SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

PG Diplo
NEP

SYLLABUS FOR

MASTER OF SCIENCE (MICROBIOLOGY) 1 YEAR COURSE

OR

POST GRADUATE DIPLOMA IN MICROBIOLOGY

School of Basic & Applied Sciences

National Education Policy-2020 NEP-

School of Basic and Applied Sciences

(Effective from Academic Session 2025-2026 Onward

DEPARTMENT OF MICROBIOLOGY

VISION AND MISSION- DEPARTMENT OF MICROBIOLOGY

Vision Our vision is to cultivate a new generation of microbiologists who are innovative leaders in scientific research and societal advancement. We strive to empower students with the knowledge and skills to address global challenges such as infectious diseases, food security, and environmental sustainability. By promoting interdisciplinary collaboration and responsible research, we aim to contribute to a healthier and more sustainable world.

Mission The mission of the Microbiology course is to provide students with a comprehensive understanding of microbial life and its impact on the environment, human health, and industry. We aim to foster critical thinking, analytical skills, and a commitment to ethical research practices. Through hands-on laboratory experiences, students will develop practical skills essential for careers in research, healthcare, and biotechnology.

DEPARTMENT OF MICROBIOLOGY

CURRICULUM MASTER OF SCIENCE- MICROBIOLOGY POSTGRADUATE ONE YEAR DEGREE PROGRAMME (2025-26 Onward)

1. **Nomenclature**: There will be full time Master's Degree Programme named as M.Sc. in Microbiology which will be written as M.Sc. Microbiology. The duration of this programme shall be of one year (one full academic year) which shall be divided in to two semesters. Each semester will be of six months. Actual teaching in each semester is required minimum of 90 days. The examination for first semester will normally be held in the month of December and for the second semester in the month of May or as convenient to the University.

2. The Medium of Instruction: The medium of Instruction will be English.

3. The Medium of Examination: The medium of examination will be English.

4. Eligibility to apply for Admission: No candidate shall be eligible for admission to One Year Full Time M.Sc. Microbiology unless he/she has successfully completed a four years Under Graduate Degree either Honors or Honors with Research (with any Biological/Applied science subjects/Agriculture sciences/Medical sciences/Biotechnology/Microbiology/Zoology/Botany) with prescribed number of Credits through the Examinations conducted by a University/Autonomous Institution or possesses such qualifications as recognized by the University. Further a candidate holding four years Bachelor Degree (either Honors or Honors with Research) in any biological science discipline from a recognized University without credit system shall also be eligible. The maximum age of a candidate for taking admission in the programme and the gap between the last Degree/Diploma courses shall be as per the norms as prescribed by the university from time to time

5. Selection Procedure for Admission: A candidate willing to seek admission to M.Sc. Microbiology will have to appear in Written Entrance Test conducted by the University or on behalf of the University and followed by the counselling as per University norms. The selection for admission will be made on merit basis or as per University norms.

6. Semesters: (a) An academic year shall consist of two semesters: Odd Semester (I Semester) : generally July to November/December Even Semester (II Semester): generally December to January to May/ June The academic calendar for each semester shall be notified well before the commencement of the semester by the Dean, School of Basic and Applied Sciences. (b) A semester shall normally extend over a period of 15 weeks. Each week shall have 30 hours of instruction including lab/ field work as applicable.

7. Credits: (a) Credit defines the quantum of contents/ syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus credits shall be assigned on the basis of the number of lectures/ tutorials / laboratory work/ project work and other forms of learning required to complete the

course contents in a 15 week schedule. (b) 1 Credit = 1 hour of lecture for theory and 1 Credit = 3 hour of laboratory for practical and dissertation. (c) Motivate students with industrial visit, educational trip, seminar/conference during semesters (not mandatory).

8. Roll Numbers and Enrolment Numbers: The University shall allot a Roll Number to the students after payment realization, thorough scrutiny / verification of the required documents for the course. After the completion of the admission procedure the enrolment number for the students shall be allotted by the University at the entry point which shall remain same for the entire period of study in the University

9. The Credit Based Course Structure: Master of Science (Microbiology)- One Year Programme- As per NEP 2020 and Choice Based Credit System (CBCS) One year Master's Program in Microbiology shall be based on the choice based credit system or as per NEP 2020 in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week. The student shall be eligible for admission to one year Master's Degree Program in Microbiology after he/she has successfully completed a four years undergraduate degree (either Honors or Honors with Research) or earned prescribed number of credits through the examinations conducted by University as equivalent to an undergraduate four year degree program (either Honors or Honors with Research). Core courses prescribed for every Semester shall be mandatory for all students registered for the one year Master's Program in Microbiology and shall carry minimum 40 credits (for one year program). There shall be Elective courses offered in semester I and shall carry a minimum of 10 credits and 10 credits shall be covered by two core paper both are consider as course paper with 20 credits.. The dissertation would be allotted in the beginning of III Semester and candidate would submit the thesis/report during IV Semester examination. The dissertation may be in the form of a field based research work/ project work/ practical training. The students may complete the dissertation work in the department/ other research institutes/ industries/ hospitals etc. The 1- Year Masters Programme will have the following components:

Core course (C): Minimum 10 credits 2) Elective course (E): Minimum 10 credits (Core+ Elective= Course papers) 3) Major Research/ Dissertation 20 4)

Eligibility for admission:

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized equivalent to the Plus Two of the Higher Secondary Board in with not less than- 45%-marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules. *If a student earns 80 credits from the courses offered by the department, then M. Sc. Microbiology will be awarded to the student.

