



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Microbiology, Session 2025-26

B. Sc.
(Hons/Hons.
with Research)
Microbiology
As per NEP2020

Prepared as per Curriculum and Credit
Framework for Undergraduate Programmes
(CCFUP) given by UGC, 2022]

Effective from
2025-26
(Also Implemented for 2024-25 Batch)



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

B Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

I Year: I Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM101	Fundamental of Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM102	Instrumentation and Microbial Technique	4	0	0	25	75	100	4	Major	Own faculty
3	BSB103	Cell Biology	4	0	0	25	75	100	4	Multidisciplinary	Any faculty
4	BSM121AE	Comprehension & Communication Skills in English	3	1	0	25	75	100	4	Ability Enhancement Courses (AEC)	Any faculty
5	BSM131	First Aid and Health	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSM151	Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM152	Cell Biology Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			17	01	04	175	525	700	20		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

B.Sc. (Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

I Year: II Semester

Certificate in Microbiology											
S N o	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credi ts	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM201	Microbial Physiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM202	Microbial Genetics	4	0	0	25	75	100	4	Major	Own faculty
3		Vocational Elective-1	4	0	0	25	75	100	4	Minor Vocational	Any faculty
4	BSM231	Food, Nutrition and Hygiene	2	0	0	25	75	100	2	Value Added Courses	Other faculty
5	BSM221SE	Computer Application	3	0	0	25	75	100	3	SEC	Any faculty
6	BSM221AE	Communication skill and Personality Development	3	0	0	25	75	100	3	AEC	Any Faculty
Practical											
7	BSM251	Microbial Physiology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSM252	Microbial Genetics Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	200	600	800	22		

Certificate in Microbiology

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

Vocational Elective-1	
Course Code	Course Name
BSB221VO	Forensic sciences
BSB222VO	Molecular diagnostics

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

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Study Evaluation Scheme (as per NEP2020)

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II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty															
						CIE	ESE																			
Theory																										
1	BSM301	Microbial Diversity	4	0	0	25	75	100	4	Major	Own faculty															
2	BSM302	Biochemistry	4	0	0	25	75	100	4	Major	Own faculty															
3	BSM303	Immunology and Serology	4	0	0	25	75	100	4	Major	Own faculty															
4	-----	Minor Elective-1	4	0	0	25	75	100	4	Minor	Any faculty															
5	BSM331	Physical Education and Yoga	2	0	0	25	75	100	2	Value Added Courses	Any faculty															
Practical																										
6	BSM351	Biochemistry Lab	0	0	2	25	75	100	1	Major	Own faculty															
7	BSM352	Immunology and Serology Lab	0	0	2	25	75	100	1	Major	Own faculty															
Total			18	0	4	175	525	700	20																	
	Hons	Honours	<table><tr><td colspan="2">Minor Elective-1</td><td>MOOCS/NPTEL/SWYAM/ Other University/College</td></tr><tr><td>Course Code</td><td>Course Name</td><td></td></tr><tr><td>BSM321</td><td>Microbial analysis of air water and soil</td><td>https://npTEL.ac.in/courses/104105139</td></tr><tr><td>BSB322</td><td>Medical Biotechnology</td><td></td></tr><tr><td colspan="3"></td></tr></table>									Minor Elective-1		MOOCS/NPTEL/SWYAM/ Other University/College	Course Code	Course Name		BSM321	Microbial analysis of air water and soil	https://npTEL.ac.in/courses/104105139	BSB322	Medical Biotechnology				
	Minor Elective-1											MOOCS/NPTEL/SWYAM/ Other University/College														
	Course Code	Course Name																								
	BSM321	Microbial analysis of air water and soil										https://npTEL.ac.in/courses/104105139														
	BSB322	Medical Biotechnology																								
L	Lecture																									
T	Tutorial																									
P	Practical																									
ESE	End Semester Examination																									
Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC. <table><tr><td>Immunology and Serology</td><td>https://npTEL.ac.in/courses/10210303 Cellular and Molecular Immunology, II Guwahati Dr. Sachin Kumar</td></tr></table>												Immunology and Serology	https://npTEL.ac.in/courses/10210303 Cellular and Molecular Immunology, II Guwahati Dr. Sachin Kumar													
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Department of Microbiology, Session 2025-26

B.Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

II Year: IV Semester

II Year: IV Semester											
S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM401	Molecular Biology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM402	Environmental Microbiology	4	0	0	25	75	100	4	Major	Own faculty
3		Minor Elective-2	4	0	0	25	75	100	4	Minor	Own faculty
4	-----	Vocational Elective-2	4	0	0	25	75	100	4	Minor Vocational	Any faculty
5	BSM431	Human Values and Environmental Ethics	2	0	0	25	75	100	2	Value Added Courses	Any faculty
Practical											
6	BSM451	Molecular Biology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM452	Environmental Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSM453SI	Summer Internship	0	0	4	25	75	100	2	Summer Internship	Any lab
Total			18	0	8	200	600	800	22		

Hons	Honours		Vocational Elective-2		Minor Elective-2	
L	Lecture		Course code	Course Name	Course code	Course Name
T	Tutorial		BSM421VO	Nanobiotechnology	BSM421	Bioprocess Technology
P	Practical		BSM422VO	Ecology and Environments	BSM422	Industrial fermentation
CIE	Continuous Internal Evaluation		MOOCS/NPTEL/SWYAM/Other University/College			

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

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III Year: V Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM501	Agricultural Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM502	Bacteriology and Virology	4	0	0	25	75	100	4	Major	Own faculty
3		Departmental Elective-1 (DE-1)	4	0	0	25	75	100	4	Minor	Own faculty
4	BSM503	Parasitology	3	0	0	25	75	100	3	Multidisciplinary	Any faculty
5	BSM521 SE	Quality control in industrial Prospectus	3	0	0	25	75	100	3	SEC	Any Faculty
6	BSM 531	Understanding India	2	0	0	25	75	100	2	Value Added	Any Faculty
Practical											
6	BSM551	Agricultural Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM552	Bacteriology and Virology Lab	0	0	4	25	75	100	2	Major	Own faculty
Total			20	0	6	200	600	800	23		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental Elective (DE)-1	
Course Code	Course Name
BSM 511	Systemic Bacteriology
BSM 512	Medical Biochemistry
	MOOCS/NPTEL/SWYAM/Other University/College

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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Study Evaluation Scheme (as per NEP2020)

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III Year: VI Semester

S N o	Course Code	Course	L	T	P	Evaluation Scheme		Total	Cre dits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM601	Medical Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM602	Microbial Metabolism	4	0	0	25	75	100	4	Major	Own faculty
3		Departmental Elective- 2(DE-2)	4	0	0	25	75	100	4	Minor	Own faculty
4	BSM603	IPR, Bioethics and Biosafety	2	0	0	25	75	100	2	Multidisciplinary	Any faculty
5	BSM621SE	Bioinformatics and Drug Designing	3	0	0	25	75	100	3	SEC	Any faculty
6	BSM631	Artificial Intelligence in Biological Sciences	2	0	0	25	75	100	2	Value Added	Any faculty
Practical											
6	BSM651	Medical Microbiology lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM652	Microbial Metabolism Lab	0	0	4	25	75	100	1	Major	Own faculty
8	BSM621AE	Seminar	0	0	2	25	75	100	2	AEC	Any faculty
Total			19	0	8	225	675	900	23		

B Sc in Microbiology

Hons	Honors
L	Lecture
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Courses

Departmental Elective-2	
Course Code	Course Name
BSM611	Plant Pathology
BSM612	Genomics and Proteomics
	MOOCs from SWAYAM/NPTEL

- Note:** 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
 2. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits.
 3. A minimum of 75% marks is required for Hons. with research.
 4. Students have to study 12 credit course works for B.Sc. Hons.
 5. Students have to do 12 credit dissertation works from reputed laboratory for B.Sc. Hons. with research.

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Faculty of Health and Life Sciences

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B Sc.(Hons./Hons. with Research) Microbiology

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IV Year: VII Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM701	Food Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM702	Industrial Microbiology	4	0	0	25	75	100	4	Major	Own faculty
3	BSM703	Microbial Signaling Mechanism	4	0	0	25	75	100	4	Major	Own faculty
4		Departmental Elective-3	4	0	0	25	75	100	4	Minor	Any faculty
5		Minor Elective-3	4	0	0	25	75	100	4	Minor	Any Faculty
Practical											
6	BSM751	Food and Industrial Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM752	Microbial signaling Mechanism Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	175	525	700	22		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Minor- Elective		Departmental elective-3	
Sub Code	Subject Name	Sub Code	Subject Name
BSM711	Dairy Microbiology	BSM721	Biostatistics
BSM712	Soil Microbiology	BSM722	Microbial Biotechnology
	**MOOCs from SWAYAM/NPTEL		

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

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B Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

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IV Year: VIII Semester

IV Year: VIII Semester											
S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Honors											
1	BSM801	Research Methodology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM802	Microbial diagnostic in health Clinic	4	0	0	25	75	100	4	Major	Own faculty
3	BSM803	Mycology and Phycology	4	0	0	25	75	100	4	Major	Own faculty
		Total	12	0	0	75	225	300	12		
OR, Honors with research											
4	BSB851	Dissertation work	0	0	40	100	200	300	12	Major	Own faculty
Total			0	0	40	100	200	300	12		

B.Sc. (Hons./Research) in Microbiology

B.Sc. (Hons./Research) in Microbiology

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

2. A four-year UG Honors degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits.

3. Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honors with Research).

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Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

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Minimum Credit Requirements to Award Degree under Each Category

S.NO.	Broad Category of Course	Minimum Credit Requirement			
		3 year		4 year	
		As per UGC	MGUG	UGC	MGUG
1	Major (Core)	60	65	80	80
2	Minor Stream	24	24	32	32
3	Multidisciplinary	09	09	09	09
4	Ability Enhancement Courses (AEC)	08	09	08	09
5	Skill Enhancement Courses (SEC)	09	09	09	09
6	Value Added Courses common for all UG	06 - 08	12	06 – 08	12
7	Summer Internship	02 - 04	02	02 – 04	02
8	Research Project / Dissertation			12	12
	Total	120	130	160	164

Credit distribution in each semester

S. N. O.	Broad Category of Course	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Semester VII	Semester VIII A (for B.Sc. Hons.)	Semester VIII B (for B.Sc. Hons. With research)
1	Major (Core)	10	10	14	10	11	10	14	12	12
2	Minor Stream	-----	4	4	8	4	4	8	-----	-----
3	Multidisciplinary	4	-----	-----	-----	3	2	-----	-----	-----
4	Ability Enhancement Courses (AEC)	4	3	-----	-----	-----	2	-----	-----	-----
5	Skill Enhancement Courses (SEC)	-----	3	-----	-----	3	3	-----	-----	-----
6	Value Added Courses	2	2	2	2	2	2	-----	-----	-----
7	Summer Internship	-----	-----	-----	2	-----	-----	-----	-----	-----
8	Research Project / Dissertation	-----	-----	-----	-----	-----	-----	-----	-----	-----
	Total	20	22	20	22	23	23	22	12	12
Total credit till VI, VII, and VIII semester							130	152	164	

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Letter Grades and Grade Points

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.

The HEIs may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

Letter Grade	Grade Point
O (outstanding)	10
A+ (Excellent)	9
A (Very good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

When students take audit courses, they may be given pass (P) or fail (F) grade without any credits.

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$\text{SGPA (Si)} = \Sigma(C_i \times G_i) / \Sigma C_i$$

Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
	SGPA				139/20=6.95

Shailendra



ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} = \Sigma(C_i \times S_i) / \Sigma C_i$$

where S_i is the SGPA of the i th semester and C_i is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
Credit: 21 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0	Credit: 26 SGPA: 6.3	Credit: 25 SGPA: 8.0

$$\text{CGPA} = 6.73 \quad (21 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0) / 145$$

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

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Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Theory)
Fundamentals of Microbiology
Code: BSM101

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn and understand the microbial diversity in the living world.
2. To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
3. To demonstrate the morphology and physiology of microbes and selection of culture media.
4. To learn collection and transportation of investigative specimens.

Unit I: Historical Introduction and Bacterial taxonomy

Introduction, Scientific development of Microbiology, Bacterial classification and Nomenclature. Morphology and Physiology of bacteria- Introduction, Microscopy, Staining Methods, Morphology of bacteria.

Unit II: Microbial Nutrition

Common nutrition requirements, Growth factors, Nutritional types of microorganisms, Culture media- constituents of culture media, types of culture media. Culture methods – Methods of culture, Anaerobic culture methods, Methods of isolating bacteria in pure cultures, Methods of measurement of cell mass and cell number.

Unit III: Control of Microorganisms

Introduction, Methods of sterilization -Physical agents – Sunlight, Heat, Ozone, filtration, radiation, Chemical Agents – Alcohol, Aldehyde, Dyes, Halogens, Phenols, Vapor phase disinfectants.

Unit IV: The Fungi (Eumycota)

Introduction, Distribution of fungi, Structure, Nutrition and Metabolism, Reproduction, Characteristics of the fungal divisions.

Unit V: Biomedical Waste Management

General Principles, Containers, Rejection Samples Urine, Faces, Sputum, Pus, Body, Fluids, Swab, Blood. Biomedical Waste Management – Introduction, Categories of Biomedical Waste, Segregation of waste, Biomedical Waste Rule, Waste treatment and disposal, Waste Management programmed (Repeated in two units).

Suggested Readings-

1. Ananth Narayanan and Paniker's Textbook of Microbiology (R. Ananthanarayan and C. K. Jayaram Paniker)
2. Textbook of microbiology Dr. C P Baveja
3. Prescott / Harley Klein's Microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton)
4. Mackie and McCartney Practical Medical Microbiology (J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons)

Course Learning Outcome (CLO)

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At the end of the course, the student will be able to:

1. Learn and understand the microbial diversity in the living world.
2. Explain various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
3. Demonstrate the morphology and physiology of microbes and selection of culture media.
4. Learn collection and transportation of investigative specimens

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Faculty of Health and Life Sciences

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I Year: I Semester (Theory)
Instrumentation and Microbial Technique
Code: BSM102

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand the basic principles of different microscopy techniques.
2. To understand the working principles, construction and applications of pH meter, and chromatography techniques.
3. To describe the techniques and applications of centrifugation and electrophoresis for biological sample separation.
4. To recognize how the spectroscopy plays a role in quantitative estimation of biomolecules.

Unit I: Microscopy

History of Microscopy, Types of microscopy, Structure of compound light microscope, Microscopy phase contrast, fluorescence microscopy, Electron microscopy and scanning tunneling microscopy, Preparation of specimens for electron microscopy, and X- ray diffraction.

Unit II: Common Laboratory Instruments

Incubators, Hot air oven, Autoclave, anaerobic cultivation apparatus and biological safety Cabinet, Structure and use of pH meter, pH indicators for measuring pH, Standardization step by step procedure, Ion selective electrodes.

Unit III: Chromatography Techniques

TLC and Paper chromatograph, Chromatographic methods for macro molecule separation – types of chromatography, - Gel permeation, Ion exchange, Hydrophobic, Reverse – phase and Affinity chromatography; HPLC.

Unit IV: Centrifugation and Electrophoresis

Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge Applications, Electrophoretic techniques: Theory and application of polyacrylamide and Agarose gel electrophoresis, Iso-electric Focusing, 2D Electrophoresis, Pulsed field gel electrophoresis (PFGE).

Unit V: Spectroscopy Techniques

Spectroscopy Techniques, UV and Visible spectroscopy; interaction of radiation with biomolecules, principle of UV- visible absorption spectrophotometry, Lambert's and Beers Law. Application of UV – visible absorption spectrophotometry in biological science, Fluorescence spectrophotometry and its application in biochemistry, Mass spectrometry.

Suggested Readings:

1. Prescott / Harley Klein's Microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton)
2. Text Book of Microbiology, Pelczar MJ, Chan, ECS & Kreig N.R, Mc Graw- Hill, New York.

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Course Learning Outcome (CLO)

At the end of the course, the student will be able to:

1. Learn and understand the basics of instrumentation in microbiology.
2. Explain various microbial techniques and analytical methods for detection of biomolecules.
3. Demonstrate the morphology of bacterial cell using different types of microscopy.

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I Year: I Semester (Theory)

Cell Biology

Code: BSM103

L	T	P	C
4	0	0	4

Course Objective (CO)

1. To study the life activities at cellular and molecular level and basic functions of the various cellular compartments and organelles.
2. To give knowledge on the structural, functional and biochemical details of all cellular activities.
3. To explain the basic principles of Cell division in prokaryotes and eukaryotes.

Unit I: Introduction to Cell

Introduction and history of Biological sciences with special reference to contribution of Indian scholars. Structure of animal, plant and bacterial cells, Diversity of cell size and shape, Cell theory, C-value paradox. Cell Membrane: Chemical components of biological membranes, organization and Fluid Mosaic Model, and membrane transport. Cytoskeleton and Extra cellular matrix.

Unit II: Structure and functions of cellular organelles and chromosome

Lysosomes: Vacuoles and micro bodies: Structure and functions. Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis.

Unit III Structure and function of nucleus

Structure and function, nuclear envelope. Chromosomes: chromatin and chromosomes organization, euchromatin and heterochromatin, nucleosome, metaphase chromosome, genes and chromosomes DNA as genetic material, Structure of DNA: Structural and numerical changes in human chromosomes and ploidy in plants. Mutations: Types of mutations, spontaneous and induced mutations, Physical and chemical mutagens.

Unit IV: Cell cycle in Eukaryotes

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast and higher organisms. Cell senescence and programmed cell death. Introduction to cell signaling and cell – cell interaction genes.

Unit V: Cell division in Prokaryotes

Procaryotic Cell cycle: Binary fission, Chromosome Replication and Partitioning, Cytokinesis. DNA replication in rapidly growing cells. Cell to Cell communication within microbial populations, Quorum Sensing and Biofilm formation.

Suggested Readings:

1. Ananth Narayanan and Paniker's Textbook of Microbiology (R. Ananthanarayan and C. K. Jayaram Paniker)
2. Textbook of microbiology Dr. C P Baveja
3. Prescott / Harley Klein's Microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton)

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Course Learning Outcomes (CLO)

At the end of the course, the student will be able to:

1. Understand the concept of Cell Biology.
2. Understand the Cell and Cell organelles structure and functions.
3. Describe the cell cycle and cell interactions in eukaryotes.
4. Describe the cell division process and cell communications in prokaryotes.

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Theory)

Skill Enhancement Course

Comprehension & Communication Skills in English

Code: BSM121SE

L	T	P	C
3	1	0	4

Course objective:

The objectives of the course are as follows:

1. To enable the students to acquire the communication skills of listening, speaking, reading and writing through a learning-centered curriculum comprising skills of intensive reading, extensive reading, written communication and oral communication.
2. To provide task-centered teaching-learning materials for students of diverse entry levels so that they eventually attain almost the same level of target behavior.
3. To enable the learner to communicate effectively and appropriately in real life situation.

UNIT I: Comprehension and Textual Analysis

Textual Comprehension: R.K. Narayan: "Toasted English" – Reading comprehension and vocabulary enhancement, Francis Bacon: "Of Studies" – Interpretation, vocabulary, and summarization. Summarization: Techniques of summarizing a given text or passage

UNIT II: Functional Language Skills

Grammar and Sentence Correction: Identification and correction of incorrect sentences, Functional grammar in context. Core Language Skills: Understanding and application of LSRW (Listening, Speaking, Reading, Writing) + Grammar. Text Analysis: Martin Luther King Jr.: "I Have a Dream" – Textual summarization and critical understanding. Grammar: Degrees of Comparison

UNIT III: Writing Skills

Letter Writing: Format and mechanics of personal and official letters, Effective correspondence techniques. Practical Writing Tasks: Application writing, Welcome speeches and vote of thanks, Paragraph and essay writing, Story writing and review writing, Abstract writing, and journal writing. Creative and Academic Composition: Exposure to various forms of written expression

UNIT IV: Productive Communication Skills

Professional Communication: Preparation of Curriculum Vitae (CV) and job applications, Types, settings, and purposes of interviews, Roles of interviewer and interviewee. Communication Theory: Definition, process, and components of communication. Oral Presentation Skills: Structure, delivery techniques, and audience engagement

UNIT V: Applied Grammar and Usage

Basic Grammar: Use of articles and parts of speech, sentence punctuation and correction. Vocabulary: Synonyms and Antonyms, One-word substitutions, Idioms and phrases, Pair of words (commonly confused/misused). Sound and Speech Elements: Vowel and consonant sounds, Homonyms and homophones. Stylistic Devices: Figures of speech and their usage in context

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Suggested Readings:

8. 1. Essential Communication Skills: A Multi-Course for English Communication. MacMillan Publishers India Pvt. Limited.
9. English Grammar & Composition by S.C. Gupta
10. Nurture English Grammar and Composition Books by Target Publications.
11. Toasted English Essay's Books by R.K Narayan.
12. BOOK: I Have a Dream – Martin Luther King.
13. Leech, Cruickshank, And Ivanic's An A-Z of English Grammar & Usage
14. Of Studies books by Francis Bacon.,

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

5. Make good resume and prepare effectively for interview.
6. Perform effectively in group discussions.
7. Explore communication beyond language.
8. Acquire good communication skills and develop confidence.

