology		2	
		GE 2/Minor Elective	B080203T	Microbial ecology and Bio control by Microorganism	6		6
		SEC3/Vocational Course	B080303T	Microbial production of Antibiotics and Organic Acids	3		3
		AECC 3/Co-curricular course	Z030301	Physical Education and Yoga	2		2

2	IV	Core Compulsory 7	B080401T	Molecular Biology and Microbial Genetics	4		6
		Core Compulsory 8	B080402P	Experiment in Molecular Biology and Microbial Genetics		2	
		GE 2/Minor Elective	B080203T	Microbial ecology and Bio control by Microorganism	6		6
		Project	B080404R	Research project/Training/Survey		3	3
		AECC 4/Co-curricular course	Z040401	Social Responsibility and Community Engagement	2		2
3	V	Core Compulsory 9	B080501T	Medical Microbiology	4		4
		Core Compulsory 10	B080502T	Immunology	4		4
		Core Compulsory 11	B080503P	Experiments in Medical Microbiology & Immunology		2	2
3	VI	Core Compulsory 12	B080601T	Food Microbiology	4		4
		Core Compulsory 13	B080602T	Industrial Microbiology	4		4
		Core Compulsory 14	B080603P	Experiment in Food and Industrial Microbiology		2	2
4		12 Months Apprenticeship/Internship through NATS or from equivalent organization/ Industry/Institute in their 4th year, will be equal to 40 credits.					
4 Honors Degree	VII	Core	MB10101T	General Microbiology	4		4
		Core	MB10102T	Biochemistry	4		4
		Core	MB10103T	Research Methodology, IPR and Bioinformatics	4		4
		Core	MB10104T	Microbial Pathogenecity	4		4
		Practical	MB10205P	Lab1		4	4
4 Honors Degree	VIII	Core	MB10201T	Applied & Industrial Microbiology	4		4
		Core	MB10202T	Food Microbiology	4		4
		Core	MB10203T	Analytical Techniques & Biostatistics	4		4
		Core	MB10204T	Nanobiotechnology	4		4
		Practical	MB10205P	Lab2		4	4

4 Honors Degree with research	VII	Core	MB10101T	General Microbiology	4		4
		Core	MB10102T	Biochemistry	4		4
		Core	MB10103T	Research Methodology, IPR and Bioinformatics	4		4
		Practical	MB10105P	Lab1		4	4
		Project	MB10106R	Summer internship/Review writing		4	4
4 Honors Degree with research	VIII	Core	MB10201T	Applied & Industrial Microbiology	4		4
		Core	MB10202T	Food Microbiology	4		4
		Core	MB10203T	Analytical Techniques & Biostatistics	4		4
		Practical	MB10205P	Lab2		4	4
		Project	MB10206R	internship/Review writing		4	4

Certificate Course in Microbial Techniques	
B. Sc. I Programme Specific Outcomes (PSOs)	
PSO1	Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.
PSO2	Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PSO4	Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.
PSO5	The certificate course will enable students to apply for technical positions in government and private labs/institutes.
Diploma in Microbial Technology	
B.Sc. II Programme based outcomes	
PSO 1	Students will develop familiarity and understanding of the microbiology concepts as relevant tovarious areas such as biochemistry, microbial physiology, molecular biology and genetics.
PSO 2	Students will exhibit reasonable abilities in the utilization of instruments, advances and techniques common to microbiology, and apply the logical strategy and theory testing in the planand execution of examinations.
PSO3	Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.
PSO4	Students will be able to describe how microorganisms obtain energy, metabolism, reproduction,survival, and interactions with their environment, hosts, and host populations.
PSO5	Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate a broad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.
PSO2	Students will learn about various biotechnological applications of microorganisms as well asindustrially relevant substances developed by microorganisms. They'll learn about the special role microbes play in genetic modification technologies.
PSO3	Students will learn and develop good laboratory practices in a microbiological laboratory, as well as be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.
PSO4	Students will learn about experimental methods, hypothesis creation and testing, and experiment design and execution. Students can develop their critical thinking skills as well as their ability to read and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.
PSO5	The Degree courses will enable students to go for higher studies in Microbiology and Alliedsubjects leading to Post Graduation and Ph.D. degrees.
Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	Analyze the biochemical composition of microbial cells, enzyme functions, and major metabolic pathways involved in microbial growth and survival.
PSO2	Understand the Research Methodology, principles of intellectual property rights, patenting, and regulatory frameworks, and apply bioinformatics tools for sequence retrieval, analysis, and interpretation of biological data.
PSO3	Analyze the role of microorganisms in food production, preservation, spoilage, and safety, including foodborne pathogens and quality control measures.
PSO4	Apply analytical techniques and biostatistical tools for experimental design, data collection, analysis, interpretation, and validation of microbiological and molecular biology research data.
PSO5	Apply nanobiotechnology concepts and laboratory techniques, including nanoparticle synthesis, characterization, and their applications in diagnostics, therapeutics, and environmental systems, using appropriate laboratory and biosafety practices.