Exit Point: For those who join 2year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

Candidates who have completed 4-year UG programme or a 3 year UG and 2 year PG programme subjects will be eligible for admission in M.S.c Microbiology course.

1. Master's Degree. Programme duration: One year (two semesters) after obtaining a Bachelor's degree (Honours/Research).
2. Master's Degree. Programme duration: two years (four semesters) after obtaining a 3 yr Bachelor's degree;

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3. Post-Graduate Diploma. Programme duration: One year (2 semesters) after any bachelor's degree
   - Post Graduate Diploma after completion of 1st year of 2-year PG program; and Minimum of 40 credits for individuals who have completed a bachelor's programme

i. PGD after 3-year Bachelor degree.
ii. PGD after 4-year bachelor degree

Multiple Entry Multiple Exit (ME-ME) in Microbiology course work.

S.NO.	ACADEMIC LEVEL	ENTRY QUALIFICATION *	EXIT QUALIFICATION AND CREDITS required for the level
1.	MASTERS in Microbiology (2 year of Master Program)	Bachelor degree (after 3 years of UG)	Master's degree; and Minimum of 80 credits from the first and second years of the program, with minimum of 40 credits in the first year and minimum of 40 credits in the second year of the program.
2.	MASTER'S in Microbiology (One year program after 4 year UG)	Bachelor's degree (honors/ honors with research) or Post Graduate Diploma	Master's degree; and Minimum of 40 credits for individuals who have completed a bachelor's degree (Honors/ Honors with Research)
3.	Master's programme in Microbiology	Bachelor's degree (honors/ honors with research)	Master's degree; and Minimum of 80 credits from the first and second years of the programme, with minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme in Microbiology.

M. Sc. Microbiology
Course Components of Academic Program
***If a student earns 80 credits from the courses offered by the department, then M. Sc. Microbiology will be awarded to the student.**

COURSE COMPONENTS	NO.	CREDITS
Discipline Specific Core Courses (DSC)	7	23
Seminar (SM), Ability Enhancement Course (AEC), Project (PROJ)	02	20
GRAND TOTAL		43

Exit Point: For those who join 2 year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

Candidates who have completed 4-year UG programme or a 3 year UG and 2 year PG programme subjects will be eligible for admission in M.S.c Microbiology course.

4. **Master's Degree. Programme duration: One year (two semesters) after obtaining a Bachelor's degree (Honours/Research).**
5. **Master's Degree. Programme duration: two years (four semesters) after obtaining a 3 yr Bachelor's degree;**
6. **Post-Graduate Diploma. Programme duration: One year (2 semesters) after any bachelor's degree**
    - **Post Graduate Diploma after completion of 1st year of 2-year PG program; and Minimum of 40 credits for individuals who have completed a bachelor's programme (Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma in Microbiology).**
    - **PGD after 3-year Bachelor degree.**
    - **PGD after 4-year bachelor degree.**

DISCIPLINE SPECIFIC CORE COURSES (DSC)

S. No.	Course Code	Course Title	Credits (L + P)
1.	MBDS-101	Medical Microbiology	3
2.	MBDS-102	Industrial Microbiology ANDPHARMACEUTICAL	3
DEPARTMENT SPECIFIC ELECTIVE OFFERED (DSE)			
3.	MBDE-103	Agricultural microbiology	3
4.	MBDE-104	Food and dairy microbiology	3
5.	MBDL-105	Lab Course based on MBDS-101 and MBDS-102	4
6.	MBDL-106	Lab Course based on MBDE-103 and MBDE-104	4
7.	MBDS-201	Epidemology	3
8.	MBDL-206	Lab course based on MBDS-201	4
Seminar (SM), Ability Enhancement Course (AEC), Project (PROJ)			
9.	MBDS-204	Dissertation	10

10.	MBPROJ - 205/AEC-205	Seminar Report Writing and Presentation /Publication (Review article/book chapter, Research Paper etc)	10
TOTAL			**47**