Shanleha



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Theory)
(Minor Co-curricular)
First Aid and Health
Code: BSM131

L	T	P	C
2	0	0	2

Course Objectives:

The objectives of the course are as follows:

1. To give immediate care.
2. To protect the casualty from further harm.
3. To relieve pain.
4. To promote recovery
5. The recovery is promoted as the heart rate goes down, which in turn prevents blood loss from the victim's body.

Unit I: Basic First Aid and technique

Aims of first aid & First aid and the law, Dealing with an emergency, Resuscitation (basic CPR), Recovery position, Initial top to toe assessment, Hand washing and Hygiene, Types and content of a first aid kit, Dressings and Bandages, Fast evacuation techniques (single rescuer), Transport techniques

Unit II: First aid related with respiratory system, Heart, Blood and Circulation and Wounds and Injuries

Basics of respiration, no breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, Swelling within the throat, Suffocation by smoke or gases and Asthma, Basics of the heart and the blood circulation, Chest discomfort, bleeding, Type of wounds, small cuts and abrasions, Head, Chest, Abdominal injuries, Amputation, Crush injuries, Shock.

Unit III: First aid related with; Nervous system and Unconsciousness, Gastrointestinal Tract, Skin, and Burns

Basics of the nervous system, Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy, Basics of the gastrointestinal system, Diarrhea, Food poisoning, Basics of the skin, Burn wounds, Dry burns and scalds (burns from fire, heat and steam), Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke, Frost bites (cold burns), Prevention of burns, Fever and Hypothermia, Animal bites, Road and traffic accidents.

Unit IV: Basic Sex Education

Overview, ground rules, and a pre-test, Basics of Urinary system and Reproductive system, Male puberty — physical and emotional changes, Female puberty — physical and emotional changes, Male-female similarities and differences, Sexual intercourse, pregnancy, and childbirth, Facts, attitudes, and myths about LGBTQ+ issues and identities, Birth control and abortion, sexual harassment, sexual abuse, and rape, Prevention of sexually transmitted diseases.

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Unit V: Mental Health and Psychological First Aid

Mental Health First Aid, Mental Health Problems in the India, The Mental Health First Aid Action Plan, Understanding Depression and Anxiety Disorders, Crisis First Aid for Suicidal Behavior & Depressive symptoms, Non-Suicidal Self-Injury, Non-crisis First Aid for Depression and Anxiety, Crisis First Aid for Panic Attacks, Traumatic events, Understanding Disorders in Which Psychosis may Occur, Crisis First Aid for Acute Psychosis, Understanding Substance Use Disorder, Crisis First Aid for Overdose, Withdrawal, Using Mental Health First Aid

Suggested reading

1. Dr. Gauri Goyal, Dr. Kumkum Rajput & Dr. Manjul Mungali. 2020. First Aid and Health, ISBN 978-93-92208-19-5
2. Indian First Aid Manual-<https://www.indianredcross.org/publications/FA-manual.pdf>
3. Red Cross First Aid/CPR/AED Instructor Manual

Course Learning Outcome (CLO):

Upon successful completion of this course the student should be able to:

1. Learn the skill needed to assess the ill or injured person and to provide CPR to infants, children and adults.
2. Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.
3. Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.
4. Learn the skill to identify Mental Health status and Psychological First Aid

Shanleenda



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Theory)
(Minor Co-curricular)
First Aid and Health
Code: BSM131

L	T	P	C
2	0	0	2

Course Objectives:

The objectives of the course are as follows:

1. To give immediate care.
2. To protect the casualty from further harm.
3. To relieve pain.
4. To promote recovery
5. The recovery is promoted as the heart rate goes down, which in turn prevents blood loss from the victim's body.

Unit I: Basic First Aid and technique

Aims of first aid & First aid and the law, Dealing with an emergency, Resuscitation (basic CPR), Recovery position, Initial top to toe assessment, Hand washing and Hygiene, Types and content of a first aid kit, Dressings and Bandages, Fast evacuation techniques (single rescuer), Transport techniques

Unit II: First aid related with respiratory system, Heart, Blood and Circulation and Wounds and Injuries

Basics of respiration, no breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, Swelling within the throat, Suffocation by smoke or gases and Asthma, Basics of the heart and the blood circulation, Chest discomfort, bleeding, Type of wounds, small cuts and abrasions, Head, Chest, Abdominal injuries, Amputation, Crush injuries, Shock.

Unit III: First aid related with; Nervous system and Unconsciousness, Gastrointestinal Tract, Skin, and Burns

Basics of the nervous system, Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy, Basics of the gastrointestinal system, Diarrhea, Food poisoning, Basics of the skin, Burn wounds, Dry burns and scalds (burns from fire, heat and steam), Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke, Frost bites (cold burns), Prevention of burns, Fever and Hypothermia, Animal bites, Road and traffic accidents.

Unit IV: Basic Sex Education

Overview, ground rules, and a pre-test, Basics of Urinary system and Reproductive system, Male puberty — physical and emotional changes, Female puberty — physical and emotional changes, Male-female similarities and differences, Sexual intercourse, pregnancy, and childbirth, Facts, attitudes, and myths about LGBTQ+ issues and identities, Birth control and abortion, sexual harassment, sexual abuse, and rape, Prevention of sexually transmitted diseases.

Unit V: Mental Health and Psychological First Aid

Shanleha



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Mental Health First Aid, Mental Health Problems in the India, The Mental Health First Aid Action Plan, Understanding Depression and Anxiety Disorders, Crisis First Aid for Suicidal Behavior & Depressive symptoms, Non-Suicidal Self-Injury, Non-crisis First Aid for Depression and Anxiety, Crisis First Aid for Panic Attacks, Traumatic events, Understanding Disorders in Which Psychosis may Occur, Crisis First Aid for Acute Psychosis, Understanding Substance Use Disorder, Crisis First Aid for Overdose, Withdrawal, Using Mental Health First Aid

Suggested reading

1. Dr. Gauri Goyal, Dr. Kumkum Rajput & Dr. Manjul Mungali. 2020. First Aid and Health, ISBN 978-93-92208-19-5
2. Indian First Aid Manual-<https://www.indianredcross.org/publications/FA-manual.pdf>
3. Red Cross First Aid/CPR/AED Instructor Manual

Course Learning Outcome (CLO):

Upon successful completion of this course the student should be able to:

1. Learn the skill needed to assess the ill or injured person and to provide CPR to infants, children and adults.
2. Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.
3. Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.
4. Learn the skill to identify Mental Health status and Psychological First Aid

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Practical)

Microbiology Lab

Code: BSM151

L	T	P	C
0	0	2	1

Course objective (CO)

1. To give practical experience to learn safety measures in laboratories.
2. To study morphology of microbial cells.
3. To learn media preparation for microbial growth.
4. To isolate microorganisms and study their morphology.

Practical -

1. Introduction to safety measures in Laboratories
2. Introduction to basic instruments in microbiology lab
3. Media Preparation
4. Serial Dilution Technique
5. Aseptic Transfers, Dilution Techniques and Pipetting.
6. Isolation of bacteria from soil and bacterial colony morphology study.
7. Study of structure of bacterial cell by simple staining and Gram staining.
8. Isolation of fungi from soil and fungal colony morphology study
9. Study of structure of fungi by lactophenol cotton blue staining
10. Study of structure of yeast cell and budding in yeast.

Suggested Readings

1. **Practical Microbiology** by D.K. Maheshwari.
2. Basic and Practical Microbiology Lab Manual Paperback 2018, by Mette Ibba (**Author**), Katherine Elasky (**Author**)

Course Learning Outcome (CLO)

At the end of the course the student will be able to

1. Explain safety measures in laboratories
2. Identify the types of microbial cell.
3. Learn media preparation and isolation of microorganisms.
4. Learn identification of microbial cell structure by staining.

Shailendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: I Semester (Practical)

Cell Biology Lab

Code: BSM152

L	T	P	C
0	0	2	1

Course objective (CO):

1. To give practical experience to learn safety measures in laboratories.
2. To study types of cell division.
3. To learn sample preparation for microtomy study.
4. To isolate microorganisms and study their morphology.

Practical :

1. Introduction to safety measures in Laboratories
2. Study of structure of any Prokaryotic cell
3. Study of structure of any Eukaryotic cell.
3. N Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, esophagus, stomach, pancreas, intestine, kidney etc.
4. Cell division in onion root tip/ insect (grasshopper) gonads.
5. Cell division in Prokaryotes.
6. Estimation of bacterial growth by using spectrophotometer.

Suggested Readings:

1. **Cell and molecular biology: A Lab Manual Kindle Edition** by (Author)
2. Molecular Biology -Practical- (ksu.edu.sa)
3. **Basic and Practical Microbiology Lab Manual Paperback 2018**, by **Mette Ibba** (Author), **Katherine Elasky** (Author)

Course Learning Outcome (CLO):

At the end of the course the student will be able to

1. Explain safety measures in laboratories
2. Identify the types of cell division.

Shailendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

B.Sc. (Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

I Year: II Semester

Certificate in Microbiology

S N o	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credi ts	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM201	Microbial Physiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM202	Microbial Genetics	4	0	0	25	75	100	4	Major	Own faculty
3		Vocational Elective-1	4	0	0	25	75	100	4	Minor Vocational	Any faculty
4	BSM231	Food, Nutrition and Hygiene	2	0	0	25	75	100	2	Value Added Courses	Other faculty
5	BSM221SE	Computer Application	3	0	0	25	75	100	3	SEC	Any faculty
6	BSM221AE	Communication skill and Personality Development	2	0	0	25	75	100	3	AEC	Any Faculty
Practical											
7	BSB251	Microbial Physiology Lab	0	0	2	25	75	100	1	Major	Own faculty
8	BSB252	Microbial Genetics Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			19	0	4	200	600	800	22		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination
AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses

Vocational Elective-1	
Course Code	Course Name
BSB221VO	Forensic sciences
BSB222VO	Molecular diagnostics

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

2. Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: II Semester (Theory)

Microbial Physiology

Code: BSM201

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To study the microorganisms types based on nutrition and transport.
2. To study the growth of microorganisms and effect of environmental factor on growth.
3. To study about phototrophic metabolism in microorganisms.

Unit I: **Microbial Nutrition**

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

Unit II: **Microbial Growth**

Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity.

Unit III: **Effect of the environment on microbial growth**

Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogen oxidizing bacteria and methanogens.

Unit IV: **Phototrophic metabolism**

Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle.

Unit V: **Nitrogen Metabolism**

Biological nitrogen fixation, nitrogenase activity and its physiological regulation. Ammonia assimilation, assimilatory and disassimilatory nitrate reduction, Nitrogen fixation, Nitrification, denitrification, ammonification, Comammox and Anammox Process.

Suggested reading

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Course learning outcomes (CLO)

After completing the course, the students will be able to:

1. Classify the micro-organisms types based on nutrition and transport.
2. Study the growth of microorganisms and effect of environmental factor on growth.
3. Study about phototrophic metabolism in microorganisms

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: II Semester (Theory)

Microbial Genetics

Code: BSM202

L	T	P	C
4	0	0	4

Course objective (CO)

To introduces the principles of cell biology and genetics. After completion of this course, students will be able to-

1. To learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc.
2. To understand how genetic information is transmitted in organism
3. To understand the role of cytoskeleton and its remodeling including the diseases associate with improper remodeling.

Unit I: Gene Structure, Replication and Expression

DNA as genetic material, Flow of Genetic Information, Nucleic Acid Structure, DNA replication, Gene Structure, Transcription, The Genetic Code, Translation, Protein folding and molecular chaperones.

Unit II: Regulation of Gene Expression

Levels of regulation of gene expression. Regulation of transcription initiation- Lac Operon, tryptophan operon, arabinose operon, two-component regulatory system. Regulation of transcription elongation- attenuation, riboswitches. Regulation at the level of translation by riboswitches and small RNA molecules. Global Regulatory systems- Catabolite repression, Quorum sensing and Sporulation in *Bacillus subtilis*.

Unit III: Mutations and DNA Repair

Mutations and their chemical basis, types of mutations and effects of mutations- wild, forward, reversion, suppressor, silent, missense, nonsense, Frameshift and conditional mutations. Detection and isolation of mutants, Carcinogenicity test. DNA repair- Excision repair, Direct repair, Mismatch repair, Recombinational repair, and SOS response.

Unit IV Microbial plasmid

Plasmids in prokaryotes and eukaryotes Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids.

Unit V Genetic Variability in Procaryotes

Horizontal Gene transfer in Procaryotes, Homologous recombination, site-specific recombination and transposition. Transposable elements. Bacterial Plasmids. Bacterial conjugation, DNA Transformation, Transduction- Generalized and Specialized.

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Suggested Reading:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science.
2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: A Molecular Approach (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, New York.
4. Iwasa J., Marshal W. Karp's Cell Biology (2018) (8th edition) Wiley & Sons, NY
5. Iwasa J., Marshal W. Karp's Cell and Molecular Biology. Concepts and experiments. (2015) (8th edition) Wiley & sons, New York
6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). Molecular Biology of the Gene (5th ed.). Pearson.
7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
8. Gupta P.K. Cell and Molecular Biology 2018. 5th edition Rastogi Publication India
9. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. (2004). S Chand and Company Ltd.
10. Satyanarayana U (2020). Biotechnology. Books and Allied (P) Ltd.
11. Singh BD. (2015). Biotechnology: Expanding Horizons (4th edition). Kalyani Publishers
12. Dubey RC. (2014) A Textbook of Biotechnology (5th edition) S Chand and Company Ltd.
13. सिंहबी. डी. (2017) बायोटेक्नोलॉजी Kalyani Publishers
14. सिंहबी. डी. आनुवंशिकी के आधार. (2017) Kalyani Publishers
15. सोनीके.सी. स्वरंकार गायत्री. आधुनिक कोशिका विज्ञान, 2018 CBC

Course Learning Outcome (CLO)

1. This course introduces the principles of cell biology and genetics. After completion of this course, students will be able to-
2. Learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc.
3. Understand how genetic information is transmitted in organism
4. Understand the role of cytoskeleton and its remodeling including the diseases associated with improper remodeling.

Shailendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

I Year: II Semester (Theory)
Food, Nutrition and Hygiene
Code: BSM231

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn the basic concept of the Food and Nutrition.
2. To study the nutritive requirement during special condition like pregnancy, lactation and diagnosis.
3. To learn about meal planning.
4. To learn food safety and procedure.

Unit I: Concept of Food and Nutrition

Concept of Food and Nutrition (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food.

Unit II: Nutrients: Macro and Micro

Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fiber.

Unit III: 1000 days Nutrition

1000 days Nutrition (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)

Unit IV: Community Health Concept

Community Health Concept (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition (c) Immunity Boosting Food.

Suggested Readings:

1. Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.
2. 1000Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf
3. <https://pediatrics.aappublications.org/content/141/2/e20173716>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/>
5. SheelSharma, Nutrition and Diet Therapy, Peepee Publishers Delhi, 2014, First Edition.

Course Learning Outcome (CLO)

At the end of the course, the student will be able to:

1. Understand the basic concept of the food, Nutrition and hygiene
2. Explain nutritive requirement during pregnancy, lactation and diagnosis
3. Prepare meal planning.

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

4.

I Year: II Semester (Theory)

Vocational elective-1

Computer Applications

Code: BSM 221SE

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To describe the basics of computers and computational data analysis
2. To study the basic editing software.
3. To study the software application and packages.

Unit I: Introduction of Computers

Characteristics of Computers, Input, Output, Storage units, CPU, Computer System, Binary number system, Binary to Decimal Conversion, Decimal to Binary Conversion, ASCII Code, Unicode.

Unit II: Computer Fundamental and Organization

Fundamental of computer, Block Diagram of computer, Hardware & Software, Memory Organization, Languages, Components & Devices, Computers Applications & Utilization, Operating System. Internet: MS-DOS, MS-Windows, Android, Multimedia and Internet, Cyber Security

Unit III: Software Application and Packages

MS-Office: MS-Word, MS Excel and Power Point, Access: Saving, Closing, Opening, selecting, editing. Finding and replacing, printing documents, formatting, page design and layout. Presentations tools, features and functions, working, with slides, drawing and designing, running and controlling a slide show. excel workbook, data in a cell / formula, functions, Chart and Graphs, Access

Unit IV: Introduction to Internet

Internet, Growth of Internet, Owners of the Internet, Anatomy of Internet, basic Internet Terminology, Net etiquette. Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on– Crime on/through the Internet.

Unit V: Information Technology and Society

Indian IT Act, Intellectual Property Rights – issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

SUGGESTED READINGS:

1. Veer Bala Rastogi, "Biostatistics: 3rd Edition", MedTech Science Press, 2022.
2. NSN Rao and NS Murthy, "Applied Statistics in Health Science", 2nd Edition, Jaypee Brothers Medical Publisher (P) LTD, 2010.

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3. S.C. Gupta and V.K Kapoor, "Fundamental of Mathematical Statistics", S. Chand & Sons, 11th Edition, 2002.
4. P.K. Sinha and Priti Sinha "Computer Fundamentals: Concepts, System and Applications", 8th edition, BPB Publication, 2003.
5. Satish Jain, "IT Tools and Business System", Revised 2010 Edition, BPB Publication, 2010.
6. S. Sagman, "Microsoft Office. 2000 for Windows", Second Indian Prim, Pearson Education, 2001.
7. C.R. Kothari, Research Methodology: Methods and Techniques, 2004.

Course Objectives and Outcomes (CLO)

At the end of the course, the student will be able to:

1. Explain concept of computers. .
2. Describe the basics of computers and computational data analysis.
3. Study the software application and packages.

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I Year: II Semester (Theory)

Vocational Elective-1

Forensic Science

Course code: BSM221VO

L	T	P	C
4	0	0	4

Course objectives:

This is an introductory course on forensic sciences with the following objectives:

1. To familiarize students with the fundamental principles of forensic sciences.
2. To impart knowledge about the injuries and deaths and how they are assessed.
3. To make students understand the process of documentation of crime scenes.
4. To impart the knowledge about the importance of cyber security in forensic sciences.

Unit I: Principles of forensic sciences

Introduction and principles of forensic science; forensic science laboratory and its organization; tools and techniques in forensic science; branches of forensic science; causes of crime; role of *modus operandi* in criminal investigation.

Unit II: Injuries and deaths

Classification of injuries and their medico-legal aspects; method of assessing various types of deaths; general and individual characteristics of handwriting; examination and comparison of handwritings and analysis of ink from various samples.

Unit III: Explosives and ballistics

Classification of firearms and explosives; introduction to internal, external and terminal ballistics; chemical evidence for explosives; process of documentation of crime scene by photography, sketching and field notes.

Unit IV: Fingerprints, DNA fingerprinting and toxicology

Fundamental principles of fingerprinting; classification of fingerprints; development of fingerprints as science for identification; principle of DNA fingerprinting; application of DNA profiling in forensics; role of the toxicologist; significance of toxicological findings in forensics.

Unit V: Forensic biology

Nature and importance of biological evidence; significance of hair, semen and blood as biological evidences; types and identification of microbial organisms of forensic significance; identification of wood, leaves, pollens, diatoms and insects as forensic evidence. Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

Suggested Readings:

1. Bhasin, MK and Nath, S 2002. Role of Forensic Science in the New Millennium, University of Delhi, Delhi.
2. James, SH and Nordby, JJ 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd ed. CRC Press, Boca Raton.