Detail Syllabus of B.Sc. I Year

or

Certificate in Microbial Technology

Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: MICROBIOLOGY		
Course Code: B080101T	**Course Title:** General Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the history, relevance of microbiology and classification of microbes.	K1, K3
CO2- To learn and understand the microbial diversity in the living world.	K2, K4
CO3- To understand the working of various microscopes and their applications.	K4, K6
CO4- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safetymeasures to be followed while handling microbes.	K1, K4
CO5- To demonstrate and understanding of bacterial, fungal, cyanobacterial, algal, viral and rickettesialclassification, culturing, reproduction and significance.	K2, K5
CO6- To learn different methods of staining of microbes.	K3, K2
CO7- To understand, learn and gain skill of isolation, culturing and maintenance of pure culture.	K3, K6
CO8- To enable the students to get sufficient knowledge in principles and applications of bio-instruments.	K2, K5

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 4-0-0

Unit	**Topics**	**Total No. of Lectures/ Hours (60)**
I	**Introduction, history and scope of Microbiology** History, scope, branches of microbiology and relevance of microbiology; Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De; Position of microorganisms in the living world. 5 kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms- bacteria, archaea, eukarya; Bergey's manual and introduction to classification of bacteria.	**8**

II	**Bacterial morphology** Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria. **The viruses** General properties and structure of animal viruses: Influenza, HIV; plant viruses: TMV; bacterial viruses: Lambda Phage and T4 bacteriophage; general features of Prions and Viroids. **Fungi** General characteristics, classification & reproduction of Saccharomyces, Aspergllus. **Protozoa** General characteristics, classification & reproduction of Giardia, Entamoeba	**10**
III	**Techniques in microbiology I** Principles of microscopy, construction and application of- Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy ,Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM	**6**
IV	**Techniques in microbiology II** Principles, construction and application of centrifuge; bacteriological Incubator & Incubator Shaker; Laminar flow; Colourimeter & Spectrophotometer (UV- Vis)	**6**
V	**Sterilization techniques and control of microorganisms** Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration; Filtration- Seitz filter, membrane filter, HEPA filter; Radiation- Ionizing and non- ionizing; Chemical methods- Alcohols, aldehydes, phenols, halogens, metallic salts, ethylene oxide.	**7**
VI	**Isolation, cultivation and preservation of microorganisms** Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique, and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure culture	**8**
VII	**Stains and staining techniques** Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Ziehl Neelsen staining;	**7**

	Structural staining- cell wall, capsule, endospore and flagella staining.	
VIII	**Biostatistics** Introduction to biostatistics – definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic biodiagrams.	**8**

Suggested Readings:

Alexopoulas C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation,New Age International, New Delhi.
Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
Benson Harold J., Microbiological Applications, WCB Mcgraw-Hill, New York.
Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
Baveja C.P., Textbook of microbiology APC 6th edition.
Dubey R.C.. and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
Sharma P.D., Microbiology, Rastogi Publications.
Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9th edition, Pearson Education.