11. **Student Advisor**: Every student shall have a teacher of the Department as his/her Student Advisor. All teachers of the department shall function as Student Advisors and will have more or less equal number of students with them. The Student Advisor will advise the students in choosing Elective courses and offer all possible student support services.
12. **Attendance**: a. The teacher handling a course shall be responsible for maintaining a record of attendance of students who have registered for the course. b. All teachers shall intimate the Head of the Department at least seven calendar days before the last instruction day in the semester, the particulars of all students who have less than 75% attendance in one or more courses. c. A candidate who has less than 75% attendance shall not be permitted to sit for the End-semester examination in the course in which the shortfall exists. However, it shall be open to the Dean/HOD to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 60%. d. A candidate who fails to put in least 75% attendance in I semester shall not be allowed to pursue the studies in II semester. Such candidates may apply to the Dean/HOD for re-registration in the I semester in the next academic session. Note : Rest of the provisions will be as framed by the University.
13. **Examination and Evaluation** (a) Evaluation will be done on a continuous basis. Three times during each semester. For The purpose of uniformity, there will be a uniform procedure of examination to be adopted by all teachers. There will be two Sessional tests (Three if any student are unable to attend any sessional test) and one End-semester examination. (b) Sessional tests (of one to two hours duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment. It will be obligatory for the Students to attend the both Sessional tests, failing which they will not be allowed to appear in the concerned semester examination. The Sessional test as part of the continuous internal assessment shall be conducted and evaluated by the teacher offering the course.
14. **A Student cannot repeat Sessional Tests (without permission from HOD).** However, if for any compulsive reason the student could not attend the test, the prerogative of arranging a special test lies with the teacher with the approval of the Head of the Department. In case of students who could not attend any of the Sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the concerned semester examinations by the concerned faculty member after the approval of the Head of the Department and the Dean concerned. (c) The Sessional tests will carry 40% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades. (d) There shall be a written End Semester Examination which shall be of 2/3 hours duration carrying 60% of total Marks assigned for the course, covering the entire syllabus prescribed for the course. (e) The End Semester practical examinations (field tour report, project report and Training report) shall normally be held before the theory examination/or as per convenience by the Department . The internal faculty shall associate themselves with the examination process. (f) Valuation of Dissertation and Viva- voce: Dissertation / project report shall be evaluated jointly by internal and one external examiner

Master of Science (Microbiology)

OUTCOME BASED MICROBIOLOGY

Programme outcome (POs)

The student will be able to:

PO 1	Implement strong the or etical and practical knowledge of microbiology to solve complex scientific problems.
PO2	Identify the situation-based problem, formulation and action is taken based on analytical thinking and principles of science.
PO3	Execute effective communication through interactive and presenting skills, technical report writings and proper documentation of ideas.
PO4	Formulate, design, experimental techniques, scientific tools, analysis of scientific data, interpretation of data and established hypothesis for various inter disciplinary research problems.
PO5	Create a conceptual, theoretical and operational approach to address various problems of inter disciplinary fields.
PO6	Enables individuals to function effectively in cross-cultural environment an individual and as a member or leader.
PO7	Understand ethical issues, academics and research ethics need and value of life long learning, scientific misconduct of a scientist to serve society.
PO8	Understand the contribution of scientific knowledge in environmental concept for sustain able development.
PO9	Enhance and adopt employability skills through research, internship and dissertation.
PO10	Successfully compete in the state level, national level and international level or competition
PO11	Demonstrate ability for collaborative research and scientific communication through projects, internship and on site training.
PO12	Develop Skills required for higher education, professional development and employability.

Program Specific Outcome (PSOs)

PSO 1	Associate the fundamental and advanced concept in diverse branches of Microbiology including Medical Microbiology, Agricultural Microbiology, Food Microbiology, RDT, Bioinformatics and Industrial Microbiology.
PSO2	Formulate, design, experimental technique, scientific tools, analysis of scientific data interpretation of data and establish a hypothesis for various interdisciplinary research problems.
PSO3	Capable of executing short research projects / patent in corporating various tools and techniques in any of the basic specializations of Microbiology.
PSO4	Acquire the ability to engage in independent and life-long learning in the broadest context sociotechnological changes.

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M.S.c Microbiology-I Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MB DS-101	Medical Microbiology	3	0	0	3	40	60	100
2	Core	MB DS-102	Industrial Microbiology ANDPHARMACEUTICAL	3	0	0	3	40	60	100
3	Elective-I	MB DE-103	Elective – I a) food and dairy microbiology	3	0	0	3	40	60	100
4	Elective-IV	MB DE-104	Elective – IV d)Agricultural microbiology	3	0	0	3	40	60	100
5.	Lab	MB DL-103	Lab Course-I (Based on paper 1 & 2)	0	0	4	4	40	60	100
6	Lab	MB DL-103	Lab Course-I (Based on paper 3 & 4)	0	0	4	4	40	60	100
				12	0	8	20	240	360	600
M.S.c Microbiology-II Semester										
8.	Core	MB DS-201	Epidemology	3	0	0	3	40	60	100
9.	Lab	MB DL-202	Lab based on MBDS-201	4	0	0	4	40	60	100
10.	Pre-Project Presentation /Ability Enhancement Course	AEC -203	Synopsis Writing Skill	1	0	0	1	40	60	100

9.	Project	MB DS-204	Dissertation	10	0	0	10	50	100	150
10.	Seminar Report Writing and Presentation	MBP ROJ - 205/A EC-205	Seminar Report Writing and Presentation /Publication (Review article/book chapter, Research Paper etc)	10	0	0	10	50	100	150
TOTAL				28	0	0	28	460	380	600

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Course code	: MBDS—101				
Course Name	: Medical Microbiology				
Semester /Year	: 1				
		L	T	P	C
		3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To make student aware to Normal microbiota of human body.
2. To gain knowledge about mechanism of pathogenesis.
3. To gain knowledge of bacterial, viral and fungal disease.

Course Content

TOTAL HOURS: 60 **CREDITS: 03**

Unit I: Basics of Medical Microbiology

Normal microbiota of human body; Role of resident flora and human host; Routes of transmission of pathogens; Nosocomial infections; Collection, transportation and processing of clinical samples; Isolation and identification of pathogenic organisms; Quality control in medical microbiology laboratory.