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3. Nanda, BB and Tiwari, RK 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
4. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

Course Learning Outcome (CLO):

Upon successful completion of this course the student will:

1. Apply the Laboratory skills to participate in the career needs of Forensic community.
2. Become trained in the laboratory skills of different division of Forensic Science.
3. Be able to work with different R&D organizations

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I Year: II Semester (Theory)
Vocational Elective-1
Molecular Diagnostics
Course code: BSM222VO

L	T	P	C
4	0	0	4

Course objectives

The course is designed to give an overview and applications of different molecular biology techniques used in disease diagnosis. The specific objectives of the course are:

1. To teach students different molecular techniques used for disease diagnosis.
2. To make students understand the utilization of these techniques in disease diagnosis.
3. To teach the use of different enzyme immunoassay based diagnostic methods.
4. To impart the knowledge about the molecular diagnostic of different human diseases.

Unit I Enzyme immunoassays

Comparison of enzymes for enzyme immunoassays; conjugation of enzymes; homogeneous and heterogeneous enzyme immunoassays; immunoblotting; polyclonal or monoclonal antibodies; immunoassays in diagnostic microbiology.

Unit II Molecular methods in clinical microbiology

Applications of PCR, RFLP, nuclear hybridization methods; single nucleotide polymorphism and plasmid finger printing in clinical microbiology; micro-dilution and macro-dilution broth procedures; diffusion test procedures.

Unit III Advanced methods of microbial diagnosis

Automation in microbial diagnosis; rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies; concepts and methods in idiotypes; anti-idiotypes and molecular mimicry and receptors; epitope design and applications.

Unit IV Techniques used in molecular diagnostics

Immunodiagnostic tests; immunofluorescence; radioimmunoassay; GLC, HPLC; electron microscopy; flow cytometry and cell sorting.

Unit V Molecular biology-based diagnostics

Molecular diagnostics for infectious diseases; molecular testing for Neisseria; molecular diagnosis for HIV-1; genetic counselling and molecular diagnosis; genetic testing; need and uses.

Suggested Reading

1. Bruns, DE, Ashwood, ER and Burtis, CAF 2007. Fundamentals of Molecular Diagnostics, 1st ed. Elsevier.
2. Tokas, J 2015. Immunology and Molecular Diagnostics. 1st ed. University Science Press.

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3. Wilson, K and Walker, J Editors, S 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th ed. Cambridge University Press

Course Learning Outcome (CLO)

Upon successful completion of this course the student will:

1. Gain an understanding of the principles governing molecular diagnostics.
2. Be able to apply the knowledge and skills gained in the course in developing new molecular diagnostic kits.

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I Year: II Semester (Theory)

Communication Skill and Personality Development

Course code: BSM221AE

L	T	P	C
2	0	0	2

Course objectives (CO)

1. To develop the writing and interview skill in students.
2. To develop communication skills and personality development skill.
3. To make good resume and oral presentation preparation for interview.
4. To explore communication beyond language and communicating.

UNIT I: Writing Skills

Letter Writing: Structure, format, and purpose of formal and informal letters, Resume and CV Writing: Essentials of preparing a professional Resume and Curriculum Vitae. Cover Letter: Writing an effective cover letter to accompany a job application, Differences: between Bio-data, Resume, and CV. Report Writing: Format, structure, and purpose of report writing for academic and professional contexts. Paragraph Writing: Techniques for coherent and effective paragraph development

UNIT II: Interview Skills

Introduction to Job Interviews: Importance and relevance of job interviews in professional life, Key factors and objectives of job interviews, Interview Process and Characteristics: Phases of a job interview, Traits of a successful interviewee. Interview Techniques: Common manners and etiquettes to be maintained, frequently asked interview questions and effective responses, Importance of dress code and grooming, Practice through mock interviews, Strategies for success in real interviews

UNIT III: Oral Presentation and Group Communication

Effective Oral Presentation: Steps for planning and delivering confident and impactful presentations, Use of visual and audio tools to enhance delivery. Group Communication Activities: Conducting group presentations and participating in group projects, Group discussions: format, purpose, and strategies, Comparison between group discussion and debate, Storytelling: Narrating a story or incident clearly and engagingly

UNIT IV: Technology-Based Communication

Digital Etiquette (Netiquette): Principles of writing professional and courteous emails. Digital Presentation Tools: Creating and delivering effective PowerPoint presentations. Editing and Writing Tools: Enhancing language and formatting skills using computer software and editing tools.

Suggested readings:

1. Sethi, J & et al. A Practice Course in English Pronunciation, Prentice Hall of India, New Delhi.
2. Sen, Leena. Communication Skills, Prentice Hall of India, New Delhi.
3. Prasad, P. Communication Skills, S.K. Kataria & Sons.
4. Bansal, R.K. and J.B. Harrison. Spoken English, Orient Language.
5. Roach Peter. English Phonetics and Phonology.
6. A.S. Hornby's. Oxford

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Course Learning Outcome (CLO)

At the end of the course the student will be able to-

1. Develop the writing and interview skill in students.
2. Develop communication skills and personality development skill.
3. Make good resume and oral presentation preparation for interview.
4. Explore communication beyond language and communicating.

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Department of Microbiology, Session 2025-26

I Year: II Semester (Practical)

Microbial Physiology Lab

Code: BSM251

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To get knowledge of laboratory investigation of microorganisms
2. To get detail knowledge and application of PAGE
3. To understand the bacterial growth curve

Practical

1. Examination of living microorganisms by negative staining.
2. Study and plot the growth curve of *E. coli* by turbidometric method.
3. Calculation of generation time from the graph plotted with the given data.
4. Estimation of fungal growth by mycelial weight measurement.
5. Effect of temperature on growth of *E. coli*.
6. Effect of pH on growth of *E. coli*.
7. Demonstration of alcoholic fermentation.
8. Carbohydrate fermentation test using different sources of sugars- glucose, fructose, lactose, mannitol, etc.
9. Nitrate reduction test

Suggested Readings

1. Lab Manual - Biochemistry.pdf (jru.edu.in)
2. Practical Clinical Biochemistry Methods And Interpretations by Ranjna Chawla, Publisher: Jaypee, ISBN:9789389188769, Year:2020
3. Practical Microbiology by D.K. Maheshwari

Course learning outcome (CLO)

At the end of the course, the student will be able to:

1. Explain the protocols for the measurement of sugars, proteins and nucleic acid in the microbial infection sample.
2. Study the principles, application and care of microbial laboratory instruments.
3. Understand theory, principle and factors affecting enzyme activity.
2. Understand the application of PAGE.

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I Year: II Semester (Practical)

Microbial Genetics Lab

Course code: BSM252

L	T	P	C
0	0	2	1

Course objective (CO)

1. To give practical experience to learn safety measures in Laboratories
2. To enhance the skills of solution preparation for DNA isolation.
3. To learn the effect of UV and other mutations on bacteria.
4. To gain hand on training to test Ames test for mutagenesis

Practicals

1. Endospore staining in *Bacillus*.
2. Study the effect of exposure of UV on bacterial growth.
3. UV induced auxotrophic mutants production and Isolation of mutants by replica plating technique.
3. Ames test for mutagenesis
- 4.. Isolation of DNA from bacteria
5. Isolation of plasmids from bacteria.
6. Isolation of antibiotic resistant bacterial population by gradient-plate method.
7. Demonstration of genetic recombination in bacteria by conjugation.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Enhance the skills for DNA isolation.
2. Discuss about the mutations and plasmids.
3. Would be able to understand effect of UV and mutations on bacteria
4. Understand the process of mutation test.

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B.Sc. (Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty	
						CIE	ESE					
Theory												
1	BSM301	Microbial Diversity	4	0	0	25	75	100	4	Major	Own faculty	
2	BSM302	Basic Biochemistry	4	0	0	25	75	100	4	Major	Own faculty	
3	BSM303	Immunology and Serology	4	0	0	25	75	100	4	Major	Own faculty	
4	-----	Minor Elective-1	4	0	0	25	75	100	4	Minor	Any faculty	
5	BSM331	Physical Education and Yoga	2	0	0	25	75	100	2	Value Added Courses	Any faculty	
Practical												
6	BSB351	Biochemistry and Microbial Biodiversity Lab	0	0	2	25	75	100	1	Major	Own faculty	
7	BSM352	Immunology and Serology Lab	0	0	2	25	75	100	1	Major	Own faculty	
Total			18	0	4	175	525	700	20			
	Hons	Honours										
	L	Lecture										
	T	Tutorial										
	P	Practical										
	ESE	End Semester Examination										
	Minor Elective-1					MOOCS/NPTEL/SWYAM/ Other University/College						
	Course Code		Course Name									
	BSM321		Microbial analysis of air water and soil		https://nptel.ac.in/courses/104105139							
	BSB322		Medical Biotechnology									
	Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.											
	Immunology and Serology									https://nptel.ac.in/courses/102103038 Cellular and Molecular Immunology, IIT Guwahati Dr. Sachin Kumar		

Date: _____
VolumeNo.: _____

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II Year: III Semester

Microbial Diversity

Code: BSM301

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn and understand the microbial diversity in the living world.
2. To learn a broad knowledge of the biology of microorganisms focusing on microbial processes and their effects on other organisms and the environment, microbial communities and biogeochemical cycles.
- 3 Appreciate the diversity of microorganisms and microbial communities and recognize how microorganisms solve the fundamental problems their environments present

Unit 1 Microbial Evolution, Taxonomy and Diversity

Microbial Evolution, Introduction to Microbial Classification and taxonomy, Concepts of taxonomy (characterization, classification and nomenclature) and systematics; classification of microorganisms, the major divisions of life, Bergey's Manual of Systematics Bacteriology.

Unit 2 Diversity of Microbial World

Prokaryotic Phylogeny and Diversity. Salient features of the following – the Archaea, Eubacteria (bacteria, cyanobacteria, actinomycetes), Protista (algae, protozoa, diatoms), Eumycota; and viruses.

Unit3 Phenotypic characters

Morphology, Biochemical tests, Bacteriophage typing, Serotyping

Unit 4 Chemotaxonomic markers

Cell wall components, lipid composition, cellular fatty acid (FAME analysis), isoprenoid quinones, protein profiles (e.g. MALDI-TOF).

Unit 5 Nucleic acid based techniques

Terminal Restriction Fragment Length Polymorphism (TRFLP); G+C content (Tm and HPLC); pyrosequencing; 16S rRNA gene sequencing; phylogenetic analysis; DNA-DNA hybridization

Suggested reading

1. Sneath, A. H. P., Mair, S. N. and Sharpe, E. M., Bergey's Manual of Systematic Bacteriology Vol. 2. Williams & Wilkins Bacteriology Symposium, Series No 2, Academic Press, London/New York
2. Goodfellow, M., Mordarski, M. and Williams, S. T., The biology of the actinomycetes, Academic Press
3. Goodfellow, M. and Minnikin, D. E., Chemical Methods in Bacterial Systematics, The Society for Applied Bacteriology. Technical Series No. 20, Academic Press
4. Barlow, A., The prokaryotes: A Handbook on the Biology of Bacteria: Ecophysiology, Isolation, Identification, Applications, Volume 1, Springer-Verlag

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5. Kurtzman, C. P., Fell, J. W. and Boekhout, T., The Yeasts - A Taxonomic Study, Elsevier
6. Prescott, L. M., Harley, J. P. and Klein, D.A., Microbiology. McGraw Hill, New York.
7. Norris, J. R. and Ribbons, D. W., Methods in Microbiology, Vol. 18 & 19, Academic Press
8. Reddy, C. A., Methods for General and Molecular Microbiology, ASM Press.

Course Learning Outcomes (CLO)

At the end of the course, the student will be able to:

1. Understand the Microbial evolution and diversity.
2. Learn about the techniques to study the bacterial morphology, Biochemical and Molecular characteristics.
3. Discuss about the different groups of microorganisms and their classification.

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II Year: III Semester (Theory)
Basic Biochemistry
Code: BSM302

L	T	P	C
4	0	0	4

Course objectives (CO)

1. To give basic knowledge of biochemistry.
2. To narrate the composition of carbohydrates, their structure, and types.
3. To elucidate the nucleic acid structure and their function.
4. To describe the amino acids and vitamins associated diseases because of their deficiency.
5. To list different types of lipids and their role in different types of membrane formation.

Unit I Basics of Biochemistry

History of biochemistry with special reference to contribution of Indian biochemists. General idea about normality, molarity, molality, percentage solutions, mole fraction. W/v and v/v solutions. Concept of pH determinations using indicators, buffer solutions and their biological importance. Water as universal solvent

Unit II Carbohydrates

Monosaccharides - structure of aldoses and ketoses, Ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers. Structure of biologically important sugar derivatives, oxidation and reduction of sugars. Formation of disaccharides, reducing and non-reducing Disaccharide. Polysaccharides –homo- and hetero-polysaccharides, structural and storage polysaccharides.

Unit III Nucleic acids structure and functions

Nucleotides - structure and properties. Nucleic acid structure –Watson - Crick Model of DNA Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit IV Amino acids and vitamins

Structural features and classification, Physical properties, optical properties (Stereoisomerism). Chemical properties of amino acids, uncommon amino acids and their function. Classification of protein, structural organization as primary, secondary, tertiary and quaternary structure of protein and characteristics of the peptide bond. Structure and active forms of water soluble and fatsoluble vitamins, Deficiency diseases and symptoms, hyper-vitaminosis. Sources, dietary requirements.

Unit V Lipids

Introduction to storage and structural lipids, various types of lipids – Oils and fats, Triglycerides-structure and function, Phospholipids- structure, classification and functions, Biological significance of various types of Phospholipids, Glycolipids and lipoproteins, serum lipids and its significance, Cholesterol and its derivatives. Introduction to lipid micelles, monolayers & bilayers.

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Suggested Readings

1. Lehninger, Albert, Cox, Michael M. Nelson, David L. (217) Lehninger principles of biochemistry New York: W. H. Freeman.
2. Voet, D., & Voet, J. G. (2011). Biochemistry. New York: J. Wiley & Sons.
3. Biochemistry –Lubertstryer Freeman International Edition.
4. Biochemistry –Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Biochemistry- J. L. Jain S. Chand and Company
6. Voet&Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E., Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
10. Hopkins, W.G., Huner, N.P., Introduction to Plant Physiology. John Wiley & Sons,
11. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
12. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Course learning outcome (CLO)

At the end of the course the student will be able to:

1. Understand the basic knowledge of biochemistry.
2. Narrate the composition of carbohydrates, their structure, and types.
3. Elucidate the nucleic acid structure and their function.
4. Describe the amino acids and vitamins associated diseases because of their deficiency.
5. List different types of lipids and their role in different types of membrane formation.

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II Year: III Semester (Theory)

Immunology and Serology

Code: BSM303

L	T	P	C
4	0	0	4

Course objective (CO)

1. To study the mechanism and types of immune system.
2. To study about immune diffusion assay and autoimmune disorder.
3. To explain the causes of immunological disorder.
4. To study about vaccines and vaccination.

Unit I- Introduction to Immunology,

Infection: definition, classification, sources, methods of transmission, factors predisposing to microbial pathogen city, types of infection diseases. Immunity, Mechanisms of innate immunity, acquired immunity Measurement of immunity, Herd immunity, Antigens –determinants of antigen city, biological classes, antibody's structure, classes, abnormal immunoglobulin specificities, Antigen – Antibody reaction: General features, measurement, serological reactions.

Unit II- Transplantation Immunology

Introduction of transplant immunology, graft rejection, tissue typing for kidney and bone marrow transplant.

Unit III Autoimmune Disorder

Autoimmune disorders, pathogenesis, organ specific and systemic autoimmune disorder and its markers such parietal cell antibody, anti-sperm antibody, lupus anticoagulants, anti-mitochondrial antibody, ANA, ds DNA, HLA – B27, ASMA anti-CCP.

Unit IV Immunological Disorder and Immunodiagnostics

Immunological disorders primary and secondary immunodeficiency, SCID, AIDS, Hypersensitivity and its type's introduction to Allergy and its laboratory test, Introduction to immunodiagnostics –RIA, and ELISA, Western blotting, Immune diffusion, Immune electrophoresis

Unit V-Vaccines & Vaccination

Vaccines classification and applications, Active and passive immunization. immune prophylaxis schedule in neonates, children and in pregnancy adjuvant, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.

Suggested Readings

1. Kuby Immunology by J. Punt, S. Stranford, P. Jones and J. Owen. 8 th edition. W.H. Freeman and Company, USA. 2018.
2. Cellular and Molecular Immunology by A.K. Abbas, A.H. Lichtman and S. Pillai. 9th edition. Elsevier, USA. 2017.
3. Roitt's Essential Immunology by P. Delves, S. Martin, D. Burton and I.M. Roitt. 13th edition.

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4. Wiley- Blackwell Scientific Publication, UK. 2017.
5. Immune biology: A short course by R. Coico and G. Sunshine. 7th edition. Wiley- Blackwell
6. Scientific Publication, UK. 2015.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Study the mechanism and types of immune system.
2. Study about immune diffusion assay and autoimmune disorder.
3. Explain the causes of immunological disorder.
4. Study about vaccines and vaccination

Shailendra



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II Year: III Semester (Theory)
Microbial analysis of Water Air and Soil
Code: BSM 321

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn Microbiological Analysis of Air, Water and Soil

Unit I Aero-microbiology

Bio-aerosols, droplet nuclei, Air-borne microbes, impact on human health and environmental, Significance in food, pharma industries, allergens, surgical operation theatres, Techniques for microbial sampling of air from various sources, Aerosol sampling, fate of aerosols, inactivation by UV light and HEPA filter, Assessment of air quality by solid, liquid impingement, Enumeration of microflora by different techniques, Air-borne transmission of microbes, their diseases and preventive control measures, To learn Microbiological Analysis of Air, Water and Soil

Unit II Soil microbiology

Biogeochemical cycles: C, P, N, S, Soil horizons, classification of soils, Microflora of various soil types and salt affected soils, Rhizosphere microflora, Preparation of Winogradsky's column to study soil microflora, Enumeration of soil microflora by different techniques

Unit III Water ecosystem

Fresh water (Ponds, Lakes, Stream); Marine water (Estuaries, mangroves, deep sea, hydrothermal vents, salt pans, Coral reef)

Unit IV Water microbiology

Microflora of water, Bacterial assessment of water and potability of water, Indicator bacteria: *E. coli*, *Staphylococcus aureus*, *Clostridium perfringens*, MPN (Black, White), MPN index, IMViC test, Physiochemical characteristics of water: TSS, TDS, DO, BOD and COD, Brief account of water borne diseases and their control measures

Unit V Environment microbiology

Waste as resource, Organic compost, Biogas, Waste water treatment, Concept of Biodegradation

Suggested reading

1. Ananthanarayan, R and C.K. Jayaram Paniker. 1978. Text Book of Microbiology. Orient Longman Ltd. Madras.
2. Harry W. Seeley Jr. and Paul. J. van Demark. 1975. Microbes in Action: A laboratory Manual of Microbiology. II Edition. W.H. Freeman and Company.
3. Ronald, M. Atlas. 1989. Microbiology: Fundamentals and Applications. II Edition. Maxwell Macmillan Intern.

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4. Pelczar, M.J. Jr., Chan E.C.S and Kreig N.R. 1993. Microbiology- Concepts and Applications. McGraw Hill Inc.
5. Kathleen Talaro and Arthur Talaro. 1993. Foundations in Microbiology. W C B Pub.
6. SubbaRao N.S. 1977. Soil Microorganisms and Plant Growth. Oxford and IBH Pub. Co.
7. Alexander. M. 1985. Introduction to Soil Microbiology. II Edition Wiley Eastern Ltd.
8. Paul, E.A. and Clark, F.E. 1989. Soil Microbiology and Biochemistry.

Course learning Outcomes (CLO)

After successful completion of this course, the students are expected to:

1. Understand the basic aspects of air microbiology
- 2 Understand the basic aspects of soil microbiology
- 3 Understand the basic aspects of water microbiology
- 4 Explain various aspects of environmental microbiology

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II Year: III Semester (Theory)

Physical Education and Yoga

Code: BSM331

L	T	P	C
2	0	0	2

Course objective (CO)

1. To study the introduction of physical education, concept of fitness and wellness.
2. To study weight management and lifestyle of an individual.
3. To learn about the relation of yoga with mental health and value education.
4. To learn about the aspects of the traditional games of India.