Suggestive digital platforms web links-
https:/www.classcentral.com/tag/microbiology
https://cmp.berkeey.edu/bacteria/bacteria.html
https://www.livescience.com/53272-what-is-a-virus.html
https://www.slideshare.net/sardar1109/algae-notes-1
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
https://microbenotes.com/laminar-flow-hood
https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf

This course can be opted as an elective by the students of following subjects: Open for all
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Course prerequisites: To study this course, a student must have had the subject biology in class 12th.

Suggested Continuous Evaluation Methods:
House Examination/Test: 10 marks
Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/Participate: 5 Marks

Further Suggestions: None

Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: MICROBIOLOGY		
Course Code: B080102P	**Course Title:** Experiments in Basic Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the instruments, microbial techniques and good lab practices for working in amicrobiology laboratory.	K3 , K5
CO2- Practical skills in the laboratory experiments in microbiology.	K2, K6
CO3- Develop skills for identifying microbes and using them for industrial, agricultural and environmentalpurpose.	K4, K5
CO4- To prepare slides and stain to see the microbial cell.	K1, K6

Credits: 2	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in labs per week): **L-T-P:** 0-0-2

S. No.	**Objectives** **Any 3 practicals from each unit may be performed/demonstrated**	**Total No. of Lectures/ Hours (60)**
1.	Good labroratory practice in Microbiology and safety measures. Cleaning and sterilization of glassware and equipments. Study of aseptic technique- preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum.	**12**
2.	Study of instruments- Microscope, autoclave, hot air oven, laminar airflow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colourimeter, spectro photometer.	**12**
3.	Preparation of different culture media- nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture. Enumeration of bacteria using spread plate and pour plate techniques. Isolation of bacteria by pour plate, spread plate and streak plate method.	**12**
4.	Staining of bacteria- Simple staining- methylene blue Gram's staining Acid fast staining Ziehl Neelsen staining Giemsa staining Structural staining- capsule, endospore. Staining of fungi using lactophenol and cotton blue.	**12**
5.	Study of permanent slide and life materials Bacteria- E.coli, Staphylococci, Streptococcocci, Lactobacillus sp.,	**12**

	Vibrio, Azospirillum Protozoans- *Amoeba, Paramaecium, Trypanaosoma, Plasmodium, Entamoeba hystolytica*. Helminths- *Fasciola, Taeniasolium, Ascaris*. Fungi- *Mucor, Rhizopus, Penicillium, Aspergillus, Alternaria*. Cyanobacteria- *Chlorella, Spirulina, Nostoc, Anabaena*.	

Suggested Readings:

Microbiology: A laboratory manual by J. Cappucino and C.T. Welsh. 11th edition, Pearson education, USA. 2016

Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultiation, New Age International, New Delhi.

Dubey R.C.. and Maheshwari D.K., Textbook of practical microbiology, S Chand Publications.

Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology, 5th edition McMillan.

Lab Virtual links-

https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32196

https://www.labster.com/microbiology-virtual-labs/

https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical- pharmacology-of-antimicrobials

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject biology in class 12th

Suggested Continuous Evaluation Methods:

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Further Suggestions: None

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U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY, LUCKNOW, U.P. (India)

B.Sc. - Microbiology (1st Year, Semester-I/II) Generic Elective-1 and 2 (GE-1 or 2)/Minor Elective-1 or 2

Minor Microbiology-1 or 2 Basic Microbiology

Effective from Session 2022-23

Programme/Class: Certificate	**Year:** First	**Semester:** First or Second
Subject: Microbiology		
Course Code: B080103T	**Course Title:** Basic Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the history, relevance of microbiology and classification of microbes.	K2, K4
CO2- To learn and understand the microbial diversity in the living world.	K4, K6
CO3- To understand the working of various microscopes and their applications.	K1, k4
CO4- To learn different methods of staining of microbes.	K2, K5
CO5- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safetymeasures to be followed while handling microbes.	K3, K2