Unit II: Pathogenesis

Pathogenicity islands; Mechanism of pathogenesis: Mechanism of bacterial adhesion, colonization and invasion, Protein toxins (Classification and mode of action), Cytoskeletal modulation of host cell; Mechanism of action of antimicrobial agents;

Unit III: Antimicrobial Chemotherapy

Methods of drug susceptibility testing: Kirby-Bauer's disc diffusion method, Stokes method,Agar dilution method, Broth dilution method, E-strip method; Emergence of drug resistance inbacteria (MRSA, ESBL and MDR TB); Resistance mechanism; Various types of vaccines for prevention of infectious diseases; COVID Vaccine, National immunization program and immunization schedule.

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Unit IV: Bacterial Diseases

Clinical features, transmission, characteristics of causative organism, pathogenesis, laboratorydiagnosis, prevention and control of bacterial diseases and clinical syndromes: Cholera, Leprosy,Diphtheria, Tetanus, Meningitis, Conjunctivitis, Pneumonia and Gastroenteritis.

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Unit V: Viral and Fungal Diseases

Clinical features, transmission, characteristics of causative organism, pathogenesis, laboratorydiagnosis, prevention and control of viral diseases: Herpes, Chikungunya, Influenza, Measles,Mumps,Hepatitis,HIV,Coronavirus,Viralcancer.Clinicalfeatures,transmission,pathogenesis,laboratorydiagnosis,preventionandcontroloffungaldiseases:Aspergillosis,Cryptococcosis, Candidiasis, Blastomycosis.

Text Books:

1. ArtiKapil.(2013).*Ananthnarayan&Paniker'sTextbookofMicrobiology*,(9thed).Universities press (India) Private Limited, ISBN: 9788173718892.
2. Ananthanarayanan,R.andPanicker,C.K.J.Textbookofmicrobiology.OrientLongman,Hyderabad
3. Chakraborthy,P.Atextbookofmicrobiology.NewCentralBookAgencyPrivateLimited, Calcutta.
4. Paniker,J.Textbookofmedicalparasitology.JaypeeBrothersMedicalPrivateLimited,New Delhi

Reference Books

1. Koneman,E.W.Koneman'scoloratlasandtextbookofdiagnosticmicrobiology.Lippincott Williamsand Wilkins, Philadelphia.
2. Topley,W.W.C.,Wilson,S.G.SandParker,M.T.TopleyandWilson'sprinciplesofbacteriology,virology and immunity. Edward Arnold, London.
3. Greenwood,D.,Slack,R.B.andPeutherer,J.F.Medicalmicrobiology.ChurchillLivingstone, London.
4. Mahon,C.R.andManuselis,G.Textbookofdiagnosticmicrobiology.Saunders,Philadelphia.

Course outcomes (Cos):

Upon successful completion of the course a student will be able to

CO1	Define Normal microbiota of human body, pathogenesis, Antimicrobial Chemotherapy, Bacterial Diseases , Viral and Fungal Diseases.
CO2	Summarize the role of resident flora and human host, Pathogenicity islands, drug susceptibility testing, bacterial diseases and clinical syndromes, control of viral diseases.
CO3	Explain the normal micrflora in human, mechanism of pathogenesis, methods of drug susceptibility testing, transmission, characteristics of causative organism, pathogenesis, laboratory diagnosis, prevention and control of bacterial ,viral and fungal disease.
CO4	Explain infection and pathogenecity, role of microorganism in human flora, various method of drug susceptibility testing, different bacterial diseases ,prevention and control,transmission,pathogenesis,laboratorydiagnosis,preventionandcontrolof fungal diseases.

CO5	Summarize the role of resident flora and human host, Pathogenicity islands, methodology of drug susceptibility testing, various bacterial, viral and fungal disease .
CO6	Justify the routes of transmission of pathogens, how to bacteria enter the host, Methods of drug susceptibility testing, pathogenesis , treatment and control of bacterial ,viral and fungal diseases.

CO-PO Mapping

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	1	1	1	2	2	1	2	2	2	2	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3	2
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: MBDS—102				
Course Name	: INDUSTRIAL AND PHARMACEUTICALMICROBIOLOGY				
Semester /Year	: I				
		L	T	P	C
		3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To make student aware to fermentor design and function.
2. To gain knowledge about media formulation and Inoculum development
3. TomakestudentawareGoodManufacturingPractices(GMP)andGoodLaboratoryPractices (GLP) in pharmaceutical industry

Course Content

Unit I: Introduction to Industrial Microbiology

Primaryandsecondarymetabolites;Structureoffermentor/bioreactor;Typesoffermentor/bioreactors; Scale up and scale down processes;Types of fermentation (Solid state,surface and submerged fermentation).Batch and continuous culture.

Unit II: Basic Aspects of Fermentation

Media formulation; Sterilization; Inoculum development; Effect of temperature, pH and highnutrientconcentrationonfermentation;Operationalmodesoffermentation(Batch,fed-batchand continuous); Downstream processing.

Unit III: Microbial Strain Improvement

Strategies for isolation and cultivation of desired microorganisms; Screening for the desiredproduct;Strategiesforstrainimprovement:Mutation,Protoplastfusion,RecombinantDNAtechnology,ideaofNovelstrategies.Preservationofculturesafterstrainimprovementprogramme.