Unit I Physical Education

Meaning Definition, Aim and Objective., Misconception About Physical Education, Need Importance and Scope of Physical Education in the Modern Society, Physical Education Relationship with General Education, Physical Education in India before Independence.

Unit II Concept of Fitness and Wellness

Meaning, Definition and Importance of Fitness and Wellness, Components of Fitness, Factor Affecting Fitness and Wellness.

Unit-III Weight Management

Meaning and Definition of Obesity, Causes of Obesity, Management of Obesity, Health problems due to Obesity, Meaning, Definition, Importance of Lifestyle, Factor affecting Lifestyle, Role of Physical activity in the maintains of Healthy Lifestyle.

Unit-IV Yoga and Meditation

Historical aspect of yoga, Definition, types scopes & importance of yoga, Yoga relation with mental health and value education, Yoga relation with Physical Education and sports, Definition of Asana, differences between asana and physical exercise, Definition and classification of pranayama, Difference between pranayama and deep breathing.

Unit-V Traditional Games of India

Meaning, Types of Traditional Games-Gili- Danda, Kanche, StapuGutte, etc. Importance/ Benefits of traditional Games, How to Design Traditional Games. Recreation in Physical Education, Meaning, Definition of Recreation, Scope and Importance of Recreation, General Principles of Recreation, Types of Recreational Activities, Aerobics and Zumba. (Fir India Movement)

Suggested Readings

1. Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006
2. Patel, Shri krishna, Physical Education, "Agrawal Publishers", Agra, 2014-15
3. Panday, Preeti, Sharirik Shiksha Sankalan, "KhelSanskritiPrakashan, Kanpur
4. Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications.
5. B.K.S. Yengar, "Light and Yog. Yoga Deepika ", George Allen of Unwin Ltd., London, 1981.

Shankar



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6. Braj Bilari Nigam, Yoga Power "The Path of Personal achievement" Domes and Publishers, New Delhi, 2001.
7. Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Domes and Publishers, New Delhi - 2001.
8. Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.
9. Janice Jerusalem, "A Guide To Yoga" Parragon Bath, Baithe-2004.

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Study the introduction of physical education, concept of fitness and wellness.
2. Study weight management and lifestyle of an individual.
3. Learn about the relation of yoga with mental health and value education.
4. Learn about the aspects of the traditional games of India.

Shailendra



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Department of Microbiology, Session 2025-26

II Year: III Semester (Theory)

Minor Elective-1

Medical Biotechnology

Course code: BSM322

L	T	P	C
4	0	0	4

Course objectives

The main objective of this course is to:

1. To empower students with the knowledge of allied biomedical sciences
2. Introduce to create a work force for advanced research
3. Introduce diagnostics in a medical environment.

Unit I Methods for diagnosis of human diseases

Karyotyping of human chromosomes, Chromosome banding– G banding and R-banding technique, Inheritance patterns in Man– Pedigree, Diagnosis using monoclonal antibodies- ELISA, DNA/RNA based diagnosis– HBV, HIV.

Unit II Inherited disorders

Chromosomal disorders caused due to structural chromosomal abnormalities (Deletions, duplications, Translocations), Chromosomal disorders caused due to numerical chromosomal abnormalities (autosomal and allosomal), Monogenic disorders (autosomal and X-linked diseases), Mitochondrial diseases – LHON, MERRF.

Unit III Gene therapy

Gene therapy – *ex-vivo* and *in-vivo* gene therapy; somatic and germline gene therapy; Strategies of gene therapy.

Unit IV Therapeutic approaches for human diseases

Gene augmentation – ADA deficiency; Prodrug therapy/suicide gene – glioma, Stem cells – potency definitions; embryonic and adult stem cells; applications of stem cells – cell based therapies and regenerative medicine, Encapsulation technology and therapeutics-Diabetes, DNA based vaccines, subunit vaccines – Herpes Simplex Virus, Recombinant attenuated vaccines– Cholera.

Unit V Drug Delivery

Drug delivery: Basic concepts, Drug delivery: Market perspective, Advance drug delivery and targeting, Rate control in drug delivery and targeting: Fundamentals and application to implantable systems, Drug targeting systems: Fundamental and applications to parental drug delivery, Routes of drug delivery, Oral drug delivery, Oral Trans-Mucosal drug delivery, Transdermal drug delivery, Nasal drug delivery, Pulmonary drug delivery, Vaginal drug delivery, Ophthalmic drug delivery, CNS drug delivery, Future direction of drug delivery and targeting, Plasmid based gene therapy, Integrating drug discovery and delivery, New generation technologies.

Suggested Readings

1. Medical Biotechnology-Pratibha Nallari, V. Venugopal Rao-Oxford Press
2. Introduction to Human Molecular Genetics – J.J Pasternak, John Wiley Publishers

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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

II Year: III Semester (Practical)

Biochemistry and Microbial Biodiversity Lab

Code: BSM351

L	T	P	C
0	0	2	1

Course Objectives (CO)

1. To study the measurement of sugars, proteins and nucleic acid in the biological sample.
2. To understand theory, principle and factors affecting enzyme activity.
3. To learn biochemical tests to identify bacteria.

Practical

1. Qualitative detection of glucose.
2. Qualitative determination of glucose.
3. Estimation of given protein concentration.
4. Titration of amino acids and find the physical constants.
5. Preparation of different buffer solutions and measure their pH.
6. Indole test for bacteria
7. Methyl Red (MR) and Voges-Proskauer (VP) Test for bacteria
8. Citrate Test for bacteria
9. Hydrogen Sulfide production test for bacteria

Suggested Readings

1. Lab Manual - Biochemistry.pdf (jru.edu.in)
2. Practical Clinical Biochemistry Methods And Interpretations by Ranjna Chawla, Publisher: Jaypee, ISBN:9789389188769, Year: 2020
3. Experiments in Microbiology, Plant pathology, Tissue culture and Microbial Biotechnology, K R Aneja, New Age International Publishers.

Course learning outcome (CLO)

At the end of the course, the student will be able to:

1. Explain the protocols for the measurement of sugars, proteins and nucleic acid in the biological sample.
2. Study the principles, application and care of laboratory instruments.
3. Understand theory, principle and factors affecting enzyme activity.
4. Differentiate bacteria based on different biochemical tests.

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II Year: III Semester (Practical)

Immunology and Serology Lab

Code: BSM 352

L	T	P	C
0	0	2	1

Course objective (CO)

1. To understand the principle of ELISA and RIA.
2. To study the principle of immunoprecipitation and IgG and IgM estimation.
3. To study the antibiotic sensitivity test.

Practical

1. To demonstrate ELISA test.
2. Tube Agglutination test: Widal test
3. Separation of serum from blood
4. Separation of plasma from blood
5. Double immune diffusion test using specific antibody and antigen.
6. Blood group determination: Slide agglutination.
7. Estimation of Haemoglobin (Hb).
8. Slide agglutination test for serotyping pathogens.
9. To perform IgG & IgM test.

Suggested Readings

1. Immunology & Serology in Laboratory Medicine Paperback – 30 April 2021
by Mary Louise Turgeon
2. Immunology & Serology in Laboratory Medicine, 7th Edition - December 16, 2020, Author:
Mary Louise Turgeon

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Understand the principle of ELISA and RIA.
2. Study the principle of immunoprecipitation and IgG and IgM estimation.
3. Study the antibiotic sensitivity test.

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B.Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

II Year: IV Semester												Diploma in Biochemistry																														
S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty																															
						CIE	ESE																																			
Theory																																										
1	BSM401	Molecular Biology	4	0	0	25	75	100	4	Major	Own faculty																															
2	BSM402	Environmental Microbiology	4	0	0	25	75	100	4	Major	Own faculty																															
3		Minor Elective-2	4	0	0	25	75	100	4	Minor	Own faculty																															
4	-----	Vocational Elective-2	4	0	0	25	75	100	4	Minor Vocational	Any faculty																															
5	BSM431	Human Values and Environmental Ethics	2	0	0	25	75	100	2	Value Added Courses	Any faculty																															
Practical																																										
6	BSM451	Molecular Biology Lab	0	0	2	25	75	100	1	Major	Own faculty																															
7	BSM452	Environmental Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty																															
8	BSM453S I	Summer Internship	0	0	4	25	75	100	2	Summer Internship	Any lab																															
Total			18	0	8	200	600	800	22																																	
<table><tr><td>Hons</td><td>Honours</td><td rowspan="5"></td><td colspan="2">Vocational Elective-2</td><td colspan="2">Minor Elective-2</td></tr><tr><td>L</td><td>Lecture</td><td>Course code</td><td>Course Name</td><td>Course code</td><td>Course Name</td></tr><tr><td>T</td><td>Tutorial</td><td>BSB421VO</td><td>Nanobiotechnology</td><td>BSB421</td><td>Bioprocess Technology</td></tr><tr><td>P</td><td>Practical</td><td>BSB422VO</td><td>Ecology and Environments</td><td>BSB422</td><td>Industrial fermentation</td></tr><tr><td>CIE</td><td>Continuous Internal Evaluation</td><td colspan="2">MOOCS/NPTEL/SWYAM/Other University/College</td><td colspan="2"></td></tr></table>												Hons	Honours		Vocational Elective-2		Minor Elective-2		L	Lecture	Course code	Course Name	Course code	Course Name	T	Tutorial	BSB421VO	Nanobiotechnology	BSB421	Bioprocess Technology	P	Practical	BSB422VO	Ecology and Environments	BSB422	Industrial fermentation	CIE	Continuous Internal Evaluation	MOOCS/NPTEL/SWYAM/Other University/College			
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Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC. 2. Students who opt to exit after completion of the second year and have secured 80 credits will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.																																										

Date: _____

Volume No.: _____

Shankar



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Department of Microbiology, Session 2025-26

Molecular Biology (Theory)

Code: BSM401

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To understand the central dogma of molecular biology.
2. To import knowledge about the key components participating in the replication of genetic material.
3. To teach the processes of transcription, RNA processing and translation.
4. To study the genetic code, recombinant DNA Technology and gene therapy.

Unit I Central Dogma of Molecular Biology

Organization of Genetic Material: split genes, overlapping genes; pseudogenes, cryptic genes, Insertion elements and transposons. Gene organization and expression in mitochondria and chloroplast, Types of Mutation and DNA repair system.

Unit II Replication

DNA as genetic material, structure, Organization Prokaryotic and Eukaryotic – Enzyme and protein involved in replication, Theta model and Rolling circle model.

Unit III Transcription

RNA structure and types of RNA, Transcription in prokaryotes and Eukaryotes: Mechanism, Promoters and RNA polymerase, transcription factors, Post – transcriptional modifications of eukaryotic mRNA.

Unit IV Translation

Properties and Wobble hypothesis, Translation: Mechanism of translation in prokaryotes and Eukaryotes, Post- translational modifications of proteins. Regulation of Gene expression and translation: Regulation of Gene expression in Prokaryotes: Operon concept (Lac), Regulation of Gene expression in Eukaryotes: transcriptional activation.

Unit V Recombinant DNA Technology and Gene Therapy

Recombinant DNA Technology, Vectors Procedure of DNA Recombination, Gene Library, Linkage Analysis, Gene Therapy, Animal Cloning and stem cells.

Suggested Readings

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Understand the central dogma of molecular biology.

Shanleudha



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2. Explain about the key components participating in the replication of genetic material.
3. Describe the processes of transcription, RNA processing and translation.
4. Study the genetic code, recombinant DNA Technology and gene therapy.

Shailendra



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Department of Microbiology, Session 2025-26

II Year: IV Semester (Theory)
Environmental Microbiology
Code: BSM 402

L	T	P	C
4	0	0	4

Course objective

The course provides the comprehensive knowledge

- 1 To learn environmental science,
- 2 To learn environmental issues
- 3 To learn the management with microorganism

Unit I Origin of life

A brief history of the physical origin of the Earth, Chemical and Cellular evolution; Microbial Diversification: Consequences for Earth's Biosphere; Endosymbiotic origin of eukaryotes. Significance of Biogeochemical cycles-Carbon, Nitrogen, Phosphorous, Sulphur.

Unit II Microbial Ecology vs. Macroecology

Basic concept of Ecosystem and Biosphere, Concept of habitat and niche, Concept of population growth and community dynamics in microbe, Basic concept of food chain-food web and energy flow; Development of microbial communities: r and k strategies.

Unit III Physiological ecology of microorganisms

Adaptation to environmental condition, Abiotic growth limiting factors-Leibig's law of minimum, Shelford law of tolerance. Microbial community succession-biofilm communities.

Unit IV Quantitative Ecology

Microbial diversity, OTU, Diversity indices (Shannon, Simpson), Alpha and beta diversity, Richness and evenness, Samples and samplings, Concept of culturability, Determination of total and viable microbial number, Molecular analysis of function and diversity of microbial community, Metagenomics and microbiomics.

Unit V Microbial Diversity and Interactions in Natural Ecosystems

Microbial Diversity in Natural Systems, Microbial Interactions, Microbial Diversity and Natural Products, Indicator Microorganisms. Municipal Wastewater Treatment, Drinking Water Treatment

Suggested reading

1. Waste Water Microbiology by Garbiel, Bitton. Wiley Publication.
2. Biopesticides: A Biotechnical Approach by S R Joshi. New Age Publication.
3. Microbial Ecology by Atlas and Bartha.
4. Soil Organic Matter and Biological Activity. Martinus Nigholf W Junk Publisher.
5. Introduction to Environmental Microbiology by Michel Wiley Liss Publication.
6. Advances in Microbial Ecology. K C Marcell, Plenum Press.
7. Bioremediation by Baker. MGH Publication.
8. Biotechnology for Waste Water and Waste Water Treatment, Prentice Hall of India
9. Modern Food Microbiology by James M Jay, Anaspen Publication.

Shankar



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10. Industrial Microbiology by L E Casida, New Age Publication.
11. Biogas Technology by B T Nijaguna, New Age Publication.

Course learning outcome (CLO)

On completion of the course, students will acquire:

1. Students will learn the major principles of environmental microbiology and the relationship of microbes to environmental processes and other living organisms.
2. Students will demonstrate proper scientific procedures to identify various types of environmental microbes.
3. Students will be evaluated by observation in the laboratory and analysis of unknown bacteria and projects.
4. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
5. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Shailendra



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II Year: IV Semester (Theory)
Bioprocess Technology
Code: BSM 421

L	T	P	C
4	0	0	4

Course Objective

The course gives insight into various concepts used in the industry:

1. To learn the Bioprocess plant layout, site selection, Analysis of economics for predicting capital Investment. Bioreactor engineering, relief system, material handling and bioprocess validation, economic and environmental assessment of bioprocess.
2. To learn concepts such as Intellectual property right, Good lab Practices, Good manufacturing practices.
3. The course gives knowledge of the key elements used in industry and also develops technical skills to succeed as an entrepreneur

Unit I Introduction to bioprocess

Historical development of bioprocess technologies, role of bioprocess engineer in the biotechnology industry, concept of Bioprocess, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets. A brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology

Unit II Fermentation process

General requirements of fermentation processes; Isolation, preservation and improvement of industrially important micro- organisms, development of inocula for industrial fermentations. Different types of fermentations, Basic design and construction of fermentor and ancillaries, An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry solid-substrate fermentation and its applications

Unit III Metabolic stoichiometry and energetics

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass available, electron balances, yield coefficient of biomass and product formation, maintenance coefficients, energetics analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

Unit IV Media design and sterilization for fermentation process

Designing of media for fermentation processes, Types of media, design and usage of various commercial media for industrial fermentations, thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air, design of sterilization equipment.

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Unit V Kinetics of microbial growth and product formation

Phases of cell growth in batch cultures, simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudking – Piret models, substrate and product inhibition on cell growth and product formation.

Suggested reading

1. Pauline. M.Doran ., “Bioprocess Engineering Principles”; Academic press.
2. Peter F.Stanbury, Allan Whitaker, “Principles of Fermentation Technology”
3. Michael L.Shuler and Fikret Kargi, “Bioprocess Engineering Basic concepts”, Prentice Hall, 1992.

Course learn outcomes (CLO)

On completion of the course, students will acquire

1. In-depth knowledge of the current research and development work in microbiology
2. The ability to plan and carry out tasks in given framework of thesis
3. The capability to clearly present and discuss the planned work/task both in written and spoken English.
4. Capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.

Shanleha



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II Year: IV Semester (Theory)

Industrial fermentation

Code: BSM 422

L	T	P	C
4	0	0	4

Course objective

1. To acquaint with different types of fermentation processes and equipment and underlying principles in downstream processing
2. To understand how microbiology is applied in manufacture of industrial products
3. To understand the beneficial role of microorganisms in fermented dairy products & in alcoholic beverages
4. To gain knowledge about biofertilizers and biopesticide in agriculture and understand various plant microbes interactions and their applications

Unit I Introduction to Fermentation

Design and components of typical fermenters, devices for aeration and agitation, Seed and Pilot Scale fermenters, types of fermenters- Aerobic fermentor, Activated sludge process, Trickling filter bioreactor, Airlift bioreactor, stirred tank bioreactor, fluidized bed bioreactor, anaerobic bioreactor, methane digester, etc.

Unit II Fermentation Processes

Fermentation- types of fermentation, solid state and submerged fermentation, factors affecting fermentation process. Media formulations and optimization. Sterilization- batch and continuous. Upstream and Downstream processing- product purification, bioseparation processes, recovery, control measures. Techniques for purification of end products- Chromatography, Electrophoresis, Distillation, Crystallization, Filtration.

Unit III Industrial production and their uses

Enzymes: Amylases, Vitamins - Vitamin B-12, Antibiotics: Penicillin. SCP: Spirulina, Organic acids: Citric acid. Production of fuels: Ethanol, Biodiesel. Health care products: Steroid transformation, Monoclonal antibodies, Vaccines.

Unit IV Food fermentation

Alcoholic beverages- beer, wine, whiskey, etc., Cheese making, Bread making, Fermented soya based foods. Meat fermentation, Fermented milk (curd, yoghurt, acidophilous milk and Kefir) and mushroom cultivation, Single cell protein, probiotics and prebiotics.

Unit V Plant-Microbe interactions

Mycorrhizae-Biology and applications, Biofertilizers, microbial inoculants, Brief account of production and application of Rhizobium, Azotobacter, phosphobacteria and Cyanobacteria. Biopesticides : Fungal, Bacterial and Viral Biopesticides and their applications.

Suggested reading

1. Cappuccino JG and Sherman N – 1999. Microbiology. A Laboratory Manual 4th Edn. Addison – Wesley.

Shailendra



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2. Casida LE – 1964. Industrial Microbiology. Wiley Eastern Ltd. New Delhi.
3. Desmond ST, and Nicholl – 1994. An Introduction to Genetic Engineering, Cambridge Univ. Press. Cambridge.
13. Dewes IW and Southerland JW – 1976. Microbial Physiology, Halsted Press, NY.
4. Fletcher M. and Gray TRG – 1987. Ecology of Microbial Communities. Cambridge Univ. Press, Cambridge

Course learning outcome (CLO)

After successful completion of the course students are able to

1. Acquaint with different types of fermentation processes and equipment and underlying principles in downstream processing
2. Understand how microbiology is applied in manufacture of industrial products
3. Understand the beneficial role of microorganisms in fermented dairy products & in alcoholic beverages
4. Gain knowledge about biofertilizers and biopesticide in agriculture and understand various plant microbes interactions and their applications

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II Year: IV Semester (Theory)

Value Added Courses

Human Values and Environmental Studies

Code: BSM431

L	T	P	C
2	0	0	2

Course objective (CO)

1. To study about human value and current practices.
2. To study about the principles of ethics secular and spiritual values in management.
3. To understand about holistic approach in decision making.
4. To get depth knowledge about the ecosystem and environmental laws.

Unit I Human Values

Introduction- Values, Characteristics, Types, Developing Value system in Indian Organization, Values in Business Management, value-based Organization, Trans –cultural Human values in Management. Swami Vivekananda's philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam view on role of parents and Teachers.