Credits: 4	GE-1 or 2/Minor Elective-1 or 2
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures Tutorials- Practical (in hours per week): **L-T-P**: 4-0-0

Unit	**Topics**	**Total No. of Lectures/ Unit & Total Hours (60)**
I	Definition, Scope, and Historical Development of Microbiology Definition and scope of microbiology; history and development of microbiology. Contribution of Antony van Leeuwenhoek. Disproved theory of spontaneous generation. Contributions of Louis Pasteur: germ theory of disease and pasteurization.	**15**
II	Pioneers of Microbiology and Foundations of Bacteriology Joseph Lister and the concept of antiseptic surgery. Robert Koch and his contributions: staining techniques, hanging drop method, isolation of pure cultures of bacteria. Koch's postulates and Koch's phenomenon.	**15**
III	Principles of Microscopy Microscopy: definition and importance. Working principle, construction, and operation of simple and compound microscopes. Magnification and resolution. Role of immersion oil in microscopy.	**15**
IV	Types of Light Microscopy Bright-field microscopy. Dark-field microscopy. Phase-contrast microscopy. Fluorescence microscopy—principle and applications.	**15**
V	Electron Microscopy Electron microscopy: principles and applications. Transmission Electron Microscopy (TEM). Scanning Electron Microscopy (SEM). Comparison of light microscopy and electron microscopy.	

VI	Bacterial Cell Structure Structure of bacterial cell. Shape and arrangement of bacteria. Anatomy of bacterial cell: capsule, flagella, and cell wall (structure and functions). Differences between archaebacterial and eubacterial cells.	
VII	Staining : Nature of stains, principles, mechanism, methods and types of staining- Simple staining, Negative staining, Differential staining, Gram's staining.	
VIII	Sterilization: Principle, types and techniques- physical agents- Sunlight, Drying Heat, Incineration, Red heat, Flaming, Hot air sterilizer, Microwave ovens, Pasteurization, Boiling, Steam under normal pressure, Steam under pressure. Chemical- Surface-active disinfectants, Phenolic compounds, Alcohols, Acids and alkalies, Filtration, Radiation and Ultrasonic and sonic vibrations.	

Suggested Readings:

Alexopoulas C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
Benson Harold J., Microbiological Applications, WCB Mcgraw-Hill, New York.
Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
Baveja C.P., Textbook of microbiology APC 6th edition.
Dubey R.C.. and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: □ Seminar/ Presentation on any topic of the above syllabus □
Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

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FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY, LUCKNOW, U.P. (India)

B.Sc. - Microbiology (1st Year, Semester-I) (SEC-1)/Vocational Course-1

Single-Cell Proteins and Mushrooms cultivation Effective from Session 2022-2023

Programme/Class: Certificate	**Year:** First	**Semester:** First
Subject: Microbiology		
Course Code: B080104T	**Course Title:** Single-Cell Proteins and Mushrooms cultivation	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the importance of Single-Cell Proteins and Mushrooms.	K1, K3
CO2- To understand, learn and gain skill of isolation, culturing and maintenance of pure culture.	K2, K4
CO3- To enable the students to get sufficient knowledge in principles and applications of bio-instruments.	K3, K4
CO4- After completing this course, students will have working knowledge on SCP and mushrooms cultivation.	K2, K5
CO5- Get employment and entrepreneurship in different applied sectors	K3, K6

Credits: 3	SEC-1/Vocational Course-1
Max. Marks: 40+60	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 3-0-0