Unit IV: Industrial Production Aspects Production of antibiotics

(streptomycin, grieseofulvin), amino acid (Glutamic acid and lysine), Production of enzymes(Pectinase, amylase, lipase, protease, cellulase and xylanase), organic acids (Citric acid, aceticacid and lactic acid), ergot alkaloids and bioplastics (PHB and PHA).Antifoam agent.

Unit V: Introduction to Quality Assurance and Validation

GoodManufacturingPractices(GMP)andGoodLaboratoryPractices(GLP)in pharmaceutical industry; Basic principles of quality control (QC) and quality assurance(QA); Guidelines for QA and QC (Raw materials, sterilization, media, stock cultures andproducts),ISO,WHOandUScertification;Sterilizationcontrolandsterility testing:Validation study; LAL test; Sterility testing and bioassay; Application of Biosensors inpharmaceuticals.

Text Books:

1. Crueger,W.andCrueger,A.Biotechnology:Atextbookofindustrialmicrobiology.SinauerAssociates, Sunderland.
2. Reed, G. Prescott and Dunn's industrial microbiology. Globe Bookservices, London.
3. Demain,A.LandDavies,J.E.Manualofindustrialmicrobiologyandbiotechnology.ASM Press,Washington, D.C.
4. Casida, J.E. Industrial microbiology. Wiley Eastern, New Delhi.
5. Patel, A.H. Industrial microbiology. MacMillan India Limited, New Delhi.

Reference Books

1. Hershnergev,C.L.,Queener,S.W.andHedemen,Q.Geneticsandbiotechnologyofindustrialmicroorganisms. ASM Press, Washington, D.C
2. Adams,M.R.,andMoss,M.O.Foodmicrobiology.RoyalSocietyofChemistryPublication, Cambridg.
3. Stanbuty,P.F.andHall,S.J.Principlesoffermentationtechnology.PergamonPress,Oxford.
4. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define Basic Aspects of Fermentation , Introduction to Industrial Microbiology, Antibiotic production and Quality Assurance and Validation
CO2	Summarize basic structure and function of fermenter, ,fermentation, strain improvement and QA and QC
CO3	Write about fermentation, concept of strain improvement, antibiotic production and Guidelines for QA and QC ,(GMP)and (GLP)in pharmaceutical industry.
CO4	Explain the basic concept of fermenter , Strategies for strain improvement:, Production of antibiotic and Quality Assurance and Validation.
CO5	Summarize the concept of Industrial and Pharmaceutical Microbiology.
CO6	Compile and write about the study of Industrial and Pharmaceutical Microbiology.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	2	3
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

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DEPD

Course code	: MBDL-105				
Course Name	: Lab Course 1 (Based on paper 1 & 2)				
Semester /Year	: I				
		L	T	P	C
		0	0	4	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn the student Biosafety guidelines and biosafetylevels.
2. To learn to perform about Isolation and biochemical characterization of pathogenic bacteria.
3. TolearntoperformDeterminationofMICandMBCconcentrationofantibioticsby broth dilutiontest.

Course Content **CREDITS: 03**

1. Biosafety guidelines and biosafety levels.
2. Prevalence of pathogenic microorganisms in clinical sample.
3. Isolation and biochemical characterization of pathogenic bacteria.
4. Isolation and identification of fungal pathogens from clinicalspecimens.
5. Determination of antimicrobial susceptibility of pathogens by disc diffusiontest.
6. Determination of MIC and MBC concentration of antibiotics by broth dilutiontest.
7. Isolation and screening of bacterial and fungal cultures for enzymeproduction.
8. Estimation of enzyme production by microbial culture *via* liquid statefermentation.
9. Estimation of enzyme production by microbial culture *via* solid statefermentation.
10. Mediaformulationforenhancedenzymeproductionbymicrobialculture*via* liquid and solidstate fermentation.
11. Optimizationofcultureconditionsforenhancedenzymeproductionb ymicrobialculture *via* liquid and solid statefermentation.
12. Production of wine from fruitjuice.
13. Monitoring of sugar reduction during wineproduction.
14. Estimation of alcohol concentration inwine.
15. Estimation of vicinal diketone inbeer.
16. Improvement of strain for increased yield by U.V.mutagenesis.

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DEPD

Course code	**: MBDE--201**				
Course Name	**: Food and Dairy Microbiology**				
Semester /Year	**: II**				
		L	**T**	**P**	**C**
		0	**0**	**3**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To aware the studentprinciples of food preservation.
2. **To make student to aware spoilage of fermented foods**
3. **To aware the student Food Safety and Quality Assurance**

Course Content

Unit I: Principles of Food Preservation

Factors influencing microbial growth in food; Asepsis; Food preservation: Principles, Physical methods(Dehydration, freeze drying, heat and irradiation), Chemical methods (Chemical preservatives and foodadditives);Canning;Processingforheattreatment(D,ZandFvalues)andworking outtreatmentparameters; Microbiological quality standards of food.

Unit II: Contamination and Spoilage

Characterization of contamination and spoilage of cereals, vegetables, fruits, meat and meatproducts, milk and milk products, fish and sea foods, beer and wines; Spoilage of fermentedfoods and canned foods. Difference between contamination and spoilage.