Unit II Present Practices of Human Values

Issues: Corruption and Bribe, Privacy Policing Web and social media, Cyber threats, Online Shopping etc. Remedies UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy.

Unit III Principles of Ethics Secular and Spiritual Values in Management

Introduction-Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, Corporate Social Responsibility- Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates.

Unit IV Ecosystem

Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of Biodiversity- In-situ & Ex- situ conservation of biodiversity, Role of individual in Pollution control, Human Population & Environment, Sustainable Development, India and UN Sustainable Development, Goals Concept of circular economy and entrepreneurship,

Unit V Environmental Laws

Definition of Environmental Laws, International Advancements in Environmental Conservation, Role of National Green Tribunal, Air Quality Index, Importance of Indian Traditional knowledge on environment, Bio assessment of Environmental Quality, Environmental Impact Assessment and Environmental Audit.

Suggested Readings

1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal *et al.*
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel
3. Human Values by A. N. Tripathi New Age International

Shankar



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4. Environmental Management by N.K. Uberoi
5. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
6. <https://www.india.gov.in/my-government/schemes>
7. <https://www.legislation.gov.uk/ukpga/2010/23/contents>
8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921

Course Learning Outcome (CLO)

At the end of the course the student will be able to:

1. Study about human value and current practices.
2. Study about the principles of ethics secular and spiritual values in management.
3. Understand about holistic approach in decision making.
4. Explain about the ecosystem and environmental laws.

Sharada



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
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II Year: IV Semester (Theory)
Vocational Elective-2
Ecology and Environments
Course code: BSM421VO

L	T	P	C
4	0	0	4

Course objectives:

The specific objectives of the course are as follows:

1. To impart basic knowledge about the environment and its allied problems.
2. To teach students about different types of ecosystem.
3. To make students understand the flow of energy in an ecosystem.
4. To increase awareness amongst students about different biogeography and environmental challenges.

Unit I: Environment and concept of ecosystem:

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Geological consideration of Atmosphere, Hydrosphere, Lithosphere; scope of ecology; principles and concepts of ecosystem; structure of ecosystem; strata of an ecosystem; development and evolution of ecosystems.

Unit II: Habitat and Niche and Population Ecology:

Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.

Unit III: Species Interactions, Community Ecology and Ecological Succession:

Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Types; mechanisms; changes involved in succession; concept of climax.

Unit IV: Ecosystem Ecology and Biogeography:

Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: Forest ecosystems; tropical evergreen forest, tropical deciduous forest, temperate evergreen forest, temperate deciduous forest, tundra and taiga; desert ecosystem; freshwater and marine ecosystems; cybernetics and homeostasis; biological control of chemical environment. Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit V: Applied Ecology:

Environmental pollution and environmental health; detection of environmental pollutants; indicators and detection systems; bio-transformation; plastic, aromatics, hazardous wastes; environmental cleanup: Case studies. global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Shantika
Suggested reading



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1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Michael Allabay, Basics of environmental science, Routledge Press.
6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5th edition) Books/Cole, Thompson Learning, Inc.
7. Mohapatra Textbook of environmental biotechnology IK publication.

Course learning Outcome (CLO):

Upon successful completion of this course the student will:

1. Understand the differences between atmosphere, hydrosphere, and lithosphere.
2. Learn about forest, desert, freshwater, and marine ecosystems.
3. Understand the flow of energy in an ecosystem.
4. Know about the role of biotechnology in addressing environmental challenges.

Shalendra



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II Year: IV Semester (Theory)
Vocational Elective-2
Nano biotechnology
Course code: BSM422VO

L	T	P	C
4	0	0	4

Course Objective:

The aim of this course is to

1. Provide basic knowledge in the interface between chemistry, physics and biology
2. Introduce nanostructure level with a focus on biotechnological usage.
3. Introduce Techniques of nanomaterial characterization
4. Introduce Drug delivery and Biosensors

Unit-I: Introduction to Nanobiotechnology:

Nanotechnology basic concepts; Cellular Nanostructures; Nanopores; Bimolecular motors; Chemical, physical and biological properties of biomaterials

Unit-II: Techniques of Nano material characterization:

Preparation and characterization of nanoparticles: nanoparticulate carrier system, Electron microscopy Atomic force microscopy

Unit-III: Nanostructures and Nanosystems:

Carbon nanotubes, Fullerenes, Nanowires, Metallic nanoparticles, Dendrimers, Quantum dots, Ultrasound contrast agents, Nanoarrays, DNA computers, DNA motors, Nanopore technology, Biogenic nanoparticles, Stealth nanoparticles, Virus like nanoparticles.

Unit-IV: Drug delivery:

Nanoparticulate carrier system, micro and nano fluidics, drug and gene delivery system, microfabrication, chip technologies, nano-imaging.

Unit-V: Biosensors:

Introduction and basic characteristics of biosensors, basic characteristics feature of ideal biosensor, different types of biosensors: Piezo electric sensors; Optical sensors; Calorimetric sensors; Electrochemical sensors, Gold nanoparticles as biosensors.

Suggested reading

1. Multilayer Thin Films, Editor(s): Gero Decher, Joseph B. Schlenoff Publisher: Wiley-VCH Verlag GmbH & Co. KGaA ISBN: 3527304401
2. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher: Wiley-Liss ISBN: 047141719X
3. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press ISBN: 0-8247-2579-

Course Learning Outcome (CLO)

Shankar



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Upon successful completion of this course the student will:

1. To apply engineering and physics concepts to the nano-scale and non-continuum domain.
2. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature.
3. Design processing conditions to engineer functional nanomaterials.

Sharada



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Department of Microbiology, Session 2025-26

Molecular Biology Lab (Practical)

Code: BSM451

Course objective (CO)

1. To study the procedure for DNA and RNA isolation from microbial sample.
2. To analyses genomic DNA by agarose gel electrophoresis.
3. To get familiar with the genetic engineering technique.

L	T	P	C
0	0	2	1

Practical-

1. Preparation of solution for Molecular Biology experiments.
2. Preservation of bacterial cultures.
3. Isolation of chromosomal DNA from bacterial cells.
4. Isolation of plasmid DNA by alkaline lysis method
5. Preparation of restriction enzyme digests of DNA sample.
6. Demonstration of Molecular cloning in plasmids.
7. Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) of proteins.

Course Learning Outcome (CLO)

At the end of the course the student will be able to

1. Identify DNA and RNA in bacterial sample.
2. Analyze the genomic DNA by agarose gel electrophoresis.
3. Understand the genetic engineering technique.

Shanleha



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

II Year: IV Semester (Practical)

Environmental Microbiology Lab

Code: BSM 451

L	T	P	C
0	0	2	1

Course objective (CO)

1. To analyze the microorganisms in water, waste water and bioremediation
2. To learn the examination of occurrence, abundance and distribution of microorganisms in the environment
3. To Know laboratory knowledge of determination of pathogenic bacteria in different water samples.

Practicals

1. Isolation of E. coli from sewage water samples with the help of EMB agar media.
2. Isolation of natural microflora from soil sample
3. Isolation of air microflora.
2. To determine the amount of Dissolved oxygen (DO) present in given water sample
3. To determine the Biological Oxygen Demand (BOD) present in given water sample
4. To check the phenomenon of antagonism by dual culture method.
5. Estimation of microflora on different plant parts.
6. Coliform test for water sample (Presumptive, confirm and complete test).
7. Measurement of toxicity of metals and pesticides for microorganisms for determination of LD50

Suggested reading

1. Experiments in Microbiology, Plant Pathology and Biotechnology by K R Aneja. New Age Publication

Course learning outcome (CLO)

After successful completion of the course students are able to:

1. Analyze the microorganisms in soil, air, water, waste water and bioremediation
2. Learn the examination of occurrence, abundance and distribution of microorganisms in the environment
3. Know laboratory knowledge of determining pathogenic bacteria from different water samples.
4. Understand the basic practical of bioremediation.

Shailendra



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Department of Microbiology, Session 2025-26

B. Sc. Microbiology

Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

III Year: V Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM501	Agricultural Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM502	Virology	4	0	0	25	75	100	4	Major	Own faculty
3	BSM503	Parasitology	3	0	0	25	75	100	3	Multidisciplinary	Own faculty
4		Departmental Elective-1 (DE-1)	4	0	0	25	75	100	4	Minor	Any faculty
5	BSM531	Quality control in industrial Prospectus	3	0	0	25	75	100	3	SES	Any Faculty
6	BSM531	Understanding India	2	0	0	25	75	100	2	Value Added	Any Faculty
Practical											
5	BSM551	Agricultural Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
6	BSM552	Virology Lab	0	0	4	25	75	100	2	Major	Own faculty
Total			20	0	6	200	600	800	23		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental Elective (DE)-1	
Sub Code	Subject Name
BSM511	Systemic Bacteriology
BSM 512	Medical Biochemistry

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

Date: _____
Volume No.: _____

Shankar



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Department of Microbiology, Session 2025-26

III Year: V Semester (Theory)
Agricultural Microbiology
Code: BSM 501

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn the outline the physico- chemical aspects of the soil and its microbial diversity
2. To learn the evaluate the role of microbes in the different biogeochemical cycles and in agriculture
3. To learn Discuss biological nitrogen fixation in symbiotic and non-symbiotic associations with plants.
4. To learn how to explain the value, production, application and crop response of biofertilizers
5. To learn how to apply the knowledge on biopesticides and their role in pest control

Unit I Soil microbiology

Soil- formation, soil structure, soil types. Physical and chemical properties of soil. Microbes in soil – types, abundance, distribution, factors influencing microbial activity in soil.

Unit II Microbial transformations of minerals

Biogeochemical cycles-Carbon, Nitrogen, Phosphorous and Sulphur cycles. Organic matter decomposition, humus formation and C:N ratio.

Unit III Biological Nitrogen fixation

Microorganisms in the Rhizosphere, Rhizoplane and Phylloplane- Biological nitrogen fixation, symbiotic and free living nitrogen fixation, nitrogenase- structure and function - Genetics of N₂ fixation- importance of nitrogen fixation.

Unit IV Types and production of Biofertilizers: Biofertilizers

Importance and various types of Biofertilizer *Rhizobium*, *Azotobacter*, *Azospirillum*, Cyanobacteria, Azolla, Phosphate solubilizing microorganism-Mycorrhizal biofertilizers, PGPR - *Pseudomonas* Sp. Biofertilizers production, quality control and BIS specification.

Unit V Plant pathogenic microorganisms and Biopesticides

Characters of plant pathogens, symptoms and control measures of bacterial, fungal and viral diseases. Microbial pesticides classification, mode of action of bacterial pesticides (*Bacillus thuringiensis*), fungal (*Trichoderma viridae*) and viral pesticides (NPV)

Suggested reading

1. Subba Rao, N. S., 2019. Biofertilizers in Agriculture and Forestry, 4 Ed., Cbs Publ & Dist Pvt Ltd, New Delhi.
2. Subba Rao, N. S. 1995. Soil microorganisms and plant growth. Oxford & IBHPublishing Co.Pvt.Ltd. New Delhi.
3. Martin Alexander, 1983. Introduction to Soil Microbiology, Wiley eastern Ltd., NewDelhi.
4. Gupta, S.K., 2014 Approaches and trends in plant disease management. Scientific publishers, Jodhpur, India.

Shanleenda



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5. Jamaluddin et al., 2013 Microbes and sustainable plant productivity. Scintific Publishers Jodhpur, India.
6. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
7. Glick, B.R. AND Pasternak, J.J, 1994. Molecular Biotechnology, ASM Press, Washington DC.
8. Purohit, S. S., Kothari, P. R. and Mathur, 1993. Basic and Agricultural Biotechnology, Agrobotanical Publishers (India). Bikaner.

E-Resources

1. <https://microbewiki.kenyon.edu/index.php>
2. <https://www.elsevier.com/books/advances-in-agricultural-microbiology/subba-rao/>
3. https://en.wikipedia.org/wiki/Agricultural_microbiology

Course learning outcome (CLO)

On completion of the course, students should be able to do

- 1: Outline the physico- chemical aspects of the soil and its microbial diversity
- 2: Evaluate the role of microbes in the different biogeochemical cycles and in agriculture
- 3: Discuss biological nitrogen fixation in symbiotic and non-symbiotic associations with plants.
- 4: Explain the value, production, application and crop response of biofertilizers
- 5: Apply the knowledge on biopesticides and their role in pest control

Sharada



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: V Semester (Theory)

Virology

Code: BSM 502

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. The major objective of this course is to acquaint students with the structure of viruses of plants, animals, and bacteria, their genome organization, and replication strategies within the host cell.
2. The student will learn how they evolve, spread and cause disease and prevention and control methods for the same.
3. The course also includes description of oncogenic viruses and their role in cancers, and emerging viruses in context of threat to public health and their management.

Unit I Introduction to Viruses

Early development of virology, General Properties of viruses, Structure of viruses, Virus reproduction, Cultivation of Virus, Virus purification and assays, Principle of virus taxonomy.

Unit II Viruses of Bacteria and Archaea

Classification of bacterial and archaeal viruses, Virulent double-stranded DNA phages- adsorption and penetration, synthesis of phage nucleic acids and proteins, assembly of phage particles, and release. Single stranded DNA phages, RNA Phages, Temperate bacteriophages and lysogeny, Bacteriophage genomes.

Unit III Eucaryotic Viruses

Taxonomy of eukaryotic viruses, Reproduction of vertebrate viruses- adsorption of virions, penetration and uncoating, genome replication and transcription in DNA Viruses, genome replication, transcription and protein synthesis in RNA viruses, assembly of virus capsids, virions release.

Unit IV Viral Infections and Other Acellular Infectious Agents

Persistent, latent and slow viral infections, cytotoxic infections and cell damage, viruses and cancer, Plant viruses, viruses of fungi and protists, insect viruses, viroids and virusoids, prions.

Unit V Viruses and Viral diseases

Salient features of viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses), Role of viruses in causing diseases. Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds.

Suggested Readings

1. Understanding Viruses by Teri Shors Jones. 3rd edition. Jones and Bartlett Learning, USA. 2016.
2. Principles of Molecular Virology by A.J. Cann. 6th edition. Academic Press, Elsevier Netherlands. 2016.
3. Principles of Virology, Molecular biology, Pathogenesis and Control by S.J. Flint, L.W. Enquist, R.M. Krug, V.R. Racaniello, A.M. Skalka. 4th edition. ASM press, USA. 2015.

Shankar



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4. Plant Virology by R. Hull. 5th edition. Academic Press, USA. 2014.
5. Virology: Principles and Applications by J. Carter and V. Saunders. 2nd edition. John Wiley and Sons, UK. 2013.
6. Introduction to Modern Virology by N.J. Dimmock, A.L. Easton and K.N. Leppard. 6th edition. Wiley-Blackwell Publishing. 2007.
7. Plant Viruses by M.V. Nayudu. Tata McGraw Hill, India. 2008.
8. Basic Virology by E.K. Wagner, M.J. Hewlett, D.C. Bloom. 3rd edition. Wiley-Blackwell Publishing. 2007.
9. Virology by J.A. Levy, H.F. Conrat and R.A. Owens. 3rd edition. Prentice Hall, USA. 2000.

Course learning outcome (CLO)

At the end of the course the student will be able to

1. Describe the nature, properties and structure of viruses and will also gain knowledge of taxonomy of different groups of viruses.
2. Familiar with diversity and multiplication of lytic and lysogenic bacteriophages
3. Describe different ways of viral transmission, and prominent and unusual
4. Understand about the replication strategies, maturation and release of important plant,
5. animal and bacterial viruses
6. Explain about strategies to prevent viral infections: vaccines and antiviral compounds.
7. Understand the concept of oncogenesis, DNA and RNA cancer causing viruses and will learn of newly emerging viruses which have the potential to cause serious threats to public health and have become a global concern.

Shalendra



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Department of Microbiology, Session 2025-26

III Year: V Semester (Theory)

Parasitology

Code: BSM503

L	T	P	C
3	0	0	3

Course Objective (CO)

1. To study the general parasitology.
2. To provide advanced knowledge on some important microbial and medically important parasites.
3. To study about protozoa, trematodes, Cestodes and nematodes.

Unit-I: General parasitology

General Introduction: Parasitology- Parasite: Classification of parasites; Types of parasites; Host; Host-parasite relationships; Sources of infection; Portal of entry; Life cycle of human parasites; Pathogenicity.

Unit-II Protozoa

Classification, general morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of protozoan parasites: *Naegleria fowleri*, *Giardia lamblia*, *Trypanosoma* spp, *Plasmodium* spp, *Cryptosporidium parvum*, *Cyclospora cayetanensis*.

Unit-III Trematodes

Classification, general account, primary and secondary host of trematodes, egg hatching, variation of life cycle in Monogenea and Digenea with examples. Morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Fasciolopsis buski*, *Clonorchis sinensis*, *Paragonimus westermani*.

Unit-IV Cestodes

Classification, general account, larval form of cestodes, comparative study of scolices in cestodes. Life cycle pattern of cestodes. Morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Hymenolepis nana*, and *Taenia saginata*.

Unit-V Nematodes

Classification, general account, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of *Trichuris trichura*, *Strongyloides stercoralis*, *Dracunculus medinensis*, *Brugia malayi*.

Suggested Reading

1. Boyd RF. Medical Parasitology. Basic Medical Microbiology, 5th ed. 1995; Pp 499-529. Little, Brown and Company Inc, USA
2. Greenwood D. Helminthes. In: Greenwood D, Slack R, Peutherer J (eds). Medical Microbiology; 15th edn, 1997; Pp 587-602, Churchill Livingstone, Harcourt Publishing Ltd, London.
3. Heynema D. In: Brooks GF, Butel JS, Morse SA. Jawetz, Menlik and Adelberg's Medical Microbiology. Medical Parasitology, Chapter 46; Pp 617- 651; 21st ed, 1998. Appleton and Lang, Stanford, Connecticut, USA.

Shankar



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4. ShibruTedla. Introduction to Parasitology: Protozoan and Helminth parasites of man. Addis Ababa University Press, 1986, Addis Ababa, Ethiopia

Course learning Outcomes (CLO)

At the end the course, the students should be able to:

1. Explain the general parasitology.
2. Discuss about protozoology, helminthology, and applied parasitology.

Sharlene



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Department of Microbiology, Session 2025-26

III Year: V Semester (Theory)

Systemic Bacteriology

Code: BSM511

L	T	P	C
4	0	0	4

Course objective (CO)

1. To describe gram positive and gram-negative cocci and their laboratory diagnosis.
2. To describe gram positive and gram-negative bacilli and their laboratory diagnosis.
3. To explain about the other pathogenic bacteria causing human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

Unit I Bacterial morphology

Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell.

Unit II: Gram Positive and negative cocci

Medical importance of *Staphylococcus*, *Pneumococcus*, and *Streptococcus* with focus on morphology, antigenic structure, pathophysiology, and laboratory diagnostics, Medical importance of *Neisseria* and *Haemophilus* with focus on morphology, antigenic structure, pathophysiology, and laboratory diagnostics.

Unit III: Gram Positive bacilli

Medical importance of *Clostridium*, *Bacillus*, and *Corynebacterium*. with focus on morphology, antigenic structure, pathophysiology, and laboratory diagnostics.

Unit IV: Gram negative bacilli

Medical importance including *Vibrio*, *Brucella*, *Pseudomonas*, and *Bacteroides*. with focus on morphology, antigenic structure, pathophysiology, and laboratory diagnostics.

Unit V: Miscellaneous group

Enterobacteriaceae, Mycobacterium, Spirochaetes, Chlamydiae, Mycoplasma, Rickettsiae with focused on morphology, antigenic structure, pathophysiology, and laboratory diagnostics.

Suggested Readings

1. Ananthanarayanan and Paniker's textbook of microbiology (R. Ananthanarayan and C. K. Jayarampaniker)
2. Textbook of microbiology by C P Baveja
3. Prescott / Harley Klein's microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton)
4. Mackie and McCartney practical Medical Microbiology (J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons).
4. Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications.