Unit	**Topics**	**Total No. of Lectures/ Unit & Total Hours (45)**
I	Introduction History of Single-Cell Protein, Advantage of SCP, Safety, acceptability and toxicology of SCP, Microorganisms used for SCP (Bacteria-*Pseudomonas fluorescens*, Lactobacillus, *Bacillus megaterium*, Yeasts-*Saccharomyces cerevisiae*, *Candida tropicalis*, *Candida utilis*, Fungi-*Aspergillus fumigatus*, *Aspergillus niger*, *Rhizopus cyclopean*, Algae-Spirulina (spa), *Chlorella pyrenoidosa*, *Chondrus crispus*, Actinomycetes and Mushrooms (a type of fungi).	**14**
II	Substrate involves in SCP production High-energy sources (alkanes, methane, methanol, ethanol, gas oil), Waste products (molasses, whey, sewage, animal manures, straw, begasse), Agricultural and forestry sources (cellulose and lignin) and Carbon dioxide	**14**
III	Composition of Protein, Fat, Ash and Nucleic acin in SCP, Production of SCP- Selection of suitable strain, Fermentation, Harvesting, Post-harvest treatment, SCP processing for food, Advantages of SCP, Limitations of SCP, Genetically engineered artificial protein as animal feed	**10**
IV	Mushroom cultivation- Recent Efforts, Modern Methods in employing in mushroom cultivation	**7**

Suggested Readings:

Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.

Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., NewDelhi.

Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
W.F. Harrigan, Laboratory methods in Microbiology, Publisher – Elsevier
Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press
Brain McNeil & Harvey (2008), Practical Fermentation Technology, John Wiley & Sons Ltd.

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: Seminar/ Presentation on any topic of the above syllabus Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

Programme/Class: Certificate	**Year:** First	**Semester:** Second
Subject: MICROBIOLOGY		
Course Code: B080201T	**Course Title:** Agriculture and Environmental Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- Get acquainted with natural habitats of diverse protection.	K1, K2
CO2- Understand how microbes interact among themselves and with higher plants and animals with the helpof various examples.	K2, K4
CO3- Become aware of the important role microbes play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.	K3, K5
CO4- Gain in depth knowledge of different types of solid waste, liquid waste and their management.	K2, K4
CO5- Get familiar with problems of pollution and applications of clear up technologies for the pollutants.	K3, K6
CO6- Know about the diverse microbial populations in various natural habitats like soil, air, water.	K4, K6
CO7- Gain knowledge of the bio-fertilizer and their types.	K3,K5

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 4-0-0

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Microorganisms and their habitats** Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersion of microbes; Animal Environment: Microbes in/on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low nutrient level; Microbial succession in decomposition of plant organic matter.	**8**
II	**Microbial Interactions** Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza (types and its applications).	**8**

III	**Biogeochemical cycling** Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle.	**8**
IV	**Waste management** Solid waste management: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: composition and strength of sewage (BOD & COD), primary, secondary, (oxidation pond, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.	**8**
V	**Microbial Bioremediation** Principle and degradation of common pesticides, organic (hydrocarbon, oil spills) and inorganic matter, biosurfactants.	**6**
VI	**Water potablity** Treatment and safety of drinking water; Methods to detect potability of water sample: Standard qualitative procedure- MPN test/Presumptive test, confirmed and completed test for faecal-coliforms Membrane filter technique, Presence/Absence test fecal coliform.	**6**
VII	**Biofertilizer** Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative; Mode of application; Advantages and Disadvantages.	**8**
VIII	**Biopesticides** Introduction and definition; Types of biopesticides; Integrated pest management (IPM); Mode of action; Factor influencing; Applications, advantages& disadvantages.	**8**

Suggested Readings:

Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
Alexopoulas C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi
Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi.
Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.
Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.