Unit III: Food borne Infections and Intoxications

Bacterialandnonbacterialinfectionsandintoxicationsof*Brucella*,*Bacillus*,*Clostridium*,*Escherichia*,*Salmonella*,*Shigella*,*Staphylococcus*,*Vibrio*,*Yersinia*,*Listeria*,nematodes,protozoa, algae, fungi and viruses; Structure and functions of aflatoxins; Laboratory testingprocedures.

Unit IV: Food Safety and Quality Assurance

Microbiological quality standards of food; Food control agencies and their

regulations:
FDA,EPA,CDCandISI;GoodManufacturingPractice;Plantsanitation(Employeesh ealthstandards, waste treatment and disposal); Hazard Analysis and Critical Control Point (HACCP)system; Food Safety Act and Trade Regulations.

Unit V: Production of Fermented Foods

Industrialproductionmethodsofbread,cheese,fermentedvegetables(Olivesan dcucumber), fermented dairy products (Acidophilus milk, cheese and yoghurt), single cellproteins, sauerkraut, meat and fishery products (Sausages and fish sauces); Production oforientalfoods(Mycoprotein,tempeh,soyasauce,idli,nattoandpoi)andbever ages(Vinegar,cider,sakeandpalmwines);AlcoholicbeveragesofHimalayanre gion;Genetically modified foods; Probiotics and its application.

Text Books:

1. Adams,M.R.,andMoss,M.O.Foodmicrobiology.RoyalSocietyofChemist ryPublication,Cambridge
2. Frazier, W.C. and Westhoff, D.C. Food microbiology. Tata McGraw Hill, New Delhi.
3. Stanbuty,P.F. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.

Reference Books

1. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.
2. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.
3. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.
4. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London
5. .Ayres,J.C.,Mundt,O.andSandinee,W.E.Microbiologyoffoods.W.H.Freem anandCompany, New

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define Principles of Food Preservation, canning, Contamination and Spoilage, Foodborne Infections and Intoxications, Food Safety and Quality Assurance,Production of Fermented Foods, alcoholic beverages, probiotics and genetically modified foods.
CO2	Describe principles and methods of Food Preservation, factors influencing microbial growth, Characterization of contamination and spoilage of different food products, Explain and differentiate between Bacterialandnonbacterialinfectionsandintoxications, Food Safety and Quality Assurance, Industrialproductionmethodsof fermented foods, Alcoholic beverages.Explain Probiotics and genetically modified foods.
CO3	Write about Principles of Food Preservation, canning, Contamination and Spoilage, Foodborne Infections and Intoxications, Food Safety and Quality Assurance, Production of Fermented Foods, alcoholic beverages, probiotics and genetically modified foods.
CO4	Explain the detailed understanding about Principles of Food Preservation, canning, Contamination and Spoilage, Foodborne Infections and Intoxications, Food Safety and Quality Assurance,Production of Fermented Foods, alcoholic beverages, probiotics and genetically modified foods.
CO5	Summarize the concept of food and dairy microbiology
CO6	Compile and write about the study of food and dairy microbiology.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	2	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	3	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBDE-203**				
Course Name	**: Elective-II Environmental Microbiology**				
Semester /Year	**: II**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To gain knowledge about abiotic and biotic Ecosystem.
2. 2.To make student to aware pollution and its types.
3. To learn about microbial interaction.

Course Content

Unit I: Fundamentals of Microbial Ecology

Ecosystem; Biotic and abiotic components; Habitat and Niche; Population and guilds; Concept of community; Stability hypothesis; Intermediate-disturbancehypothesis;Conceptof ecologicalniche; Ecosystem organization: Structure and functions, Primary production,Energy dynamics (Trophic

organization and energy flow pathways); Microbial communitydynamics: r and k strategies of population selection withincommunities.

Unit II: Air and AquaticMicrobiology

Aerobiology:Dropletnuclei,Aerosol,Assessmentofairquality,Solidandliquidimpingementmethods,Briefaccountofairborntransmissionofmicrobes;Aquaticmicrobiology: Zonation and microbiota of fresh water (Ponds, lake and rivers) and marinehabitats(Estuariesanddeepsea),Upwellinganddownwelling,Eutrophication,algaeineutrophication,algalblooms,Foodchain,Mechanismofdissolvedorganicmatterproduction, Microbial assessment of water quality, Water purification.

Unit III: Microbial Interactions

Positive and negative interactions amongst microbial populations: Cooperation, Neutralism,Commensalism, Synergism, Mutualism, Competition, Amensalism, Parasitism, Predation;Interactions between microorganisms and plants: Rhizobacteria, Mycorrhiza, Epiphytic andendophytic microorganisms; Interactions between microorganisms and animals: Predation onmicroorganisms by animals, Cultivation of microorganisms by animals for food and foodprocessing.

Unit IV: Pollution and its Control

Airpollutionanditscontrol:Sources,Majorpollutants,Adverseeffectonlivingorganisms(Acidrainanditsimpactonecosystem,greenhouseeffect,globalwarming,ozonelayerdepletion and its effect, smog), Control through biotechnology (Deodorization, reduction in CO2emission, bioscrubbers, biobeds and biofilters); Water pollution and its control: Sources, Groundwater contamination, Wastes: Characterization of solid and liquid wastes, Solid waste treatment(Landfills, incineration, composting, anaerobic digestion and pyrolysis), Waste water treatment(Pretreatment, primary, secondary and tertiary treatment, Application of biofilm in waste watertreatment); Environment impact assessment. Soil pollution; source and causes, soil salinity.

Unit V: Impact of Microbes on Environment

Biodegradation of recalcitrant compounds: Pesticides and Petroleum; Bioremediation: *In situ* and*Exsitu*remediation, Bioremediation of oil spills; Bioaugmentation; Biomagnification; Biomineralization; Metal corrosion: Mode of deterioration, Microorganisms involved, Mode ofprevention; Bioleaching of ore;

Text Books:

1. Atlas,R.M.andBartha,R.Microbialecology:Fundamentalsandapplications.Benjamin/Cummings Science Publishing, USA.
2. Evans,G.M.andJohn,J.C.F.Environmentalbiotechnology:Theoryandapplications.John Wiley and Sons, New York.

Reference Books

1. Alexander, M. Microbial ecology. John Wiley and Sons, New York
2. Eldowney, S., and Waites, S. Pollution: Ecology and biotreatment. Longman, Harlow.
3. Baker, K.H. and Herson, D.S. Bioremediation. McGraw- Hill, New York.
4. Marshal, K.C. Advances of microbial ecology. Plenum Press, New York.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define terminology used in Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment.
CO2	Explain and give examples where applicable related to ecosystem, ecosystem organization and microbial community, air borne transmission of microbes, aquatic microbiology, Positive and negative interactions amongst microbial populations, Interactions between microorganisms and plants , Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment.
CO3	Write about the concept of ecosystem, ecosystem organization and microbial community, air borne transmission of microbes, aquatic microbiology, Positive and negative interactions amongst microbial populations, Interactions between microorganisms and plants , Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment
CO4	Explain Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO5	Summarize the study of Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO6	Generalize the concept of Environmental Microbiology

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	3	3	2
CO3	2	3	2	2	2	1	1	2	2	2	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	2	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

CO- PSO-PO Mapping:

Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBDE- 203**				
Course Name	**: Elective–IIIAGRICULTURALMICROBIOLOGY**				
Semester /Year	**: II**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn about understandthePhysico-chemical characteristics of soil.
2. To gain knowledge about biocontrol Agents for Agriculturally Important Crop Plants
3. To gain knowledge about isolation, purification, mass multiplication of Biofertilizer.

Course Content

Unit I: Abiotic and Biotic Components of Soil

Soil as a habitat for microorganisms; Soil enzymes and significance; Soil microbes; Influence ofmicrobial metabolism on soil chemistry and humus formation; Organic matter dynamics in soil:Microbial decomposition of cellulose, hemicellulose and lignin, Factors affecting organic matterdecomposition.

Unit II: Rhizosphere and Rhizoplane Microorganisms

Rhizosphere; Rhizoplane; Composition of root exudates; Factors affecting exudation; Plantgrowth promoting rhizobacteria; Mycorrhiza; Rhizosphere effect; Factors affecting microbialcommunity in soil; Mechanism of plant growth promotion: Mechanism of nitrogen fixation,Mechanismofphosphatesolubilizationandphosphatemobilization,Mechanismofironchelation, Production of plant growth promoting hormones from bacteria and fungi, Production of antibiotics by plant growth promoting microorganisms.

Unit III: Plant Pathogens

General symptoms of plant diseases, Symptoms, causative organisms, disease

cycle andcontrol measures of plant diseases: Blight of rice, Citrus canker, Wilt of potato, *Pythium*seedrot, Grapes downy mildew, Potato early and late blights, Fusarial wilt, Wheat-smut and rust,Tikka leaf spot in groundnut, Common viral diseases of plants (Paddy, cotton, potato, tobacco,cauliflower,tomatoandsugarcane);Biochemicalandgeneticbasisofvirulenceinplantpathogens.

Unit IV: Biocontrol Agents for Agriculturally Important Crop Plants

Biopesticides:Sourceorganisms(*Bacillusthuringiensis*,*Beauveriabassiana*,*Metarhiziumanisopliae*, *Trichoderma*and Baculoviruses); Mechanism of biocontrol; Other meansof pathogen control: Application of viral proteins in controlling viral diseases, Antisense RNAtechnology in disease control and RNAi in controlling plant pathogens.

Unit V: Biofertilizers

Isolation, purification, mass multiplication, inoculum production and method of application ofbiofertilizers. Bacterial biofertilizers: *Azospirillum*, *Azotobacter*, Phosphobacteria, *Rhizobium*,*Bradyrhizobium*, *Azorhizobium*, Mycorrhizal fertilizers, Algal biofertilizers: Storage, shelf life,quality control and marketing of biofertilizers.

Text Books:

1. Gupta, S.K,Biofertilizers, KedarNath Ram Nath, Meerut.
2. SubbaRao,N.S(1995).SoilmicroorganismsandplantgrowthOxfordandIBHpublishing co. Pvt. Ltd., New Delhi.

Reference Books

1. Kannaiyan, S. (2003).Bioetchnology of biofertilizers, CHIPS, Texas.
2. Rai,M.K.(2005).Handbookofmicrobialbiofertilizers,TheHaworthPress,Inc.NewYork.
3. Reddy,S.M.etal.(2002).Bioinoculantsforsustainableagricultureandforestry.ScientificPublishers.
4. Saleem,F.andShakoori,A.R.(2012).Developmentofbioinsecticide.LapLambertAcademic Publishing GmbH and Company.
5. Aggarwal, S.K. (2005). Advanced environmental biotechnology. APH publication

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the role and affect of microorganism in agriculture.

CO2	Identify phytopathogens and apply the knowledge of their life cycle in prevention of plant diseases.
CO3	Apply the knowledge of rhizospheric bacteria in development of biofertilizers.
CO4	Summarize the mechanism of biocontrol utilized by biopesticides
CO5	Appreciate the diversity of microorganism and microbial communities inhabiting soil and affecting soil composition and causing plant diseases.
CO6	Compile information on plant microbes interactions like rhizosphere and mycorrhizae and their applications especially the biopesticides, biofertilizers and their production techniques.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	3	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MMDL204**
Course Name	**: Lab Course II (Based on paper Elective I,II and III)**
Semester /Year	**: II**

L	T	P	C
3	0	0	3

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn about Microbiological examination of food.
2. To learn to perform Production ofsauerkraut.
3. To learn to perform Microbial production ofcurd.

Course Content CREDITS: 04

1. Microbiological examination offood.
2. Assay of quality of milk sample using MBRTtest.
3. Adulteration tests formilk.
4. Microbial production ofcurd.
5. Isolation and identification of *Lactobacillus* from fermented dairyproducts.
6. Isolation and biochemical identification of microorganisms from contaminated food and dairy samples.
7. Production of sauerkraut.
8. Estimation of lactic acid production insauerkraut.
9. Effect of salt concentration on lactic acid production insauerkraut.
10. Estimation of acidity of vinegar.
11. Preparation of nannoparticles.
12. Microbiological testing of drug sample.
13. Detection of viral antigens by RTPCR.
14. Detection of HIV antigen by TriDot kit
15. Determination of TLC, DLC and CRP of blood sample.
16. Isolation and characterization of microorganism from air, water and soil.
17. Detection of BOD and COD of water sample.
18. Isolation and characterization of PGPR.
19. Detection of nitrogen fixing ability of bacteria.
20. Detection of siderophore production.
21. Preparation of spawn for mushroom cultivation.
22. Production and storage of button mushroom.
23. Interpretation, rectification, restoration and enhancement of aerial photographs.
24. Acquisition of data for remote sensing.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identification of food borne, environmental and soil borne diseases and detection of viral antigens in blood sample.

CO2	Interpretation of aerial photographs and data in GIS
CO3	Assess quality of food, drugs and environmental samples.
CO4	Characterize bacteria isolated from soil, food and environment.
CO5	Evaluate production of lactic acid in sauerkraut.
CO6	Production of biofertilizers ,mushroom and nannoparticles.

Course code	**: MBPROJ-205**
Course Name :	**DISSERTATION**
Semester/Year	**:II Sem**

	L	T	P	C
	0	**0**	**10**	**10**

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the fundamental framework of research process, des igns andMethodologies.
2. TolearnthestudenttoStructurethemethodologiestoaccomplishorganizedcon duct of interdisciplinaryresearch.
3. Togainknowledgetoppublishtheresearchoutcomeinscientificpeerreviewedj ournal.

CO1	Observe a small research work to accomplish organized conduct of in various field.
CO2	Select and identify the methodology of project
CO3	Apply and Impart the outcome of their project in various seminars and conferences.
CO4	Apply and Present project work to a panel of experts.
CO5	Choose a Publish the research outcome in scientific peer reviewed journal.
CO6	Solve a research work by research methodology.

Course Content

Topics for Dissertation

1. Drug Discovery
2. Drug Resistance
3. Infection and Immunity
4. Plant- Microbes Interaction
5. Microbial Diversity
6. Bioremediation
7. Prevalence and Characterization of Pathogenic Microorganisms
8. Food Adulteration and Food borne Pathogens
9. Fermented Foods
10. Strain Improvement
11. Enzyme Production
12. Microbial Biotechnology
13. Biomass and Bioenergy Production

Any other topic suggested by departmental committee may also be considered for the dissertation

Course code : MBRS-206
Course Name:–Seminar and Report Writing
Semester/Year: IISemester

	L	T	P	C
		0	10	10

L- Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. **To learn an innovative research to solve the problems faced in current scenario.**
2. **To understand independent and collaborative research projects.**
3. **Tolearnoriginalresearchofsignificanceandquality,forpublications, presentations and original research proposals.**

Course outcomes (Cos):

Upon successful completion of the course a student will be able to

CO1	Observe **innovative** research to solve the problems faced in current scenario.
CO2	Observe and Recognize the basic concept of reading of review literatue/research paper.
CO3	Apply ofadequatescientificunderstandingofthebasicconceptsininstrumentationused in research for both qualitative and quantitative analysis.
CO4	Analyzeand carry out independent and collaborative research projects.
CO5	Choose a original research of significance and quality, for publications, presentations and original research proposals.
CO6	Formulate a small research proposal and published in research article.