Shalendra



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Course learning Outcomes (CLO)

At the end the course, the students should be able to

- 1 Describe gram positive and gram-negative cocci and their laboratory diagnosis.
- 2 Describe gram positive and gram-negative bacilli and their laboratory diagnosis.
- 3 Explain about the other pathogenic bacteria causing human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

Sharada



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III Year: V Semester (Theory)

Quality control in Industrial Perspective

Code: BSM531

L	T	P	C
3	0	0	3

Course objective (CO)

1. To contribute a deep insight to the principles of quality systems and management of safety and quality assurance.
2. To render a basic knowledge in assessment of quality, hazards impending the safety and regulation implemented to assure quality.

Unit I Introduction

Microbiological Laboratory and Safe Practice Good laboratory practices, Good microbiological practices. Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration.

Unit II Industrial Technique

Determining Microbes in Food / Pharmaceutical Samples Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products. Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

Unit III Industrial Procedure

Pathogenic Microorganisms of importance in Food & Water, Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

Unit IV Safety Manual

HACCP for Food Safety and Microbial Standards Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

Unit V Rules and Regulations

OECD guidelines for Good Laboratory Practices (GLP), National Accreditation Board for Testing and Calibration Laboratories (NABL), Biosafety Levels and risk factors, Biosecurity, FCO or Fertilizer (Control) Order guidelines, FCI Regulations, Food Safety and Standard regulations, Norms and standards for pharmaceuticals.

Suggested reading

1. Harrigan WF (1998), Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer.

Shankar



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4. Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Course learning outcome (CLO)

At the end the course, the students should be able to

1. Contribute a deep insight to the principles of quality systems and management of safety and quality assurance
2. To render a basic knowledge in assessment of quality, hazards impending the safety and regulation implemented to assure quality

Sharada



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: V Semester (THEORY)

Understanding India

Code: BSM531

L	T	P	C
2	0	0	2

Course Objectives

1. To expose students to the rich cultural and civilizational background of India.
2. To acquaint students with India's struggle for independence.
3. To provide a foundational understanding of the Indian Constitution.
4. To introduce the patterns of economic development in independent India.

UNIT I: Geographical Features of India

India on the world map and its neighboring countries, Physical features: mountains, plateaus, plains, coasts, islands, Natural resources: vegetation, rivers, soils, and climate

UNIT II: Religious and Artistic Traditions

Religious Traditions: Vedic Age, Buddhism and Jainism, Bhakti and Sufi Movements, Social Reform Movements and Revivalism. Art and Architecture: Indus Valley Town Planning, Rock-Cut Architecture, Temple Architecture Styles, Indo-Islamic and Colonial Architecture, Ajanta Paintings and the Bengal School of Art

UNIT III: India's Freedom Struggle

Revolt of 1857, Formation of the Indian National Congress, Swadeshi Movement, Gandhian Movements, Subhas Chandra Bose and the Indian National Army (INA), Independence and Partition of India

UNIT IV: Constitution of India

The Preamble, Salient Features, Fundamental Rights, Fundamental Duties

UNIT V: Indian Economy

Nature of the Mixed Economy, Role of the Planning Commission, Economic Liberalization after 1991

Suggested Readings

1. Basham, A.L. The Wonder That Was India. New Delhi: Rupa, 1994.
2. Basu, Durga Das. Introduction to the Constitution of India. New Delhi: Lexis Nexis, 2012.
3. Chandra, Bipan et al. India's Struggle for Independence. New Delhi: Penguin, 1989.
4. Chandra, Satish. History of Medieval India. New Delhi: Orient BlackSwan, 2009.
5. Dutt, R. & Sundharam. Indian Economy. New Delhi: S. Chand & Co., 2018.
6. Hussain, Majid. Geography of India, Ed. Tasawwur Husain Zaidi. Noida: McGraw Hill, 2022.
7. Lahiri, Nayanjot. Marshaling the Past: Ancient India and Its Modern Histories. New Delhi: Permanent Black, 2012.
8. Ray, Tirthankar. The Economic History of India 1857–1947. New Delhi: Oxford University Press, 2006.
9. Sharma, R.S. India's Ancient Past. New Delhi: Oxford University Press, 2007.
10. Thapar, Romila. The Penguin History of Early India: From the Origins to AD 1300. New Delhi: Penguin India, 2003.

Shankar



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Course Learning Outcomes (CLOs) : Upon successful completion of this course, students will be able to:

1. Understand the **geographical features** and diversity of India.
2. Gain insights into the **cultural traditions and population dynamics** of the country.
3. Analyze **India's struggle for freedom** and key historical events.
4. Comprehend the **basic structure and features of the Indian Constitution**, including fundamental rights and duties.
5. Develop an overview of the **Indian economy and its post-independence transformation**.

Sharada



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Department of Microbiology, Session 2025-26

III Year: V Semester (Practical)
Agricultural Microbiology Lab
Code: BSM551

L	T	P	C
0	0	2	1

Course objective (CO)

1. To provide practical knowledge in the isolation and characterization of microbes important in agriculture.
2. To comprehend plant-pathogen interactions
3. To gain expertise in isolation of organisms that has the potential of biofertilizers
4. To provide skills for biofertilizer production
5. To impart training on Study of plant pathogens

Practical

1. Isolation and Enumeration of Bacteria, Fungi and Actinomycetes from soil
2. Determination of organic matter decomposition in soil
3. Isolation of antagonistic microorganisms from soil
4. Isolation and authentication of Rhizobium from legume root nodules
5. Isolation of *Azotobacter* from soil
6. Isolation of *Azospirillum* from roots
7. Examination of Mycorrhizae- AM
8. Isolation of Phosphate solubilizing bacteria from soil
9. Isolation and identification of cyanobacteria
10. Isolation of *Trichoderma viridae*

Book suggesting

1. James. G. Cappucino. And Natabe Sherman, 2014. Microbiology – A Laboratory Manual, X Ed., Pearson Education (Singapore) Pvt. Ltd., India.
2. Dubey, R.C and Maheswari, D.K. 2012. Practical Microbiology, 5 Ed., Chand and Company Ltd., New Delhi.
3. Aneja. K.R, 2017. Experiments in Microbiology plant pathology tissue culture and mushroom production technology, 5 Ed. New Age International publishers (P) Ltd, New Delhi.
4. John G. Holt. 2000. Bergey's Manual of Determinative Bacteriology. 9 Ed. Lippincott Williams and Wilkins, USA.
5. Kannan N, 2003. Hand book of Laboratory culture media, Reagents and Buffers. Panama Publishing Corporation, New Delhi.
6. Sadasivam, S and Manikam, A., 1992. Biochemical methods for agricultural sciences. Wiley Eastern Ltd., New Delhi.

E-Resources

1. <https://www.google.com/search?q=isolation+of+rhizobium+from+root+Nodule>
2. <https://www.google.com/search?channel=nrow5&client=firefox-bd&q=biofertilizers+isolation+methods>

Shankar



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Course learning outcome (CLO)

On completion of the course, students should be able to

- 1: Demonstrate the importance of microbes in agriculture
- 2: Explain the methods of isolation, identification of nitrogen fixing bacteria.
- 3: Use standard methods for the mass production of Biofertilizers
- 4: Create expertise in examination of Mycorrhizae
- 5: Discuss and demonstrate the methods to identify plant pathogens

Shailendra



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: V Semester (Practical)

Virology lab

Code: BSM552

L	T	P	C
0	0	4	2

Course Objectives (CO)

1. To explain the various methods of isolation and quantification of microorganism
2. To describe the various methods to detect bacteria and differentiate between bacteria.
3. To understand the requirements for establishing a virology laboratory.

Practical

1. Enumeration of plaque forming units (PFU) of viruses.
2. Demonstration of morphological structures of viruses (DNA and RNA) and their important characters using electron micrographs.
3. Study of the methods of isolation and propagation of plant viruses.
4. Study of cytopathic effects of viruses using photographs.

Suggested Readings

1. Cell And Molecular Biology : A Lab Manual Kindle Edition by K. V. Chaitanya
2. Molecular Biology -Practical- (ksu.edu.sa)
3. Virology: A Laboratory Manual, Book by Danny L. Wiedbrauk, Florence G. Burleson, and Thomas M. Chambers.
4. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
5. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
6. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
7. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
8. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.
9. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
10. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
11. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

Course learning outcome (CLO)

At the end of the course, the student will be able to:

1. To explain the various methods of isolation and quantification of viruses and their applications.
2. To describe the various methods to detect virus growth.
3. To understand the requirements for establishing a virology laboratory.

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

B Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

III Year: VI Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM601	Medical Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM602	Microbial Metabolism	4	0	0	25	75		100	4	Major
3		Departmental Elective-2 (DE-2)	4	0	0	25	75	100	4	Minor	Own faculty
4	BSM603	Bioethics and Biosafety and IPR	2	0	0	25	75	100	2	Multidisciplinary	Any faculty
5	BSM621SE	Bioinformatics and Drug Designing	3	0	0	25	75	100	3	SES	Any faculty
6	BSM631	Artificial Intelligence in Biological Sciences	2	0	0	25	75	100	2	Value added	Any faculty
Practical											
6	BSM651	Medical Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
	BSM652	Microbial Metabolism Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSM	Seminar	0	0	4	25	75	100	2	AEC	Any faculty
Total			19	0	8	225	675	900	23		

B. Sc. in Microbiology

Hons	Honors
L	Lecture
P	Practical
AEC	Ability Enhancement Courses
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental Elective-2	
Sub Code	Subject Name
BSM611	Plant Pathology
BSM612	Genomics and Proteomics
	MOOCs from SWAYAM/NPTEL

Note:

1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.
2. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 120 credits.
3. A minimum of 75% marks is required for Hons. with research.
4. Students have to study 12 credit course works for B.Sc. Hons.
5. Students have to do 12 credit dissertation works from reputed laboratory for B.Sc. Hons. with research.

Date: _____

Volume No.: _____

Shankar



Mahayogi Gorakhnath University, Gorakhpur

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Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)

Medical Microbiology

Code: BSM601

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn studying microorganisms, their interactions with humans, and their role in diseases
2. To learn complex biological processes and chemical interactions, so a solid understanding of these subjects is beneficial.

Unit I History of Medical Microbiology

Contribution of pioneers in the field of Medical Microbiology, Normal Microflora of human body: skin, mouth, alimentary canal and genitourinary tract.

Unit II Bacterial and Viral disease

Bacterial diseases Diseases caused by certain bacterial pathogens *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Mycobacterium tuberculosis*, *Salmonella typhi*, *Vibrio cholera*

Viral diseases Diseases caused by certain viruses Human Immunodeficiency Virus, Hepatitis Virus, Influenza virus, Herpes virus.

Unit III Parasitic diseases

Diseases caused by protozoa *Giardia* sp., *Plasmodium* sp., *Leshmania* sp., and *Entamoeba* sp.

Unit IV Pathogenic fungal disease

Dermatophytes- *Trichophyton*, *Microsporum*, Filamentous fungi causing subcutaneous infection by *Mucor*, *Rhizopus* and *Aspergillus*, Systemic mycoses caused by *Blastomyces*, *Histoplasma* and Yeast like fungi: *Candida* and *Cryptococci*

Unit V Antibiotics and Chemotherapeutics

Historical development of chemotherapeutic and antibiotic substances, Major antimicrobial agents, Mode of action of chemotherapeutic and antibiotic, Antibiotic resistance, Sample collection and processing Drug resistance, Mechanism of antibiotic resistance, Antibiotic susceptibility assay. Collection and transport of appropriate clinical sample specimen for clinical diagnostics

Suggested Readings

1. Annadurai, A. A textbook of Immunology and Immunotechnology. S. Chnd
2. Ananthanarayanan R and Panicker C K. Textbook of Microbiology. Orient Longman.
3. Baveja, CP. Text book of Microbiology. Arya publications.
4. Ken S.Rosenthal, Patrick R.Murray, and Michael A.Pfaller. Medical Microbiology 7th Edition, Elsevier
5. Karen C.Carroll, Geo.Brooks, Stephen Morse, and Janet Butel.Jawetz, Melnick, &Adelberg's Medical Microbiology, Lang
6. Suggestive digital platforms web links:
<https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-ofantimicrobials>

Shailendra



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

<https://vlab.amrita.edu/?sub=3&rch=73>

<https://www.mooc-list.co/tags/pathology>

<https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms>

Course learning outcome (CLO)

On completion of the course, students should be able to:

1. Studying microorganisms, their interactions with humans, and their role in diseases
2. Delve into complex biological processes and chemical interactions, so a solid understanding of these subjects is beneficial

Shanleudha



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)

Microbial Metabolism

Code: BSM602

L	T	P	C
4	0	0	4

Course objective (CO)

1. To understand how information on genomics, metabolism and physiology
2. To understand the role of metabolism and their metabolite
3. To learn the use of these metabolite in industries
4. Learn the role of metabolism and its effect of physiology

Unit I Carbohydrate Metabolism

Introduction, Aerobic respiration, Glycolysis and its regulation, TCA cycle, Electron Transport chain, Oxidative phosphorylation, & production of ATP, balance sheet of glucose oxidation. Anaerobic respiration, Fermentations. Gluconeogenesis and its regulation., amphibolic & anaplerotic reactions., Oxidative stress, Pentose phosphate pathway (HMP shunt), Entner Doudroff Pathway, glyoxylate pathway, substrate level phosphorylation.

Unit II Brief account of photosynthesis –

Oxygenic and anoxygenic photosynthesis; CO₂ fixation- Calvin cycle - C₃-C₄ pathway. Chemolithotrophy - sulphur - iron - hydrogen - nitrogen oxidations; methanogenesis; luminescence.

Unit III Lipid Metabolism

Lipid Metabolism: Beta – oxidations of saturated fatty acids. Ketone bodies, Biosynthesis of fatty acids – Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis. Biosynthesis of cholesterol, regulation.

Unit IV Protein and Amino acid Metabolism

Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids, Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, Biologically active amines Recycling of Purine and Pyrimidine nucleotides by salvage pathways.

Unit V Synthesis of Biomolecules

Biosynthesis of biopolymers; Assimilation of nitrogen, sulphur, phosphorus etc.; Biosynthesis of sugars and polysaccharides, amino acids, purines, pyrimidines and nucleotides and their regulation.

Suggested readings

1. Doelle H.W. 1969. Bacterial Metabolism. Academic Press.
2. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag. Moat AG. 1979. Microbial Physiology. John Wiley & Sons.
3. Sokatch JR. 1969. Bacterial Physiology and Metabolism. Academic Press.
4. Moat A G., Foster J W., Spector M P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009.

Course learning outcome (CLO)

1. Understand how information on genomics, metabolism and physiology

Shanleudha



Mahayogi Gorakhnath University, Gorakhpur
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Department of Microbiology, Session 2025-26

2. Understand the role of metabolism and their metabolite
3. The use of these metabolite in industries
4. The role of metabolism and its effect of physiology

Sharada



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)

Plant pathology

Code: BSM611

L	T	P	C
4	0	0	4

Course objective (CO)

1. To provide basic knowledge about the pathogens their ecology and host pathogen interactions.
2. To provide basic knowledge about the microorganism their taxonomy, growth, reproduction and role in nature.
3. To generate overall knowledge about the cereals diseases and their management.
4. To generate overall knowledge about the diseases of horticultural crops and their management

Unit I Introduction and History of plant pathology:

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H. H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists (K.C.Mehta, Mundkur, Dastur and Sadasivan).

Unit II Stages in development of a disease

Infection, invasion, colonization, dissemination of pathogens and perennation, Plant disease epidemiology Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit III Host Pathogen Interaction

Microbial Pathogenicity, Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction). Genetics of Plant Diseases Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance. Defense Mechanisms in Plants Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts.

Unit IV Control of Plant Diseases

Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material. cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches. chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.

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Biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants. genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes.

Unit V Specific Plant diseases

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control A. Important diseases caused by fungi: White rust of crucifers - *Albugo candida*. Late blight of potato - *Phytophthora infestans*. Ergot of rye - *Claviceps purpurea*. Black stem rust of wheat - *Puccinia graminis tritici*. Red rot of sugarcane, *Colletotrichum falcatum*. B. Important diseases caused by phytopathogenic bacteria: Angular leaf spot of cotton and crown gall.

Course learning outcome (CLO)

At the end of the course, the student should be able to

1. Provide basic knowledge about the pathogens their ecology and host pathogen interactions.
2. Provide basic knowledge about the microorganism their taxonomy, growth, reproduction and role in nature.
3. Generate overall knowledge about the cereals diseases and their management.
4. Generate overall knowledge about the diseases of horticultural crops and their management

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)

Genomics and Proteomics

Code: BSM722

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn and understand the history, relevance of microbiology and classification of microbes.
2. To learn and understand the microbial diversity in the living world.
3. To learn and understand the working of various microscopes and their applications.
4. To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes

Unit I Basics of genomics and proteomics

Brief Recapitulation of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast, Genome mapping Genetic and physical maps; markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, in situ hybridization, comparative gene mapping

Unit II Genome Sequencing Projects and Genomic Techniques and Tools

Genome sequencing projects for microbes, accessing and retrieving genome project information from the web, Vectors for large scale genome projects, Clone by-clone strategy, shotgun sequencing and Sequencing Standards

Unit III Comparative genomics

Identification and classification of organisms using molecular markers- 16S rRNA typing/ sequencing, SNPs, track emerging diseases and design new anti microbial drugs; determining gene location in genome sequence, The minimal genome and the Barcode of Life.

Unit IV Functional Genomics

Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in genome, gene function- forward and reverse genetics, gene ethics; protein-protein and protein-DNA interactions; protein chips and functional proteomics; clinical and biomedical applications of proteomics; introduction to metabolomics, lipidomics, metagenomics and systems biology

Unit V Proteomics

Aims, strategies and challenges in proteomics; Protein separations, protein analyses, Quantitative proteomics, Identification and analysis of proteins by 2D gel electrophoresis, Isoelectric focusing, Spot visualization and picking, Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry, mass spectrum (base peak, molecular ion, fragment ion, metastable ion), Ion source (MALDI, electrospray, chemical ionization), mass analyzer (quadrupole, TOF, Ion trap) ; Detector (multiplier), Clinical proteomics, Protein-protein interaction: solid ELISA, pull-down assay, coimmunoprecipitation, yeast-two hybrid system, application, proteome databases

Suggested reading

1. Robert Weaver, Molecular Biology, 5th Edition, McGraw-Hill, 2012.

Shanleenda



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2. Genomes, by T.A. Brown, Garland Science, 3rd Edition, 2006
3. Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, William M. Gelbart, David T. Suzuki, Jeffrey H. Miller, An Introduction to Genetic Analysis, Eleventh Edition,
4. Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006) Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub
5. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology. Totowa, NJ: Humana Press.
- 6 . Campbell, A. M., & Heyer, L. J. (2003). Discovering Genomics, Proteomics, and Bioinformatics. San Francisco: Benjamin Cumming

Course learning Outcomes (CLO):

The student at the completion of the course will be able to:

1. To understand the history, relevance of microbiology and classification of microbes.
2. To learn and understand the microbial diversity in the living world.
- 3 To understand the working of various microscopes and their applications.
4. Gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.

Sharada



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)
IPR, Bioethics and Biosafety
Code: BSM661

L	T	P	C
2	0	0	2

Course Objectives:

The objectives of the course are as follows

1. To understand importance of IPR, bioethics and biosafety.
2. To understand regulatory guidelines and their importance.
3. To understand importance of patent and procedure for patent filling.
4. To understand procedure of assessment of biosafety for biotech foods.
5. To understand ethical implications in biological sciences.

Unit I Intellectual Property Rights (IPR)

Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; introduction to history of GATT, WTO, WIPO and TRIPS.

Unit-II Introduction to Bioethics and Biosafety

Bioethics-Necessity of bioethics, different paradigms of bioethics- National and international ethical issues against the molecular technologies. Institutional, social, Cultural, Business and Consumer issues

Unit III Biosafety regulation guidelines

Biosafety-Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and good laboratory practices (GLP) and good manufacturing practices (GMP). Implications of biotechnological products and techniques: Bioterrorism, transgenic science, GM crops, GMO/LMO and their release in environment.

Unit IV Bioethics towards Biodiversity protection and conservation

Convention on biodiversity, Indian Biodiversity act, Legal implications, Biodiversity and farmers' rights. Human genome project and stem cells research: Introduction, Ethical, legal and social implications of HGP. Stem Cell Research- biosafety and its ethical issues

Unit V Food and pharma safety

The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops, Environmental aspects of biotech applications. FlavrSavr Tomato as model case, Biosafety assessment of biotech pharmaceutical products.

Suggested reading

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers
3. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
4. Intellectual property rights – Ganguli – Tat McGraw-Hill
5. Biotechnology-B. D. Singh- Kalyani Publications

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Course Learning Outcome (CLO)

Upon successful completion of this course the student should be able to:

1. Understand the scope and aspects of Bioethics and biosafety
2. Learn the ethical implications of IPR, biosafety, GLP and GMP, concerns related to GMO's and their regulation.
3. Analyze the safer use of Biotechnology in agriculture, animal husbandry, pharmaceuticals, and environment by implanting biosafety regulations.
4. Comprehend the ability to understand biosafety assessment procedure for biotech food, pharmaceuticals and other products.

Sharada



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)
Bioinformatics and Drug Designing
Code: BSM601SE

L	T	P	C
3	0	0	3

Course Objectives

1. To study the basics of bioinformatics and drug designing.
2. To understand the software used for sequence analysis of biomolecules.
3. To study the protein sequence database like BLAST and FASTA
4. To study about drug designing process.

Unit-I Introduction and bioinformatics resources

Bioinformatics tools and resources, the major content of the databases, Literature databases: Nucleic acid sequence databases: Gen Bank, EMBL, DDBJ Genome Databases at NCBI, EBI, TIGR, SANGER Other Databases of Patterns/ Motifs/ System Biology (Gene and protein network database and resources) Various file formats for bio molecular sequences: genbank, fasta, gcg, msf, nbrfpir etc.

Unit II - Sequence analysis

Basic concepts of sequence similarity, identity and homology. Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series. Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments BLAST and FASTA algorithms. Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.

Unit- III Protein sequence databases

SWISS PROT, TrEMBL, PIR, PDB Protein-Protein Interactions- PDB & MMDB, Homology Modeling, In-silicogeneration of novel ligand molecules, Molecular docking, Running docking algorithm Structure Analysis/ H- Bond, Evaluation of results on basis of binding energy

Unit- IV Phylogeny

Definitions of homologues, orthologues, paralogues Phylogenetic analysis- Definition and description of phylogenetic trees and various types of trees. Method of construction of Phylogenetic trees distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method Structural bioinformatics Chemo informatics, Immuno informatics etc.

Unit-V Drug Designing

Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation, Structure-based drug design: Identification and Analysis of Binding sites and virtual screening, Ligand based drug design: Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology,, Pharmacophore mapping, In silico prediction ADMET properties for Drug Molecules

Suggested Readings

1. Aurther M lesk (2008) Introduction to Bioinformatics 3rd edition OUP Oxford
2. Philip E. Bourne, Helge Weissig (2003). Structural Bioinformatics (Methods of Biochemical Analysis, Wiley-Blackwell
3. Essential Bioinformatics by Jin Xiong. Texas A&M University Cambridge

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4. Data mining in Bioinformatics, Jason Wang, M.J. Jaki. Hannu T.T.T., Denis. S. Springer International Edition.

Course learning outcomes (CLO)

At the end of the course, the student should be able to-

1. Explain the basics of Bioinformatics and drug designing.
2. Discuss the software used for sequence analysis of biomolecules.
3. Describe the protein sequence database like BLAST and FASTA
4. Explain about drug designing process

Sharada



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: VI Semester (Theory)

Artificial Intelligence in Biological Sciences

Code: BSM631

L	T	P	C
2	0	0	2

Course Objective:

1. To learn various concepts of AI Techniques.
2. To learn various applications in Pharmaceutical
3. To apply in drug designing and Precision Medicine
4. To learn about AI in medical imaging, agriculture and synthetic biology

UNIT 1: Introduction to AI

Concept of AI, history, current status, scope, agents, environments Biological Intelligence Vs Artificial Intelligence, AI Basics: concepts, terminologies and workflow, ML, DL.

UNIT 2: Applications of AI in Pharma:

Applications of AI in the Pharmaceutical Industry, AI-driven applications for drug design, lead optimization, and clinical trials, Artificial Intelligence for Biomarker Discovery

UNIT 3: AI in Health and Medicine:

AI in Precision Medicine, AI in shaping the future of Bioinformatics, AI in health diagnostics / Confluence of AI and Smart Devices for Monitoring Health and Disease, AI in medical imaging

UNIT 4 : AI in Biotechnology and Life Science

Artificial Intelligence and Synthetic Biology, Transforming Agriculture with AI, AI in biology and bioinformatics

UNIT 5 : Future and Ethical Concerns of AI

Future Prospects of AI in healthcare and research, Technological advancements and their potential impact on AI in biotech, new trends and opportunities for AI-powered biotech in the future. Risks involved and ethical concerns, Need of regulatory frameworks for AI in biotech

Course Learning Outcomes (CLO)

1. Understand the various concepts of Artificial Intelligence in Biotech & health tech companies globally
2. Understand how New Companies are being built by combining Biotech & Artificial Intelligence
3. Experience how Artificial Intelligence is revolutionizing health care

SUGGESTED READING

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
3. Carl Townsend, "Introduction to Prolog Programming"
4. Ivan Bratko, "PROLOG Programming for Artificial Intelligence", Addison-Wesley, 2nd Edition.

Shankar



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5. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.
6. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010
7. SarojKaushik, "Artificial Intelligence", Cengage Learning India, 2011

Sharada



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

III Year: VI Semester (Practical)

Medical Microbiology Lab

Code: BSM651

L	T	P	C
0	0	4	2

Course objective (CO)

1. To learn the handling of animal and human affected with microorganism
2. To learn the identification and primary treatment of affected

Practicals

1. Isolation of pathogenic bacteria using blood agar medium
2. Isolation and characterization of skin normal microflora
3. Isolation of bacteria from teeth crevices
4. Catalase test for identification of bacteria
5. Oxidase test for identification of bacteria
6. Urease test for identification of bacteria
7. Coagulase test for identification of bacteria
8. Bile solubility test for identification of bacteria
9. Antibiotic sensitivity test against bacteria
10. Minimum Inhibitory Concentration (MIC) determination

Suggested Readings:

1. Hudson L, and Hay FC, Practical Immunology, 3rd edition, Wiley.
2. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology, 3rd edition, ASM. Ed.3; 1986.
3. Talwar GP and Gupta SK, A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi
4. Aneja KR, Experiments in Microbiology, Plant Pathology and Biotechnology, 1st edition, New Age International Publisher
5. Randhawa VS, Practicals and Viva in Medical Microbiology, Harcourt India Pvt. Ltd.

Course Learning Outcome (CLO)

Upon successful completion of this course the student should be able to

1. Understand the handling of animal and human affected with microorganism
2. Learn the identification of Minimum inhibitory dose of antibiotics for pathogenic bacteria.

Shalendra



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Department of Microbiology, Session 2025-26

III Year: VI Semester (Practical)
Microbial Metabolism Lab
Code: BSM652

L	T	P	C
0	0	2	1

Course objective

1. To learn practice general laboratory safety
2. To learn practice safe handling of microorganisms, including aseptic technique
3. To learn Recognition of various cellular and colony morphologies of prokaryotes
3. To learn correctly use and maintain a compound microscope

Practical

1. Carbohydrate catabolism by Bacteria (oxidation and fermentation of glucose).
2. Amylase Production test.
3. Cellulase production test.
4. Production of pectolytic enzymes.
5. Hydrolysis of gelatin by bacteria.
6. Casein hydrolysis by bacteria.
7. Microbial reactions in litmus milk.

Suggested readings

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
5. Stanier RY, Ingraham JJ, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Course learning outcome (CLO)

On completion of the course, students should be able to:

1. Use differential and selective growth media to obtain pure cultures, correctly perform and interpret Gram Stains and other staining techniques
2. Interpret and analyze results from various assays used to identify bacteria and apply these methods to other situations
3. Enrich, isolate and characterize prokaryotes based on the various metabolic strategies by which they adapt to their environment
4. Communicate fundamental concepts of microbiology, both in written and in oral format

Shankar



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Department of Microbiology, Session 2025-26

B Sc. (Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)

Effective from the session 2025-26

IV Year: VII Semester											
S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	BSM701	Food Microbiology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM702	Industrial Microbiology	4	0	0	25	75	100	4	Major	Own faculty
3	BSM703	Microbial Signaling mechanism	4	0	0	25	75	100	4	Major	Own faculty
4		Departmental Elective-3	4	0	0	25	75	100	4	Minor	Any faculty
5		Minor Elective-3	4	0	0	25	75	100	4	Minor	Any Faculty
Practical											
6	BSB751	Food and Industrial Microbiology Lab	0	0	2	25	75	100	1	Major	Own faculty
7	BSB752	Microbial signaling Mechanism Lab	0	0	2	25	75	100	1	Major	Own faculty
Total			20	0	4	175	525	700	22		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Departmental Elective-3		Minor Elective-3	
Sub Code	Subject Name	Sub Code	Subject Name
BSM711	Dairy Microbiology	BSM721	Biostatistics
BSM712	Soil Microbiology	BSM722	Microbial Biotechnology
	**MOOCs from SWAYAM/NPTEL		
Biostatistics		https://nptel.ac.in/courses/102101056 NOC:Introduction to Biostatistics, IIT Bombay, Prof. ShamikSen	

Note: Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

Date:_____
Volume No.:_____

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VII Semester (Theory)

Food Microbiology

Code: BSM701

L	T	P	C
4	0	0	4

Course Outcome:

The Course aims to

1. Introduce the scope and development of food microbiology
2. Highlight fermentation technologies in the food processing industry.
3. Create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.
4. Give an overview on food spoilage organisms- Food borne diseases- to understand infection process and food borne outbreaks.
5. Impart knowledge on quality and safety assurance in the food industry

Unit I Microbial Growth in Foods

History and importance of food microbiology. Factors affecting the microbial growth of a food- Intrinsic & Extrinsic factors - pH, moisture, water activity, oxidation-reduction potential, nutrient composition.

Unit II Food Spoilage and Food-borne diseases

Microbial contamination of foods, Food spoilage, factors affecting food spoilage, Microbial spoilage of foods- Milk and dairy products, Meat and poultry, fish and sea foods, vegetables and canned food. Food infections and Food intoxications. Food hygiene and Sanitation. Food poisoning- Bacterial toxins, Mycotoxins and Algal toxins.

Unit III Microbial fermentations

Alcoholic Beverages (Beer, Wine and Whiskey). Fermented foods – Pickles, Sauerkraut, Soy products and Bread. Fermented milk and dairy products – Cheese, Yoghurt, fermented milk, curd and Kefir.

Unit IV Food preservation

Principles of food preservation. Physical methods of food preservation – drying, heat processing, chilling and freezing, radiation, Pasteurization. Chemical methods of food preservation.

Unit V Quality and safety assurance

Quality control and quality assurance measures. Food standards. GMP, HACCP, FDA.BIS Laboratory services.

Book suggesting

1. Carl, A.B and Tortorello, M.L. 2014. Microbiology, 2nd Ed. Academic Press, London.
2. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi.
3. Tucker, G.S. 2008. Food Biodeterioration and Preservation. Blackwell Publishers, UK.
4. Jay, J.M. 2000. Modern Food Microbiology 6th Ed. Aspen Publication, USA.
5. Joshi V. K and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. (VOL II).

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6. Carl, A.B and Tortorello, M.L. 2014. Microbiology, 2nd Ed. Academic Press, London.
7. Frazier, W.C and D.C Westhoff. 1978. Food Microbiology. 3rd ed. Tata Macgraw Hill publishing Co., New Delhi.
8. Sivasankar, B. 2010. Food processing and preservation, PHL Learning Pvt. Ltd., New Delhi.
9. Tucker, G.S. 2008. Food Biodeterioration and Preservation. Blackwell Publishers, UK.
10. Jay, J.M. 2000. Modern Food Microbiology 6th Ed. Aspen Publication, USA

Web resources:

1. <http://www.microbes.info>
2. <http://www.fsis.usda.gov/>
3. <http://www.cdc.gov>.
4. [http://www.microbes.info/resource/food microbiology](http://www.microbes.info/resource/food%20microbiology)
5. [http://www.binewsonline.com/1/what is food microbiology.html](http://www.binewsonline.com/1/what%20is%20food%20microbiology.html)

Course learning outcome (CLO)

On completion of the course, students should be able to

- 1: Explain the role of microorganisms in food and factors influencing their growth.
- 2: Discuss and demonstrate an overview on food spoilage organisms- Food borne diseases.
- 3: Assess the techniques/processes used in microbial products using fermentation technology.
- 4: Apply the different aspects of food preservation
- 5: Evaluate the quality assurance of foods especially by HACCP, FDA

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Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Microbiology, Session 2025-26

IV Year: VII Semester (Theory)

Industrial Microbiology

Code: BSM702

L	T	P	C
4	0	0	4

Course Outcome:

The Course aims to:

1. Understand industries involving microbial technology
2. Make knowledge on production of various industrial microbial products.
3. Know the various techniques used in industries.
4. Impart the functioning of bioreactors
5. Create a comprehensive knowledge on upstream and downstream processing

Unit I Introduction to Fermentation Industry

History and scope of industrial microbiology. Fermentor design and types, Components of fermentor- Agitator, Aerator, Pressure Gauge, pH, DO probe. Instrumentation and Control systems in fermentor. Fermentation- upstream and downstream process.

Unit II Media Formulations and Industrially Important Microorganisms

Media for microbial fermentations, Raw materials used in media production, Large scale cultivation of Industrially important microbes. Media formulation strategies - carbon, nitrogen, vitamin and mineral sources. Industrially important microbes, Assay techniques of fermented products, Screening methods, Strain selection and improvement - mutation and recombinant DNA technology.

Unit III Industrial Production

Industrial products derived from microbes- production of enzyme, organic acids, alcohol, antibiotics, steroid transformations, primary and secondary metabolites, Single cell protein (SCP), vaccines.

Unit IV Yeast Technology

Introduction to Yeasts, classification, genetics, strain improvement for brewing, baking, distilleries.

Unit V Rules and Regulation

Novel approaches to Industrial effluent treatment, waste water treatment and disposal. Biodegradation and Bioremediation, Institutional Bio-safety committee.

Suggested Reading

1. Srivastva, M.L. 2008. Fermentation Technology, Narosa Publ. House, New Delhi.
2. Michael J. Waites, Neil L.Morgan, John S. Rockey and Gray Higton. 2001. Industrial Microbiology An Introduction, Replika Press Pvt Ltd. New Delhi.
3. Wulf Crueger and Anneliese Crueger. 2000. A textbook of Industrial
4. Microbiology II Ed. Panima Publishing Corporation, New Delhi
5. Prescott and Dunn's. 1997. Industrial Microbiology. CBS publishers and Distributors.
6. Patel A.H. 1996. Industrial Microbiology, Macmillan India Limited
7. Stanbury, P.F., Whittaker, A. and Hali, S.J. 1995. Principles of Fermentation Technology, II Ed., Pergamon Press.

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8. V. K. Joshi and Ashok Pandey. 1999. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology.

9. Casida, L.E. 1986. Industrial Microbiology, Eastern Limited, New York

E-Resources:

1. www.rmit.edu.au/courses/034150

2. microbiologyonline.org

3. <https://www.omicsonlineorg/.../industrial-microbiology-journals-articlesppt-list.php>

4. www.nature.com/nrmicro/series/applied and industrial

The Course learning outcome (CLO)

1. At the end of the course students will be able to
2. Understand industries involving microbial technology
3. Make knowledge on production of various industrial microbial products.
4. Know the various techniques used in industries.
5. Impart the functioning of bioreactors
6. Create a comprehensive knowledge on upstream and downstream processing

Sharada



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VII Semester (Theory)

Microbial Signaling Mechanism

Code: BSM703

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn classify organisms, understand the basic differences between prokaryotic and eukaryotic cells, structural and functional integrity of a cell.
2. To learn evaluate the transport across plasma membrane transport across the organelles.
3. To learn analyze the cellular interactions and importance of cytoskeleton.
4. To learn evaluate the molecular mechanism behind cell cycle, causes of deregulation of cell cycle and effects
5. To understand the molecular mechanism of cell signaling, different types receptors, different signal transduction pathways with examples, difference between apoptosis and necrosis

Unit I Microbial relation to host

Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non-symbiotic interactions. Microbe-animal interaction: termite gut microflora, nematophagus fungi and symbiotic luminescent bacteria, microbial Pathogenicity

Unit II Microbes to host -interaction

Cell adhesion molecules: cadherins, Immunoglobulin like molecules, integrins and selectins. Cell junctions: tight junction, desmosome, hemidesmosome and gap junctions. Microtubules, microfilaments and their dynamics. Centrosome, cilia, flagella. Mitotic apparatus and movement of chromosomes

Unit III Introduction to cell signaling

Components of signaling- Upstream components, receptor and ligand concept, types of ligands and its relevance, receptor kinases, Downstream components, G-proteins, Secondary messengers- cyclic AMP, adenylate cyclase cascade, cyclic GMP, calcium calmodulin kinases, effector molecules (Transcription factors) and gene expression.

Unit IV Cell signaling mechanism

Signaling mechanism in various phase Cytosolic, Nuclear & membrane bound receptors. Light signal transduction- perception of light pigments involved in activation of phytochrome/cryptochrome. abiotic stress signaling- sensing of environmental factors, activation of specific molecules and secondary messengers, activation of downstream components, leading to stress gene expression.

Unit V Physiological Adaptations and Intercellular signaling in microorganism

Introduction to two component system, regulatory systems during aerobic- anaerobic shifts: Arc, Fnr, Nar, FhlA regulon, response to phosphate supply: The Pho regulon Quorum sensing: A and C signaling system, sporulation in Bacillus subtilis, control of competence in Bacillus subtilis. Heat-Shock responses, osmotic homeostasis, Bioluminescence.

Suggested reading

1. Molecular Biology of cell, Alberts. B et al.

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2. Molecular Cell Biology, Lodish et al.
3. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
4. Cell in Development and inheritance, EB Wilson, MacMilan, New York.
5. Developmental Biology- Scott F Gilbert.
6. Essential Developmental Biology - Jonathan Slack
7. Developmental Biology,-Werner A Muller
8. Reproduction in Eukaryotic cells, DM Prescott, Academic press.
9. Principles of Development - Lewis Wolpert
10. Fertilization, FT Longo, Chapman and Hall
11. The Coiled Spring, Ethan Bier, Cold Spring Harbor Press

Course learning outcomes (CLO)

At the end of the course student will be able to

1. Classify organisms understand the basic differences between prokaryotic and eukaryotic cells, structural and functional integrity of a cell.
2. Evaluate the transport across plasma membrane transport across the organelles.
3. Analyze the cellular interactions and importance of cytoskeleton.
4. Evaluate the molecular mechanism behind cell cycle, causes of deregulation of cell cycle and effects
5. Understand the molecular mechanism of cell signaling, different types receptors, different signal transduction pathways with examples, difference between apoptosis and necrosis.

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Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VII Semester (Practical)

Food and Industrial Microbiology Lab

Code: BSB751

L	T	P	C
0	0	2	1

Course Objectives

1. Program aims to develop students' understanding of microbiology with hand on experience in the isolation of the bacteria from different sources.
2. gives the understanding about the production of enzymes by the microorganisms and its activity.
3. Understanding of application of microorganisms in industries.

Practicals

1. Microbiological analysis of food.
2. Isolation of pathogenic bacteria from food.
3. Isolation and characterization of microorganisms from soil, water and air samples.
4. Isolation of Rhizobia from root nodule using Yeast Extract Agar Medium (YEMA)
5. Growth curve study.
6. Preparation of wine by fermentation.
7. Preparation of Sauerkraut.
8. To determine the presence of amylase activity
9. Biosurfactant isolation and its characterization.
10. Enzymatic assay of industrially important enzyme- lignolytic enzymes.

Suggested Reading

1. Experiments in Microbiology, Plant pathology and Biotechnology, KR Aneja, New Age International Publishers.

Course Learning Outcome

At the end of the course the student will be able to:

1. Properly use aseptic techniques, including sterilization.
2. Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria.
3. Learning methods for production of enzymes.
4. Production of industrially important products.

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Faculty of Health and Life Sciences

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IV Year: VII Semester (Practical)

Microbial Signaling Mechanism Lab

Code: BSB752

L	T	P	C
0	0	2	1

Course Objective

1. To give hand on experience on isolation and characterization of microbes from different sources, and their identification by biochemical tests.
2. To impart hand-on experience and laboratory skills in Microbiology.
3. To identify biofilm formation by bacteria, role of bacteria in pathogenicity and to learn antibiotic susceptibility test.

Practical

1. Identification of pathogenic bacteria by culture and biochemical methods.
2. Production of Indole acetic acid, and siderophore by bacteria.
3. Production of Hydrogen cyanide by Fluorescent pseudomonds.
3. Antibiotic susceptibility testing.
4. Determine the minimum inhibitory concentrations (MICs) of antimicrobial agents.
5. Measuring biofilm formation by bacteria.
6. Identification of starch-degrading bacteria
7. Identification of pectin-degrading bacteria
8. Carbohydrate Fermentation test.

Book suggesting

- 1.Experiments in Microbiology, Plant pathology and Biotechnology, KR Aneja, New Age International Publishers.

Course Learning Outcomes

1. Know General bacteriology and microbial techniques for isolation of pure cultures of microbes from different sources
2. Know role of microorganisms in pathogenicity and antibiotic sensitivity.
3. to identify bacteria based on different biochemical tests.

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Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VII Semester (Theory)

Dairy Microbiology

Code: BSM711

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn microbiological analytical systems in dairy microbiology and related sciences
2. To learn with the starter organisms, their metabolism and genetics; different types of starters, propagation, preservation and applications of starters.
3. To understand microbiology of processed foods, significance of different food microorganisms, their control and other related aspects.
4. To learn the fermentation techniques used in dairy industry, role of microorganisms in fermentation and to gain skills to control fermentation process.
5. To impart current knowledge pertaining to Quality Assurance, Food Safety Standards, enumeration and legal product standards.

Unit I Factors

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit II Principle

Spoilage of milk and butter, bread, canned foods, Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kaumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics:

Unit III Health and Microorganism

Health benefits, types of microorganisms used, probiotic foods available in market
Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology

Unit IV Technique in dairy Microbiology

MBRT of milk samples and their standard plate count. Alkaline phosphatase test to check the efficiency of pasteurization of milk.

Suggested readings

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon
4. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.

Course learning outcome (CLO)

1. Learn microbiological analytical systems in dairy microbiology and related sciences
2. Learn with the starter organisms, their metabolism and genetics; different types of starters, propagation, preservation and applications of starters.

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3. Understand microbiology of processed foods, significance of different food microorganisms, their control and other related aspects.
4. Learn the fermentation techniques used in dairy industry, role of microorganisms in fermentation and to gain skills to control fermentation process.
5. Impart current knowledge pertaining to Quality Assurance, Food Safety Standards, enumeration and legal product standards.

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IV Year: VII Semester (Theory)

Soil Microbiology

Code: BSM712

L	T	P	C
4	0	0	4

Course objective (CO)

1. To help students keep abreast of the most recent advances in soil microbiology.
2. To provide students with knowledge concerning soil microorganisms both harmful and beneficial 2 and how to control and enhance each respectively.
3. To provide students with useful information regarding the taxonomical, physiological, and environmental aspects of soil microorganisms.
4. To learn the roles of soil microbes, such as decomposing dead organic matter, enriching the soil with nutrients, increasing water infiltration, improving soil texture, etc.
5. To acquire knowledge on such topics as: organisms and interactions, mycorrhizal symbioses, biological dinitrogen fixation (both symbiotic and non-symbiotic)

Unit I Soil microbiology

Development of Soil Microbiology, Significant developments in soil microbiology, types of microorganisms in soil (Bacteria, fungi, myxomycetes, algae, protozoa, bacteriophages, fungal viruses), Methods used in soil microbiological studies, Molecular methods in soil microbiology.

Unit II The Rhizosphere and the Phyllosphere

Rhizosphere, Rhizosphere effect, Nitrogen fixation in rhizosphere, Alteration of rhizosphere microflora, Associative and Antagonistic activities in the rhizosphere, Root exudates, Fungistasis. Plant growth promoting rhizobacteria (PGPR), Siderophores, Genetic manipulation and commercialization of PGPRs. Phyllosphere, Biochemical reactions in phyllosphere.

Unit III Nitrogen fixing microorganisms and Mycorrhiza

Nitrogen fixing bacteria- Free living, Symbiotic, Blue green algae, *Rhizobium*, Actinorhiza, Nitrogenase, Mechanism of nitrogen fixation, Ammonia assimilation. Mycorrhizae- Fungal symbioses with roots, Ectomycorrhizae, Endomycorrhizae, Arbuscular Mycorrhiza, Vesicular-Arbuscular Mycorrhiza (VAM)

Unit IV Organic Matter Decomposition

Degradation of plant residues, Humus, Mineralization and immobilization processes, Effects of residues of crop on plant growth, soil sickness, vermicomposting, green manure, Anaerobic decomposition of Organic matter, Biogas, Degradation of hydrocarbons.

Unit V Biodegradation of Pesticides and Pollutants

Pesticides, Insecticides- DDT, BHC, Malathion, Parathion, Diazinon. Herbicides- 2,4-D, TCA and Dalapon, Chloropham, etc. Fungicides- PCP, PCNB, Streptomycin, Cycloheximide, Blasticidin-S, Terramycin. Fate of pesticides in soil (Biodegradation), Bioavailability of pesticides/ pollutants, Bioremediation, Herbicides and Plant diseases.

Suggested readings

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1. Kotwzan B., Adamiak W., Grabas K. and Pawełczyk A. (2006) Introduction to Environmental Microbiology, Oficyna Wydawnicza Politechniki Wrocławskiej
2. Maier R. M., Pepper I. L. and Gerba C. P., (2010) Environmental Microbiology 2nd edn, California, Academic Press
3. Aneja K.R, Jain P. and Aneja R. (2009) A Textbook of Basic and Applied Microbiology, 1st edn. New Delhi, New Age International Publishers
4. Soil Microbiology (Fourth edition of soil microorganisms and plant growth), N.S. Subbarao, Oxford and IBH Publishing CO. PVT. LTD.

Course learning outcome

At the end of the course students will be able to

1. Learn useful information regarding the taxonomical, physiological, and environmental aspects of soil microorganisms.
2. Learn the roles of soil microbes, such as decomposing dead organic matter, enriching the soil with nutrients, increasing water infiltration, improving soil texture, etc.
3. Acquire knowledge on such topics as: organisms and interactions, mycorrhizal symbioses, biological dinitrogen fixation (both symbiotic and non-symbiotic)

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IV Year: VII Semester (Theory)

Biostatistics

Code: BSM721

L	T	P	C
4	0	0	4

COURSE OBJECTIVES:

1. Basic understanding of statistics.
2. Application of statistics in biological processes and research purposes.
3. Basics of data collection in population

Unit I: Introduction of Biostatistics

Definition, use of biostatistics, scale measurements, frequency distribution, Classification and tabulation of data, Diagrammatical and graphical representation of data, Frequency distribution, line, bar, Pie chart, histogram

Unit II: Measure of Central tendency

Conceptual understanding of statistical measures, Measurement of central tendency: mean, median, mode

Unit III: Measures of Dispersion and Variance: Range, Quartiles, Mean Deviation, Standard deviation, Coefficient of Variance, Correlation and Regression, Probability, Normal Probability Normal Curve, Distribution

Unit IV: Sampling & Data Collection Technique

Definition of population, sample, sampling criteria, type of sampling technique

Unit V: Testing of Hypothesis:

Hypothesis, Type I and Type II error: Goodness of Fit Test, Student, t- test, Chi-Square test, Overview ANOVA, Use of statistical tools;

Suggested reading -

1. Introduction to Probability & Statistics - Medenhall, Beaver, Beaver 14th Edition
2. Introduction to Probability and statistics for engineers and scientists, S M Ross, 3rd Edition

Course learning outcome –

At the end of the course students will be able to-

1. Understand and interpret commonly reported statistical measures published in biological research.
2. Analyze the different type of data using appropriate statistical software.
3. Demonstrate a good understanding of descriptive statistics and graphical tools

Shailendra



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Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VII Semester (Theory)

Microbial Biotechnology

Code: BSM722

L	T	P	C
4	0	0	4

Course Objectives:

1. Basic understanding of Microbial Biotechnology and its applications
2. Understand role of recombinant microbes in pharmaceutical industries, food industry and biofertilizer production.
3. Understand role of microorganisms in biofuel and biogas production.

Unit I: Microbial Biotechnology and its Applications

Microbial Biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications, Genetically engineered microbes for industrial applications.

Unit II: Recombinant Microbial Production

Recombinant microbial production processes in pharmaceutical industries- Streptokinase, recombinant vaccines (Hepatitis B vaccine), Microbial polysaccharides and polyesters. Microbial production of bio-pesticides, microbial biosensors, biostimulants.

Unit III Biofertilizer Production Technology

Biofertilizers- history, sources and importance of biofertilizers, characteristics of biofertilizers- Rhizobium, Azotobacter, Azospirillum, Blue Green Algae, Azolla, Phosphate solubilizing microorganisms, VAM. Biofertilizer production technology- strain selection, sterilization, growth and fermentation, standards and quality control, biofertilizer application technology, constraints in the commercialization of biofertilizer technology.

Unit IV: Biodegradation and Bioremediation

Degradation of xenobiotics, biomining-mineral recovery, removal of heavy metals from effluents. Biodegradation of recalcitrant compounds. Microbial based accumulation. Microbes as decomposers. Prebiotics, probiotics and synbiotics.

Unit V: Microbial Biofuel and Biogas Production

Microbial enhanced oil recovery, Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste, algal biomass for fuel, biogas production. Biogas Production- Methane and Hydrogen production using microbial culture. Biohydrogen, Microbial fuel cells, Bioinoculant.

Suggested reading -

1. Current Protocols in Molecular Biology, Edited by: Fred M. Ausubel, Roger Brent, Robert E Kingston, David D Moore, John A Smith, Kevin Struhl. John Wiley and Sons Inc. 2007.
2. Bensons Microbiology Applications by Alfred E. Brown, MGH Publications
3. Agricultural Microbiology, Subbarao NS.

Shanleha



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B Sc.(Hons./Hons. with Research) Microbiology

Study Evaluation Scheme (as per NEP2020)
Effective from the session 2025-26

IV Year: VIII Semester											
S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Honors											
1	BSM801	Research Methodology	4	0	0	25	75	100	4	Major	Own faculty
2	BSM802	Microbial diagnostic in health Clinic	4	0	0	25	75	100	4	Major	Own faculty
3	BSM803	Mycology and Phycology	4	0	0	25	75	100	4	Major	Own faculty
		Total	12	0	0	75	225	300	12		
OR, Honors with research											
4	BSB851	Research Project and Dissertation	0	0	40	100	200	300	12	Major	Own faculty
Total			0	0	40	100	200	300	12		

Hons	Honours
L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

Note: 1. Evaluation Scheme, promotion scheme, grading system and CGPA calculation adopted from CCFUP, given by UGC.

2. A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 160 credits.

3. Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 160 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

Date:_____

Volume No.:_____

Date: _____
Volume No.: _____

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IV Year: VIII Semester (Theory)

Research Methodology

Code: BSM801

L	T	P	C
4	0	0	4

Course objective (CO)

1. To demonstrate knowledge of research processes
2. To perform literature reviews using print and online databases;
3. To employ American Psychological Association (APA) formats for citations of print and electronic materials;
4. To identify, explain, compare, and prepare the key elements of a research proposal/report;
5. To define and develop a possible HIED research interest area using specific research designs;
6. To compare and contrast quantitative and qualitative research

Unit I Foundations of Research: Meaning

Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit II Problem Identification & Formulation:

Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance

Unit III Types of research and research Design:

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit IV Qualitative and Quantitative Research:

Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. (10%), Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Unit V Sampling and analysis of data : Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

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Unit VI Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Books suggested-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

Course learning outcome (CLO)

1. Demonstrate knowledge of research processes
2. Perform literature reviews using print and online databases;
3. Employ American Psychological Association (APA) formats for citations of print and electronic materials;
4. Identify, explain, compare, and prepare the key elements of a research proposal/report; Define and develop a possible HIED research interest area using specific research designs;
5. Compare and contrast quantitative and qualitative research

Shanleha



IV Year: VIII Semester (Theory)
Microbial diagnostic in health clinic
Code: BSM802

L	T	P	C
4	0	0	4

Course objective (CO)

1. To proficiently supervise and perform full range of clinical Microbiology laboratory tests.
2. To develop and evaluate test systems and interpretive algorithms.
3. To enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information
4. To provide the student with the cognitive and psychomotor competencies to meet the entry requirements for the profession of medical laboratory science.

Unit I Overview of disease

Introduction to disease diagnosis and sample collection, Common diseases and their causative agents: Typhoid, cholera, malaria and AIDS. Causative agents: Bacteria, viruses, parasites, fungi and sporozoites, Collection and processing of clinical samples: Blood, Urine, Sputum, CSF and Faeces

Unit II Laboratory Diagnosis

A) Steps in disease diagnosis: Microscopy, smear preparation, staining and staining types-Gram's staining, acid fast staining.

B) Cultivation of microorganisms: preparation of nutrient media-Nutrient agar, Blood agar, salmonella shigella agar, EMB agar and McConkey's agar, Inoculation and incubation in brief

Unit III Molecular Laboratory Diagnosis

A) Serology- definition and role of serum, plasma, serological methods Agglutination, precipitation, common tests- WIDAL test, VDRL test and ELISA test.

B) Rapid disease diagnosis tests and kits-HIV, Dengue kit, swine flu kit.

Unit IV Action of antibiotic study

A) Introduction to antibiotics: Definition, source, common antibiotics- Penicillin and ampicillin, action of antibiotics in brief.

B) Methods of antibiotic sensitivity and resistance detection: sensitivity, resistance sensitivity test- Disc diffusion, MIC.

Shailendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Book suggesting

1. Ananthnarayan and Panikars ,Textbook of Microbiololgy(8th edition), University Press, Hyderabad
2. JayaramPaniker CK (2004). Text book of Medical Parasitology. Fifth edition, Jaypee Brothers
3. Medical Publishers (P) Ltd., New Delhi Essentials of Medical Microbiology. 4th Edition. Rajesh Bhatia. JAYPEE Publisher
4. Tortora G.J., Funke B.R., Case C.L.(2006). Microbiology: an Introduction. 8th edition. Pearson Education Inc
- 5.Frobisher , Hindsill et al., Fundamentals of Microbiology : W.B. Saunders Company, 7th edition USA, Topman co. Ltd. Japan 9. Stainer, Roger et al., General Microbiology
6. Atlas R.A. Microbiology- Fundamental and Applications, Macmillan
7. James G Cappuccino and Natalie Sherman (2004). Microbiology: A laboratory manual. Sixth edition, Published by Pearson Education

Course learning outcome (CLO)

1. Able to supervise/perform routine Clinical Microbiology laboratory testing.
2. Able to provide Medical laboratory services in all types of clinical laboratories from Primary healthcare laboratory to Tertiary health care institution in the fields of Systematic Bacteriology, Immunology, Medical Mycology, Parasitology and Medical Virology.
3. Able to make specimen- oriented decision on predetermined criteria including working knowledge of critical values. PSO4.Students will be able to communicate with other members of healthcare team, customers and patients in an effective manner, understand and demonstrate safe laboratory practices.
4. Students will be able to process information and ensure quality control as appropriate to routine laboratory

Shankar



Mahayogi Gorakhnath University, Gorakhpur
Faculty of Health and Life Sciences
Department of Microbiology, Session 2025-26

IV Year: VIII Semester (Theory)
Mycology and Phycology
Code: BSM803

L	T	P	C
4	0	0	4

Course objective (CO)

1. To learn the importance of fungi in various ecological roles
2. To demonstrate an understanding of how fungi impact human affairs
3. To outline the higher taxonomy of the fungi and how the fungi relate to other organisms
4. To discuss the characteristics of the major classes and orders within the fungal kingdom
5. To identify the major families and certain species of mushrooms and other macrofungi
6. To demonstrate a working knowledge of how fungi grow and reproduce, and where and how they can be isolated

Unit I Overview of Mycology and Phycology

Introduction of algae: Occurrence and distribution, thallus structure, characteristics, nutrition, classification and reproduction. Introduction of fungi: Occurrence and distribution, somatic structure, hyphal growth, nutrition, heterothallism, sex hormones in fungi, physiological specialization in fungi, fungi and ecosystem; saprophytic parasitic, mutualistic and symbiotic relationship with plants and animals. Classification of fungi. Reproduction in fungi: asexual, sexual and parasexual.

Unit II Taxonomy

Study of the different classes with reference to occurrence, somatic structure and life cycle and economic importance representing the following genera: Acrasiomycetes (Dictyostelium), Myxomycetes (Endosporus and exosporus), Chytridiomycetes (Neocallimastix), Oomycetes (Phytophthora), Zygomycetes (Rhizopus), Ascomycotina (Hemiascomycetes- Saccharomyces, Plectomycetes - Penicillium Pyrenomycetes – Xylaria, Discomycetes - Peziza), Basidiomycotina (Hymenomycetes Agaricus, Teliomycetes - Puccinia), Deuteromycetes (Alternaria)

Unit III Role in Agriculture

Algae as pollution indicators, eutrophication agent and role in bioremediation, algae in global warming and environmental sustainability, cyanobacteria and selected microalgae in agriculture-biofertilizer and algalization,

Unit IV Economical value

Importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecule

Unit V Lichens:

Ascolichens, basidiolichens, deuterolichens, Mycorrhiza: ecto-, endo-, ectendo-, VAM, Fungi as insect symbionts, fungi as biocontrol agents, attack of fungi on other microorganisms, potential application in Agriculture, environment, industry, food. Role of fungi in Biodeterioration of wood, paper, textile. Myxotoxins, quorum sensing in fungi

Shalendra



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

Suggested Readings:

1. Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3rd Ed.) Wiley Eastern Ltd., New Del
2. Charile M. & Watkinson S.C. The Fungi, Publisher: Academic Press.
3. E.Moore –Landeekeer: Fundamentals of the fungi, Publisher: Prentice Hall.
4. L. Barsanti, Paolo Gualtieri: Algae: anatomy, biochemistry, and biotechnology
5. Ayhan Demirbas, M. Fatih Demirbas: Algae Energy: Algae as a New Source of Biodiesel (2010)
6. Linda E. Graham, James Graham, James M. Graham: Algae (2009)
7. Burnett J.H., Publisher: Edward, Arnold Crane Russak: Fundamentals of Mycology

Course learning outcome (CLO)

1. Discuss the importance of fungi in various ecological roles
2. Demonstrate an understanding of how fungi impact human affairs
3. Outline the higher taxonomy of the fungi and how the fungi relate to other organisms
4. Discuss the characteristics of the major classes and orders within the fungal kingdom
5. Identify the major families and certain species of mushrooms and other macrofungi
6. Demonstrate a working knowledge of how fungi grow and reproduce, and where and how they can be isolated

Shankar



Mahayogi Gorakhnath University, Gorakhpur

Faculty of Health and Life Sciences

Department of Microbiology, Session 2025-26

IV Year: VIII Semester (Practical)

Research Project and Dissertation

Code: BMB851

L	T	P	C
0	0	24	12

Course Objectives (CO)

1. To learn designing of the experiments as an individual.
2. To perform application-based understanding about the experiments and their analysis by reading the research papers.
3. To study about synopsis preparation and present them.

Dissertation work

Dissertation work helps students to explore and strengthen the understanding of fundamentals through practical application of theoretical concepts. It helps students to boost their skills and widen their horizon of thinking. It acts like a beginner's guide to do larger research projects later in their career. It involves the following steps.

1. A topic will be given by the guide to the students for the project.
2. Student will search literature on assigned project
3. Student can take suggestions on topic from the respective subject experts.
4. Student will make plan and design material methods based on topic.
5. Final execution of experimental work.
6. Result and Discussion writing.
7. Presentation.

Course Learning Outcomes (CLO):

At the end of the course, the student should be able to-

1. Design the experiments as an individual.
2. Perform application-based understanding about the experiments and their analysis by reading the research papers.
3. Make synopsis and present them.

Shalendra