Suggestive digital platforms web links-
https://www.classcentral.com/tag/microbiology
https://www.mooc-list.com/tags/biotechnology
https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health

https://collegelearners.com/ebooks/agricultural-microbiology-pdf-free-download

This course can be opted as an elective by the students of following subjects: Open for all
……

Course prerequisites: To study this course, a student must have had the subject General Microbiology in I
semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods:
House Examination/Test: 10 marks
Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks
Class performance/Participate: 5 Marks

Further Suggestions: None

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Programme/Class: Certificate	**Year:** First	**Semester:** Second
Subject: MICROBIOLOGY		
Course Code: B080202P	**Course Title:** Experiments in Agriculture and Environmental Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the instruments, microbial techniques and good lab practices for working in amicrobiology laboratory.	K1, K2
CO2- Practical skill in the laboratory experiments in microbiology.	K2, K3
CO3- Develop skills for identifying microbes and using them for industrial, agricultural and environmentalpurpose.	K3, K5
CO4- To prepare slides and stain to see the microbial cell.	K2, K5

Credits: 2	
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures-Tutorials-Practical(in hours per week): **L-T-P:** 0-0-2

S. No.	**Objectives**	**Total No. of Lectures/ Hours (60)**
1	To analyse soil- pH, moisture, water holding capacity.	**8**
2	Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28° C & 45° C) Isolation of bacteria and fungi from rhizosphere and rhizoplane. Isolation of bacteria & fungi from air environment by exposure plate method. Isolation of Rhizobium sp. from leguminous root nodule.	**16**
3	To determine BOD of waste water sample. Bacteriological examinaiton of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test.	**12**
4	Specimen study of plant pathogens. Black rust of wheat White rust of crucifer Leaf curl of tomato Downy mildew Red rot of sugarcane	**10**
5	Study of permanent slide and life materials *Cladosporium* *Helmithosporium* *Mucor* *Curvularia* *Alternaria* *Geotrichurn* *Trichoderma* *Rhizopus*	**14**

Suggested Readings:

Agrios A.G. Plant Pathology, Elsevier Academic Press, New Delhi, 2006.
Atlas RM and Batha R (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
Maier RM, Pepper IL and Gerba Cp (2009). Environmental Microbiology. 2nd edition, Academic Press.
Subba Rao NS. (1999). Soil Microbiology, 4th edition. Oxford & IBH Publishing Co. New Delhi.

Virtual Lab Links-
https://vlab.amrita.edu/?sub=3&brch=73
https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/

This course can be opted as an elective by the students of following subjects: Open for all
……

Course prerequisites: To study this course, a student must have had the subject General Microbiology in I
semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods
……

Further Suggestions: None

B.Sc. - Microbiology (1st Year, Semester-I/II) Generic Elective-1 and 2 (GE-1 or 2)/Minor Elective-1 or 2

Minor Microbiology-1 or 2 Basic Microbiology

Effective from Session 2022-23

Programme/Class: Certificate	**Year:** First	**Semester:** First or Second
Subject: Microbiology		
Course Code: B080103T	**Course Title:** Basic Microbiology	

Course Outcomes:	**Bloom's Taxonomy**
CO1- To understand the history, relevance of microbiology and classification of microbes.	K2, K3
CO2- To learn and understand the microbial diversity in the living world.	K2, K4
CO3- To understand the working of various microscopes and their applications.	K3, K5
CO4- To learn different methods of staining of microbes.	K4, K6
CO5- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safetymeasures to be followed while handling microbes.	K5, K6

Credits: 4	**Core:** Generic Elective
Max. Marks: 25+75	**Min. Passing marks:** as per rules

Total No. of Lectures Tutorials- Practical (in hours per week): **L-T-P**: 4-0-0

Unit	**Topics**	**Total No. of Lectures/ Unit & Total Hours (60)**
I	Definition and Scope of Microbiology, History and Development of Microbiology, Contribution of Antony van Leeuwenhoek, Louis Pasteur-Germ theory of disease, Disapproved theory of spontaneous generation, Pasteurization, Joseph Lister-Antiseptic surgery, Robert Koch-Staining technique, Hanging drop method, Method of isolating pure culture of bacteria, Koch postulates and Koch's phenomenon.	**15**
II	Microscopy- working principle, construction and operation of simple and compound microscope., Magnification, Resolution, Immersion oil, Bright Field Microscope, Dark-Field Microscope, Phase-Contrast Microscopy, Fluorescent Microscopy, Electron Microscopy- TEM and SEM.	**15**
III	Diversity of Microbial World, Comparison of Prokaryotic and Eukaryotic cells, Prokaryotic cell, Study of bacteria- Structure of bacterial cell, Shape of bacteria, Arrangement of Bacterial cell, Anatomy of Bacterial cell-Capsule, Flagella, Cell Wall (function and structure), Differences between archaebacterial and eubacterial cell.	**15**
IV	Staining : Nature of stains, principles, mechanism, methods and types of staining- Simple staining, Negative staining, Differential staining, Gram's staining. Sterilization: Principle, types and techniques- physical agents- Sunlight, Drying Heat, Incineration, Red heat, Flaming, Hot air sterilizer, Microwave ovens,	**15**

	Pasteurization, Boiling, Steam under normal pressure, Steam under pressure. Chemical- Surface-active disinfectants, Phenolic compounds, Alcohols, Acids	

	and alkalies, Filtration, Radiation and Ultrasonic and sonic vibrations.	

Suggested Readings:

Alexopoulas C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
Benson Harold J., Microbiological Applications, WCB Mcgraw-Hill, New York.
Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
Baveja C.P., Textbook of microbiology APC 6th edition.
Dubey R.C.. and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
8. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: □ Seminar/ Presentation on any topic of the above syllabus □
Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

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FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY, LUCKNOW, U.P. (India)

B.Sc. - Microbiology (1st Year, Semester-II) (SEC-2)/Vocational Course-2

Microbial production of Foods and Beverages

Effective from Session 2022-2023

Programme/Class: Certificate	**Year:** First	**Semester:** Second
Subject: Microbiology		
Course Code: B080204T	**Course Title:** Microbial production of Foods and Beverages	

Course Outcomes:	**Bloom's Taxonomy**
Upon completion the students will learn about the role of Microorganism in food Microbiology.	K1, K2
Assimilate knowledge about Microbial Examination of food.	K2, K3
Learn about fermentation techniques.	K4, K5
Will get sufficient knowledge regarding analysis of milk and beverages.	K3, K5

Credits: 3	SEC-2/Vocational Course-2
Max. Marks: 40+60	**Min. Passing marks:** as per rules

Total No. of Lectures- Tutorials- Practical (in hours per week): **L-T-P**:3-0-0

Unit	Topics	Total No. of Lectures/ Unit & Hours (45)
I	Fermentation – Defined and Characterized, Lactic Acid Bacteria, Products of fermentation (Dairy product-Cheese, Yoghurt, Nonbeverages food products of Plant origin- Souekraut, Pickles, Bread, Production process, Advantages of fermented foods	**15**
II	Beverage and distilled product (Alcoholic Beverages)- Beer, Wines, Rum, and Whisky, Alcoholic beverages production- general aspects, Yeast- Nutrition and growth, Reproduction, Uses- Baking, alcoholoic fermentation, industrial ethanol production.	**15**
III	Microbially Derived Food Products (SCP, Mushroom, Vitamins and Amino acids), Protease in Food industry and Lactase in dairy industry	**8**
IV	Fermented Foods- Recent Efforts, Modern Methods in employing in fermented products, Advantages and disadvantages of fermented products.	**7**

Suggested Readings:

Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.
R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill
Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)
Varnam A.H. & Evans M G – Food borne pathogens. Wolfe Publishing House, London
B.D. Singh (2015) Biotechnology, Kalyani Publisher
Prajapati (2007) Fundamentals of Dairy microbiology, Indian Council of Agricultural Research, NewDelhi
Andrew Proctor (2011) Alternatives to conventional food processing. RSC Publisher
Arun K. Bhunia & Bibek Ray, Fundamental Food Microbiology, 5th Ed., CRC Press

This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject
Suggested Continuous Evaluation Methods: Seminar/ Presentation on any topic of the above syllabus Test with multiple choice questions/ short and long answer questions Attendance
Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject
Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.
At the End of the whole syllabus any remarks/ suggestions: