Content framework for website

Programme:

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

Introduction

A Bachelor of Science (B.Sc.) in Microbiology (honours/honours with research)is an undergraduate academic program typically spanning three to four years. The "Honours" designation signifies that the program offers a more in-depth and rigorous curriculum compared to a standard bachelor's degree.Within the context of microbiology, an "Honours" program often involves additional coursework, research projects, and possibly internships or fieldwork. This designation indicates that students are expected to delve deeper into the subject matter, developing a more comprehensive understanding of microbiological principles, techniques, and applications

The "Honours with Research" variant of the program typically requires students to conduct an independent research project under the supervision of a faculty member or mentor. This research component allows students to explore specific topics within microbiology in greater depth, develop critical thinking and analytical skills, and contribute to the advancement of scientific knowledge in the field.

In summary, a B.Sc. (Hons) in Microbiology, whether with or without research, is an advanced undergraduate program that provides specialized training in microbiology, preparing students for careers in research, healthcare, industry, or further academic study at the graduate level.

Eligibility:

12th (PCB)or (PCM) or equivalent from any state board with 45% marks

Program Objectives of BSc. Microbiology (honours/honours with research)

i. The students will get exposure totheoretical and practical aspects of Microbiology.

ii. The programme includes details of microorganisms which are important for the fields of agriculture, medicine andindustrial importance.

iii. The students will learn the concepts of biomolecules, enzymes, immunology, cell biology,molecular biology, genetic engineering. They will apply these concepts to make the study of microbiology for sustainabledevelopment of human society.

iv. The practical courses have been designed to equip the students with the laboratory skills inmicrobiology and allied subjects (biochemistry, biotechnology) .

v. The programme will provide students with the knowledge and skills that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas.

vi. The programme will help the students to develop arange of generic skills that are relevant in enhancing entrepreneurship skills.

vii. The students will learn about the impact of microbes on the health of the planet and its inhabitants, as well as the significance of microbiology in the study of all life forms.

Programme outcomes

The NEP 2020 has placed significant emphasis on outcome-based education, which highlights the importance of specific learning outcomes for each course. For the FYUGP in Microbiology, NEP 2020 has set forth a set of programme learning outcomes as below:

Type oflearningoutcomes	TheLearningoutcomesdescriptors
Generic learning outcomes:	***Complex problem-solving***:Microbiology students will be able to analyze and interpret resultsfrom a variety of microbiological methods, and apply these methods to analogous situations. Usemathematical and graphing skills and reasoning to solve problems in microbiology.Understand that microbiology is a complex field with real-world implications, and commit to mastering the material.
	Critical Thinking-Microbiology students will be demonstrate the capacity to cultivates independent thinking and is able to integrate knowledgefrom other disciplines of chemistry , biochemistry, biotechnology andbioinformatics. and fit that knowledge into the context of microbiology. Understand the basic concepts, fundamental principles, and thescientific theories related to various scientific phenomena and their relevancies inthe day-to-day life.
	Creativity:Microbiology students will beable to create experiments to investigate microbial processes, interactions, and functions. such as creative approch for discovering new antibiotics to combat drug-resistant pathogens. Ability to place scientific statements and themes in contexts and also evaluate them interms of generic conventions
	Communication Skills:Communicate and collaborate with other disciplines by effectively communicatingthe fundamental concepts of microbiology in written and oral formatwhich will help in expressing ideas and viewsclearly and effectively.Ability to listen and follow scientific viewpoints and engage with them.Ability to participate constructively in class room discussions.
	Analyticalreasoning/thinkingAnalyze and interpret results from a variety of microbiological methods and quantitative reasoning by using mathematical calculations and graphing skills tosolve problems in microbiology.

	Research-relatedskills:Able to analyze, designstandards, resolve and troubleshoot problems in implementation or standardizationof Life sciences protocols coping up to suit in a position in academia or industry orInstitutions and to pursue a career in research.Enhancement of ability to read, assimilate and discuss scholarly articles and researchpapers showcasing microbiology as well as interdisciplinary areas of life sciences. Systematically collect, record, and analyze data, identify sources of error,interpret the results, and reach logical conclusions.
	Coordinating/collaboratingwithothers:Communicate and collaborate with other disciplines by effectively communicatingthe fundamental concepts of microbiology in written and oral format.
	Leadershipreadiness/qualities:Taking on responsibilities such as organizing events, leading discussions, or managing projects can help develop leadership skills.Engaging in internships or research project in microbiology-related fields can offer practical experiences where students can take on leadership rolessuch as initiative, problem-solving, and teamwork.
	Learning how to learn skills:Learning how to learn enables students to adapt to new information and advancements in the field of microbiology.Efficient learning strategies enable students to manage their time effectively, allowing them to balance their workload and responsibilities more efficiently.
	Digitalandtechnologicalskills:Incorporate advanced digital skills in designing, developing,managing and deploying in media and technical field.
	Multicultural competence*:* as a member in diverse team in multidisciplinary settings where specialties of diverse field work for common goal student develops a sense of multiculturalism
	Value inculcation: Microbiologists must uphold the highest standards of integrity in their research, including honesty, transparency, and adherence to ethical guidelines. This includes accurately reporting data, acknowledging sources, and avoiding conflicts of interest. Microbiologists should consider the ethical implications of their research, including the potential impact on human health, the environment, and society as a whole. Ethical considerations may include issues such as the use of genetically modified organisms, animal testing, and informed consent in clinical research.
	Autonomy, responsibility and accountability*:*Autonomy and responsibility in learning cultivate leadership qualities and effective collaboration skills. Microbiology professionals often work in interdisciplinary teams, where taking initiative and assuming

	accountability contribute to successful teamwork and project outcomes.in scientific investigation
	Environmental awareness and action: develops a basic understanding of the microbiological principlesthat have environmental implicationssuch as bioremediation of polluted sites, microbial ecology in extreme environments, and climate change mitigation strategies involving microbial communities.and gains an awareness of regulatory requirementsand their compliance in microbiological research.
	Community engagement and service:Understand the relationship between science and society by recognizing anddiscussing logical, scientific and ethical issues in microbiology.Creative educational resources, outreach programs, and multimedia tools help engage and inspire interest in microbiology.
	Empathy: Incorporating empathy into microbiology education can therefore lead to more holistic and compassionate healthcare practices, benefiting both patients and healthcare professionals alike. It encourages students to consider the human aspects of microbiological research and practice, ultimately contributing to a more humane and ethical approach to healthcare .

Curriculum Structure

Semester-wise and Broad course category-wise Credit distribution of 4 years UG programmeof Microbiology

Semester	Major Courses – Core (MCC)	Minor course (MC) /vocational courses (VC)	Multidisciplinary courses (MD)	Skill Enhancement course (SEC)	Ability Enhancement courses (AEC)	Value Addition Courses (VAC)	Total credits acquired	Total credits required
I	Introduction to Microbiology(5)	Antiseptic and Disinfectant formulation and Standardization **(VC)** (5)	Choose from DIBNS Pool (3)	Choose from DIBNS Pool (3)	Choose from DIBNS Pool (2)	Choose from DIBNS Pool (2)	20	20
II	Fundamentals of Microbiology(5)	Environmental monitoring programmefor public health **(VC)** (5)	Choose from DIBNS Pool (3)	Choose from DIBNS Pool (3)	Choose from DIBNS Pool (2)	Choose from DIBNS Pool (2)	20	20
							40	**40**
Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate in Microbiology if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester								

III	Fundamentals ofbiochemistry(5) Applied Microbiology(5)	Food fermentation - The Science of cooking with microbes **(VC)**(5)	Choose from DIBNS Pool (3)		Choose from DIBNS Pool (2)		20	20
IV	Soil and Agricultural Microbiology(5) Food and Dairy Microbiology(5)	Microbial Products for Agriculture Application (Biofertilizers, biopesticides) (5) **(VC)**		Choose from DIBNS Pool (3)	MOOCS/SWAYAM/NPTEL (2)	Choose from DIBNS Pool (2)	22	20
							82	**80**
	Students who opt to exit after completion of the second year and have secured 82 credits will be awarded the UG diploma in Microbiology if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year.							
V	Industrial Microbiology (5) Immunology (5) IPR(5)	*choose any one course from identified minor disciplines **(i.e. Botany, Chemistry and Zoology)*** (5)	-	Internship (2)	-	-	22	20
VI	**Environmental Microbiology (5)** **Biological Techniques (5)** **Molecular Biology(5)**	*choose any one course from identified minor disciplines **(i.e. Botany, Chemistry***	-	-	-	-	20	20

		and Zoology) (5)						
	60	**30 (24)**					**124**	**120**
	Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Microbiology after successful completion of three years, securing 124 credits							
VII	Medical Microbiology (5) RDT (5) Virology (5)	*choose any one course from identified minor disciplines* ***(i.e. Botany, Chemistry and Zoology)*** (5)	-	-	-	-	20	20
VIII	Research Methodology (5)	*choose any one course from identified minor disciplines* ***(i.e. Botany, Chemistry and Zoology)*** (5)	-	Dissertation/ Research presentation (12)	-	-	22	20
	80	**40 (32)**	**9**	**9+2int+12dis**	**8**	**6**	**166**	**160**
	Students will be awarded UG Degree (Honours with Research) in the Microbiology if, they secure 166 credits							
	I. Research Methodology (5)	*choose any one course from identified minor disciplines* ***(i.e. Botany, Chemistry and Zoology)*** (5)		Environmental pollution and Bioremediation (4) Microbial Ecology (4) Enzymology			**22**	**20**

				(4)				
	Students will be awarded UG Degree (Honours) in the Microbiology if, they secure 166 credits							

Courses:

Major Discipline: The major discipline refers to the primary subject of study, and the degree will be granted in that specific field. Microbiology students are required to earn 50% of the total credits through Microbiology Major (core) courses within the major discipline (Microbiology)

MAJOR COURSES

For 3 years-60 credits
For 4 years-80 credits

Offered by the Microbiology Department for Microbiology Majoring Students

Semester	Course name	Credits	Teaching Hours per week
I	**Introduction to Microbiology**	5 (3+1+1)	6 hours
II	**Fundamentals of Microbiology**	5 (3+1+1)	6 hours
III	**Fundamentals of biochemistry**	5 (3+1+1)	6 hours
	Applied Microbiology	5 (3+1+1)	6 hours
IV	**Soil and Agricultural Microbiology**	5 (3+1+1)	6 hours
	Food and Dairy Microbiology	5 (3+1+1)	6 hours
V	**Industrial Microbiology**	5 (3+1+1)	6 hours
	Immunology	5 (3+1+1)	6 hours
	IPR	5 (3+1+1)	6 hours
VI	**Environmental Microbiology**	5 (3+1+1)	6 hours
	Biological Techniques	5 (3+1+1)	6 hours
	Molecular Biology	5 (3+1+1)	6 hours
VII	**Medical Microbiology**	5 (3+1+1)	6 hours
	RDT	5 (3+1+1)	6 hours
	Virology		
	Bioprocess Technology	5 (3+1+1)	6 hours
VIII	**Biostats and Research Methodology**	5 (3+1+1)	6 hours
	Total Credits	**80 credits**	

Key Point:

Change of Major: *A student can decide to continue the chosen major or change the major and minor at the end of the second semester or first year.*

MINOR COURSES

For 3 years-30 credits
For 4 years-40 credits

Minor discipline helps a student to gain a broader understanding beyond the major discipline.

Semester	Microbiology OR (20)	Botany OR (20)	Chemistry O (20)	Zoology (20)	Vocational courses (20) credits)
I	NA	NA	NA	NA	**Antiseptic and Disinfectant formulation and Standarization**
II	NA	NA	NA	NA	**Environmental monitoring programme for public health**
III	NA	NA	NA	NA	**Food fermentation -The Science of cooking with microbes**
IV	NA	NA	NA	NA	**Microbial Products for Agriculture Application (Biofertilizers, biopesticides)**
V	General Microbiology	Analytical Techniques in Plant Sciences	Basic Chemistry	Apiculture	NA
VI	Food Microbiology	Natural Resource Management	Molecules of Life	Wildlife management	NA
VII	Industrial Microbiology	Micro propagation techniques	Advance Spectroscopy	Integrated Pest Management	NA
VIII	Agricultural Microbiology	Biodiversity and Conservation	Fundamentals of Analytical Chemistry	Sericulture	NA

Key points:

- *Microbiology majoring students can also choose their minor courses of the study from identified minor disciplines* ***(i.e.Botany, Chemistry and Zoology****) or any* ***Vocational courses*** *in the place of Minor.*
- ***A 50%*** *of the total credits from minors may be secured in any of the relevant discipline* ***(i.e. Botany, Chemistry and Zoology****) and another* ***50%*** *of the total credits can be earned from vocational as per students' choice.*
- ***Vocational courses as Minor****: A minimum of* ***20 credits*** *will be allotted as the 'Minor' stream relating to* ***Vocational Education and Training*** *and these can be related to the major or minor discipline or choice of the student. These courses will be useful to find a job for those students who exit before completing the programme.*
- ***Minor discipline*** *helps a student to gain a broader understanding beyond the major discipline. For instance, if a student pursuing* ***Microbiology major*** *obtains a minimum of* ***20 credits*** *from a bunch of courses in* ***Chemistry****, then the student will be awarded* ***B.Sc. degree in Microbiology*** *with a Minor in* ***Chemistry***
- *Students are advised to choose Minor discipline from other relevant subjects in such a way that the knowledge gained from the Minor papers enriches the study of the Core Major course of the student*
- *The minor discipline selected in the fourth semester will be maintained throughout the duration of the program.*
- *For optimal academic performance, students* ***are encouraged to seek guidance*** *from faculty members within their major discipline prior to selecting minor courses.*

DIBNS MULTIDISCIPLINARY COURSES POOL

Total credits- 9 credits

*These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. Students **are not allowed** to choose or repeat courses already undergone at the **higher secondary level (12th class)** in the proposed major and minor stream under this category*

1. Fascinating world of microbes
2. General Microbiology
3. Food Microbiology
4. Industrial Microbiology
5. Microbial Diversity
6. Physics of Life
7. General Astronomy
8. Biotechnology for human welfare
9. IPRs
10. Plant tissue culture
11. Genetics
12. Chemistry Essentials for Everyday Life
13. Environmental Chemistry-Pollution Control Strategies
14. Elements and Compounds
15. Library and information services
16. Technical writing and communication skill
17. Intellectual property and its management in agriculture
18. Basic concepts in lab techniques
19. Agriculture research ethics and rural development programme
20. Disaster management
21. Fundamentals of Accounting
22. Introduction to Management
23. Fundamentals of Marketing
24. Web Designing
25. Programming in Python
26. DBMS and MySql
27. Ecommerce
28. Cyber law and Security
29. Ergonomical Education
30. Preventive and social medicine

DIBNS ABILITY ENHANCEMENT COURSES (AEC) POOL

Total credits-8 credits

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

1. English Language-I
2. English Language-I
3. French Language -I
4. French Language -II
5. German Language-I
6. German Language-II
7. Sanskrit Language-I
8. Sanskrit Language-II
9. Professional Communication Skills
10. Value Education
11. Personality Development and Soft Skills
12. The Constitution, Human Rights, and the Law
13. ICT integrated presentation skills

NB: NB: In the place of these courses, students may select MOOCs courses from the SWAYAM/NPTEL upto the permissible limit

DIBNS SKILL ENHANCEMENT COURSES (SEC) POOL

Total credits-9 credits

These courses are aimed at imparting practical skills and hands-on training to enhance the employability of students. The DIBNS has designed these courses as per the industry needs

1. Skills in Entrepreneurship, sales and distribution
2. Fermented foods & dairy products
3. Microbial Products for Agriculture Application (Biofertilizers, biopesticides)
4. Quality Control and Regulatory Affairs in Food
5. Bioethics & Biosafety
6. Management of Microbial Laboratory
7. Microbiological hazards and food safety
8. Epidemiology and public health
9. Basics of Instrumentation
10. Electrical Circuit network Skill
11. Sensors and Detectors Technology
12. Radiation Safety
13. Weather forecasting
14. Introduction to SCI-LAB Programming
15. Computational Physics Skills
16. Regulatory Affairs in Biotechnology
17. Entrepreneurship and Innovation
18. Data Science for Biotechnology
19. Bioethics and Biotechnology Policy
20. Biotechnology Marketing and Sales
21. Biostatistics and Experimental Design
22. Medical transcription
23. Medical writing
24. Soil and Water Analysis
25. Aromatherapy & Essential Oils
26. Herbal Drug Formulations
27. Mushroom Production Technology
28. Basics of Internet
29. Basics of Computer Hardware
30. MS Office
31. Stress Management
32. Personality Development

33. Tally Accounting (With GST)
34. Photography and Editing
35. Office Management
36. HR Analytics
37. Organic Farming
38. Portfolio Manager
39. Public Speaking
40. Social and Life Skills
41. Beautician
42. Fashion Designing
43. Digital Marketing
44. Game Designing
45. Web design and Development
46. Social Media Marketing
47. Graphics Designing and Animation
48. Entrepreneurship Skills
49. Tourism Management
50. Life Skills Education
51. Personal Financial Planning
52. Cyber Security

NB: In the place of these courses, students may select MOOCs courses from the SWAYAM/NPTEL upto the permissible limit

Value Added Courses:

Total credits-6credits

The course aims at enabling the students to acquire and demonstrate the knowledge and understanding of **constitution of India** and **environment** in its totality. The focus over the **sports and fitness** of students and cutting-edge areas that are fast gaining prominences, such as Artificial Intelligence (AI), 3-D machining, big data analysis, **digital learning**, for enhancing the employability of the students.

1. Health and Wellness
2. Yoga Education
3. Sports and Fitness
4. Understanding and connecting with environment
5. Understanding India/Digital and Technological Solutions
6. Physical Education
7. Life Skills and personality development
8. Moral values in modern Education
9. Human and Professional Ethics
10. History of Science
11. Solar PB Panel and Installation Maintenance
12. Nondestructive Testing
13. Environmental Physics
14. Environmental studies
15. Indian Knowledge System
16. Financial Literacy
17. Computer Applications
18. Artificial Intelligence Basics and applications in Daily Life
19. Cloud Computing
20. First aid, bls and emergency care
21. Nutrition health & fitness

NB: In the place of these courses, students may select MOOCs courses from the SWAYAM/NPTEL upto the permissible limit

Summer Internship /Apprenticeship:

Total credits: 2 credits

A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning. Microbiology students will have an opportunity to gain valuable, real-world experience in a chosen area of interest through internships programme in industry hospitals, academia, or any national laboratories. Our students are required to earned 2 credits through internship.

Project/Dissertation work:

Total credits: 12 credits

Students choosing a 4-Year Bachelor's degree (Honours with Research) in Microbiology are required to take up research projects under the guidance of a faculty member of department of Microbiology. The students are expected to complete the Research Project in the eighth semester. The research outcomes of their project work may be published in peer-reviewed journals or may be presented in conferences /seminars or may be patented.

Honours students not undertaking research project will do 3 theory courses* for 12 credits in lieu of a research project / Dissertation

***Management of Microbiology lab**
***Microbial Ecology**
*** Enzymology**

MOOCS/SWAYAM/NPTEL

SWAYAM (Study Webs of Active learning for Young Aspiring Minds) is an online portal to provide best teaching-learning experience. SWAYAM is an initiative of Govt of India to promote access for open-learning. Any Students can register to this portal for online courses. SWAYAM is an instrument for a self-actualization providing opportunities for life-long learning. Dolphin PG Institute has taken a step forward towards establishing an SWAYAM-NPTEL local Chapter under the National Programme on Technology Enhanced Learning (NPTEL). The primary aim of this Chapter is to facilitate our students in acquiring knowledge through enriched NPTEL video lectures and obtaining NPTEL certificates for the courses they undertake. This initiative also aims to enhance our students' employability in the industry or prepare them for further higher education in various fields. Dr.AasheeshRaturi, faculty member of the Physics department, has been appointed as the Single Point of Contact (SPOC) for the NPTEL DIBNS Local Chapter and officially recognized by IITM. The responsibilities of the SPOC is to identify mentors from different departments who will encourage students to enrol in relevant NPTEL courses, oversee their progress on a weekly basis, motivate them to complete assignments, register for NPTEL exams, and guide them towards successfully completing the NPTEL courses.

1. MOOCs Courses - Click here
2. SWAYAM Courses – Click here
3. NPTEL Courses- Click here

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IST SEMESTER

MAJOR COURSE

Subject- Introduction to Microbiology

Total Number of Credits: 4+1

Total hours- 60h

Course Description:This subject gives a general insight into the history, basics ofmicrobiology and imparts knowledge about culture media and cultivation techniques used in microbiology.

Course Outcomes:

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

CO1. Understand theories and concepts of microorganisms.

CO2. Understand microscope and different stains and staining techniques

CO3. Describe the morphology of prokaryotic cells

CO4. Understanding composition and preparations of various liquids and solids Culture Media

CO5. Analyzing specimen of aerobes by inoculation of Culture Media

Unit-I: Historical Aspects and Scope of Medical Microbiology :(12Hrs)

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis.Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology.Establishment of fields of medical microbiology and immunology through the work of Ehrlich, Metchnikoff, Jenner.An overview of Scope of Microbiology.

Unit-II: Microscopy and Staining techniques (12Hrs)

Microscopy: Study of compound microscope – magnification, resolution and components of microscope. Introduction and principles of staining, dye and stain, Staining methods such as Gram, Endospore , Capsule and fungal staining.

Unit-III: Classification and General Bacteriology: (12Hrs)

Microbial Classification: kingdom system .Phenotypic and Genotypic basis of classification .Difference between Prokaryotic and eukaryotic cells, Ultra structure of bacterial cell: Morphology of bacteria, Structure and properties of cell wall , Capsule , flagella, fimbrie, pili and spore.

Unit-IV: Culture Media (12Hrs)

Cultural Media: Classification, Liquid and solid Media, Synthetic media, Selective media, differential media, transport media, culture media for fungi . containers for medias, distribution ofmedias in tubes, bottles and Petri dishes. Composition and preparation of cultural Media, role of ingredients of culture media, Precautions during media preparation.

Unit-V: Cultivation and Sterilization techniques (12Hrs)

Pure culture isolation and preservation: Streaking, serial dilution and plating methods, cultivation, maintenance and preservation/stocking of pure cultures, cultivation of aerobic and anaerobic bacteria.Various physical methods of sterilization – heat, UV radiation, ionizing radiation, filtration, characters affecting sterilization, auto clave control and sterilization indicators.

Practicals (30hr)

1. To demonstrate safe code practice for microbiology laboratory.

2. To demonstrate glassware used in microbiology.

3. To demonstrate working and handling of Microscope.

4. To demonstrate method of sterilization by autoclave.

5. To demonstrate method of sterilization by Hot air oven.

6. To perform Gram staining

7. To perform Indian ink staining

8. To prepare the basic culture media

9.To perform the pure culture techniques for isolation of bacteria.

Text books:

Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology.

McGrawHillInternational,Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan Modi H.A, Elementary Microbiology Vol I, Fundamentals of MicrobiologyDubey R. C. and D. K. Maheshwari. A textbook of Microbiology. S Chandand Company. New Delhi, India

Reference books :

Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition

Salle A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education

McDonnell G. E. Antisepsis, Disinfection, and Sterilization: Types, Actionand Resistance. United States: Wiley.

Bergey's Manual of Systematic Bacteriology.Volume Two: TheProteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer.

Atlas R. M. Handbook of Microbiological Media. Ukraine:Taylor andFrancis.

Practical books :

Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson EducationLimited

Aneja K. R. Experiments in Microbiology, Plant Pathology And Biotechnology. New Age International, New Delhi, India

Dubey R. C. and Maheshwari D. K. Practical Microbiology. S. Chand andCompany Limited, New Delhi, India

Sastry A. S. and Bhat S. K. Essentials of Practical Microbiology. JaypeeBrothers, Medical Publishers Private Limited, Pune, Maharashtra, India

IInd SEMESTER

MAJOR COURSE

Subject: Fundamentals of Microbiology

Total Number of Credits: 4+1

Total hours- 60h

Course Discription: Students should understand the principles behind sterilization and disinfection methods and be able to apply appropriate techniques to control bacterial growthand capable of interpreting bacterial growth curves and how different environmental factors affect growth.

Course Outcomes:

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

CO1**.** Applying safety measures and Understand the types and properties of disinfectant in microbiology.

CO2**.**Understand the different methods of bacterial reproduction.

CO3.Understanding theories and applying skills related to growth and Nutrition of Bacteria-

CO4**.** Understand the basic and microbiological instrumentations.

CO5. To learn the basics of Virology, Mycology & Parasitology.

Unit-I: Fundmentals of microbiology lab , Antiseptics & Disinfectants::(12Hrs)

General safety measures used in Microbiology laboratory, Management and quality control of medical microbiology laboratory. Antiseptics & Disinfectants: Definition, types and properties, mode of action, use, qualities of good disinfectants Chemical disinfectants – phenol and its compounds, alcohol, halogen, heavy metals and quaternary ammonium compounds, aldehyde, gaseous compound. Use and abuse of disinfectants. Precautions while using the disinfectants.

Unit-II:Reproduction in Bacteria:(12Hrs)

Vegetative Budding (Fragmentation and Binary fission) and Asexual methods (Endospore formation or sporulation ,Conidia and Zoospore) of reproduction. Genetic recombination (Transformation, Conjugation and Transduction

Unit-II: Growth and Nutrition of Bacteria: (12hrs)

Growth and Nutrition of Bacteria: various phases of growth, typical growth curve, Nutrition of microbes and physical condition required for growth. Effect of Carbon, Nitrogen, Growth factors, Vitamins, Temperature, pH, Osmotic Pressure, Oxygen and Carbon Di Oxide on microbial growth.

Unit-IV: Basic and Microbiological Instrumentation: (12Hrs)

Principle, working, use, care & maintenance of Laminar air flow, Autoclave, hot air Oven, Incubator, Colony Counter,Mac-intos Field-jar .Distillation plant, Centrifuge Machine, Analytical Balance, Hotplate, Magnetic Stirrer, Water Bath.

Unit-V:Introduction to Virology, Mycology &Parasitology :(12Hrs)

Discovery of viruses; Characteristic feature of viruses, viroids, virusoids and prions; Charactersticmorphology, classificationand reproduction of fungi, General characteristics of protozoa with special reference to entamoeba and plasmodium.

Practicals((30hr)

1. To demonstrate techniques for cleaning of glassware's.

2. To demonstrate working and maintenance of laminar air flow

3. To demonstrate working and maintenance of autoclave.

4. To demonstrate biomedical waste management

5. To demonstrate hot air oven.

6. To demonstrate the use of disinfectants and preparation of working dilution of various disinfectants.

7. To demonstrate incubator and preservation of cultures.

8. To demonstrate sterilization method by filtration.

Text books:

Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology.

McGrawHillInternational,Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan Modi H.A, Elementary Microbiology Vol I, Fundamentals of MicrobiologyDubey R. C. and D. K. Maheshwari. A textbook of Microbiology. S Chandand Company. New Delhi, India

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Powar C. B. and Daginawala H. I. General microbiology Volume I. Himalaya

Publishing House Private Limited, Pune, India.

McDonnell G. E. Antisepsis, Disinfection, and Sterilization: Types, Actionand Resistance. United States: Wiley.

Bergey's Manual of Systematic Bacteriology.Volume Two: TheProteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer.

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Aneja K. R. Experiments in Microbiology, Plant Pathology And Biotechnology. New Age International, New Delhi, India

Dubey R. C. and Maheshwari D. K. Practical Microbiology. S. Chand andCompany Limited, New Delhi, India

Sastry A. S. and Bhat S. K. Essentials of Practical Microbiology. JaypeeBrothers, Medical Publishers Private Limited, Pune, Maharashtra, India

DIBNS pools of Vocational courses offered by department of Microbiology for all other courses

Sl. No.	Subject	Credits
1.	**Disinfection, Sterilization and Antisepsis**	5(4+1)
2.	**Epedimeology and public health**	5(4+1)
3.	**Food fermentation -The Science of cooking with microbes**	5(4+1)
4.	**Microbial Products for Agriculture Application (Biofertilizers, biopesticides)**	5(4+1)

Subject- Disinfection, Sterilization and Antisepsis

Total Number of Credits: 4+1

Total hours- 60h

Course Description

This paper is aimed to train students to have theoretical and technical education in basic and application areas of disinfection, sterilization and antisepsis. The course will help students t understand and implement the approaches for asepsis..

Course Outcome:

CO1. Gain knowledge about disinfection, antisepsis and sterilization.

CO2. Understand the key principles of Cleaning & Disinfection.

CO3. Comprehend the role of antisepsis.

CO4. Analysis of formulation,evaluation& standardization methods of disinfectants.

CO5. Application of sterilization in specific context and settings.

UNIT- I: Introduction of Disinfection, antisepsis and sterilization (12h)

Overview of disinfection, antisepsis and sterilization principles.

Mode of action of sterilization.

Physical methods of sterilization: Temperature, Filtration,desiccation,osmotic pressure,Radiation

Basic principles of ventilation, composition of Air, Air flow, Humidity and temperature

Unit-II: Classification and details of disinfectants (12h)

Difference between cleaning, sanitization & disinfecting. Key principles of Cleaning & Disinfection. CDC Guideline for Disinfection and Sterilization,Guidelines for using sodium hypochlorite as a disinfectant for biological waste. Factors Influencing Efficacy of Disinfection/Sterilization

Selection criteria and concentration determination of disinfectant

Preparation and application of disinfection,Manufacturer's specifications,Reading of labels.Different classes & levels of disinfectants

Safety issues & environmental considerations regarding use of chemicals as disinfectants.Cost-effectiveness of disinfectants

Unit-III: Antiseptics (12h)

Classification of antiseptics,Hand Hygiene in Health Care Settings

Topical antiseptic products (hand-sanitizers & soaps)

Health Care Sanitizers & Public use sanitizers

FDA regulations of sanitizers

Unit-IV: Formulation,evaluation& standardization methods of disinfectants (12h)

Formulation of disinfectants as recommended by organizations.Evaluation of disinfectants by Phenol coefficient test,Quantitative surface test & microbiocidal tests.

Hygienic hand rub method, Fingerpad method

Microbial resistance to disinfectants

Disinfectant challenge testing

Unit-V: Applications of sterilization in specific context (12h)

Sanitization & sterilization of salons,cosmetic settings, dentists

Sterilization of operation theaters

Different processes of Water treatment & purification, removal of bacteria

Practicals(30hr)

1. To study the effect of temperature on microbial growth.
2. To determine the Phenol Coefficient of given disinfectant.
3. To evaluate the efficacy of a hygienic handrub.
4. To evaluate different hand drying methods for removing bacteria from washed hands.
5. To evaluate the evaluation of antiseptics filter paper disk methods.
6. To formulate a hand sanitizer.
7. To determine phenol coefficient of the given disinfectant.
8. To comparatively assess commercially available disinfectants by finger-pad method.

Textbooks:

Microbiology,Pelczar Jr M. J., Chan E. C. S., Krieg N. R. 5th edition (1986), McGraw Hill Book Company NY

Prescott, Harley, and Klein's Microbiology, J. M. Willey, L. M. Sherwood, C. J. Woolverton, 7th Edition (2008), McGraw Hill Higher Education- USA

Reference books:

Ascenzi, J.M., Ed. Handbook of Disinfectants and Antiseptics, 5th ed.; Marcel Dekker: New York, 1995; Block, S.S., Ed. Disinfection, Sterilization, and Preservation, 5th ed.; Lippincott

Williams & Wilkins Publishers: Philadelphia, 2000. Russell, A.D.; Hugo, W.B.; Ayliffe, G.A.J., Eds. Principles and Practices of Disinfection, Preservation and Sterilization, 3rd ed.; Blackwell Science Inc.: London, 1999.

Sandle, T., ed. (2012). The CDC Handbook: A Guide to Cleaning and Disinfecting Cleanrooms (1st ed.). Grosvenor House Publishing Limited. ISBN 978-1781487686.

Lowbury, E.J.L., Ayliffe, G.A.J., Geddes, A.M., Williams, J.D. (1998). Disinfection (1) Types of Chemical Disinfectant and Formulation of Policy for Disinfection. In: Lowbury, E.J.L., Ayliffe, G.A.J., Geddes, A.M., Williams, J.D. (eds) Control of Hospital Infection. Springer, Boston, MA. https://doi.org/10.1007/978-1-4899-6884-5_6

Subject- Epidemiology & Public Health

Total Number of Credits: 4+1

Total hours- 60h

Course Description

This paper helps in skill enhancement of the students of Microbiology so that they can understand the principles of epidemiology.The students can comprehend the role of

microbiology in public health.

Course Outcome:

CO1. Gain knowledge about the epidemics and different types of outbreaks.

CO2. Understand the importance of Public Health Microbiology.

CO3. Comprehend the role of sanitization and prophylaxis in control of infections.

CO4. Understand the transmission and control of air borne,water borne and food borne infections.

CO5. Describe hospital acquired infection and sanitation in community

Unit-I: Introduction to Epidemiology and Public Health (12h)

Concept of disease cycle,outbreaks, epidemics,epidemiology.Introduction to public health: definition, scope, concept and importance of public health. Roles of microbiologist in epidemiology and monitoring public health. Control and Surveillance of microbial infections. One Health Mission and Approach regarding public health.

Unit-II: Air borne infections & vector transmitted infections (12h)

Air borne infections: air and its composition – indoor air – outdoor air – air borne diseases (bacterial, fungal and viral) – methods of enumeration of microorganisms in air. Diseases transmitted by Vectors (fomites ,arthropods).

Unit-III: Water borne infections (12h)

Water borne infections: kinds of water – water borne diseases (viral, bacterial, protozoan), methods of enumeration of microorganisms in water,indicator organism, control of water borne diseases. Determination of potability of water, Water treatment & disinfection.

Unit-IV: Food borne infections (12h)

Food borne diseases: definition and importance of food hygiene,types (spoilage of meat and its products, fish and fish products and eggs), role of microorganisms in food spoilage and poisoning, food borne diseases,types of food borne diseases, detection and control of food borne diseases.

Unit-V: Hospital acquired infections (12h)

Hospital acquired infection: Prophylactic immunization, disposal of infective hospital and laboratory materials, monitoring of sanitation in community, techniques used for the diagnosis of hospital acquired infection.

Practicals(30hr)

1. Enumeration (Counting) Of Bacteria in water sample By Plate Count Or Serial Dilution Agar Plate Technique.
2. Bacteriological examination of food samples
3. Enumeration of microorganisms in air through settle plate method.
4. Determination of potability of water through membrane filteration method .
5. To detect the presence of coliform in given water sample by
    a) Presumptive test
    b) Confirmed test
    c) Completed test

Text books

Ghimire P. and Parajuli K. (2005) A Text Book of Microbiology, Vidhyarthi Pustak Bhandar Publication, Kathmandu.

Brownson, R.C., Baker, E.A., Leet T.L. and Follespie K.N. (2003) Evidence Based Public Health, Oxford University Press.

Reference books

Engelkirk P.G. and Duben-Engelkirk J. (2015) Burton's Microbiology for the Health Sciences, 10th Edn. Wolters Kluwer Health.

Park K. (2017) Parks Text Book of Preventive and Social Medicine, Banarsidas Bhanot Publishers.

Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn. Springer.

FOOD FERMENTATION -The Science of cooking with microbes

Total Number of Credits: 4+1

Total hours- 60h

Course Objectives:

Food Fermentation: The Science of Cooking with Microbes, explore the roles that microbes play in the production, preservation, and enhancement of diverse foods in a variety of culinary traditions and to create a scientific environment among students which make them acquaint for food and fermentation industry.

Course Outcomes (COs)

CO1 Development of scientific knowledge regarding various fermented foods and

there health benefits.

CO2 Application and evaluation of microbes in production of different milk

product focusing on with their industry and research institution.

CO3 Describing the manufacturing process of some fermented foods with the helpof some microbes.

CO4 Acquire knowledge regarding fermentation product formed by using somevegetables.

CO5 Evaluate technical awareness regarding fermentation product prepared byusing grains

UNIT-I: Fermetation Methods(12h)

Historical Background of Fermentation; Significance of Fermented Foods; Types of

Fermentation and mechanisms involved; Microorganisms involved in FoodFermentations. nutritive value of fermented foods .

UNIT-II: Alcoholic Fermentation(12h)

Importance of ethanol; Production of ethanol from sugar, starch and cellulosicsubstrates; Wines and their importance; Microorganisms involved in WineProduction; Prodcution of White and Red Wine; Apple Cide and Wines from otherFruits; Industrial Production of Vinegar.

UNIT-III: Fermented Milk Products(12h)

Past, present and future of milk based fermented foods; Microbiology of Fermented Milk-Starter Lactic Culture; Industrial production and nutritional values of milk based fermented foods like Curd, Yoghurt, Kafir, Butter Milk and Cheeses.

UNIT-IV: Lactic Acid Fermentation(12h)

Importance of Lactic Acid fermentation; Fermentation techniques and Importance of Sauerkraut, Kanji, Cucumber Pickle, Olives and Mixed vegetables pickles.

UNIT-V: Grain Based and Fermented food Products(12h)

Industrial production and nutritional values of Grain based Fermented foods like Soy sauce, Bread, Idli, Dosa, Jalebi and Bhature;Meat product s; Microorganisms and production process of Sausages and Sauces.

Practicals (30hr)

1. Production of Sauerkraut.
2. Estimation of lactic acid production in sauerkraut.
3. Effect of salt concentration on lactic acid production in sauerkraut.
4. Production of Kanji through fermentation .
5. To study fermentation in alcoholic beverage production.
6. To investigate fermentation in wine production.
7. Testing for pH, acidity, alcohol content, and other chemical parameters of wine.
8. Assessing Sensory Evaluation (taste, aroma, texture, and appearance of wine).

Text Books

1. Adams, M.R., and Moss, M.O. (2000) Food microbiology. Royal Society of Chemistry Publication, Cambridge.

2. Frazier, W.C. and Westhoff, D.C. (1988) Food microbiology. Tata McGraw Hill, New Delhi.

Reference Books:

1. Jay J.M., Loessner, M.J. and Golden D.A. (2005) Modern Food Microbiology, 7 th Edn.Springer, p.782.

2. Matthews K.R., Kniel K.E. and Montville T.J. (2017) Food microbiology: An Introduction,4 th Edn., ASM Press, Washington, DC

3. The Microbiological Safety and Quality of Food. 2000. Barbara M. Lund, Baird-Parker,Gould G.W. An Aspen publication, Maryland, U.S.A

4. Wood, B.J. (2012) Microbiology of fermented foods. Elsevier Applied Sciences,

London.

Practical Books

1.Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/CummingsPublishing Company, San Francisco.

2.Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown,Dubuque.

3. McLandsborough, L. Food microbiology laboratory. CRC Press, Boca Raton.

4.. Harrigan, W.F. Laboratory methods in food microbiology. Gulf Professional Publishing,Houston.

Microbial Products for Agriculture Application (Biofertilizers, biopesticides)

Total Number of Credits: 4+1

Total hours- 60h

Course Description: This course explores the principles, applications, and advancements in microbial products specifically designed for agricultural purposes, focusing on biofertilizers and biopesticides. Students will gain knowledge into the fundamental concepts of microbiology as it relates to agriculture, emphasizing the roles of beneficial microorganisms in enhancing crop productivity and managing pests sustainably.

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

Course Outcomes (COs)

CO1 Attain basic information regarding biofertilizer and their application forplant growth.

CO2 Inculcate deep knowledge and understanding of Non - Symbiotic N2 fixers

CO3 Appraising the role ofPhosphate solubilizing microbes microbes in biofertilizer production.

CO4 Demonstrate the scientific knowledge about various types of Mycorrhizal biofertilizers.

CO5 Understand the concept of production, field application of *Bacillusthuringiensis* as an important biopesticides.

UNIT-1: Biofertilizers(12h)

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers; Symbiotic N 2 fixers: Rhizobium (Isolation, characteristics, inoculums production, mass multiplication and field application), Frankia (Isolation, characteristics, inoculum production, mass multiplication and field application), Cyanobacteria (Isolation, characteristics, Inoculum production, mass multiplication, field application and role in rice cultivation).

Unit 2 Non - Symbiotic N2 fixers(12h)

Free living Azospirillum, Azotobacter - free isolation, characteristics, mass inoculum production andfield application.

Unit 3 Phosphate solubilizers(12h)

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, fieldapplication.

Unit 4 Mycorrhizal biofertilizers(12h)

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculumproduction of VAM, field applications of Ectomycorrhizae and VAM.

UNIT-V: Biopesticides(12h)

General account of microbes used as biopesticides and their advantages over synthetic pesticides; Bacillus thuringiensis: Mechanism of biocontrol; Production of bioinsecticide, Field applications, Viruses: Cultivation, Mechanism of biocontrol, Field applications.

Practicals

1. Isolation and identification of Rhizobium from root nodules of leguminous plants.
2. Isolation and purification of Azotobacter from soil.
3. Isolation and purification of Azospirillum from roots.
4. Isolation and purification of Phosphate solubilising bacteria from soil
5. Isolation and purification of Bacillus from soil.
6. Isolation and purification of Trichoderma from soil.

Text Books:

1.Satyanarayana, T., Johri, B.N. and Prakash, A. Microorganisms in environmental management: Microbes and environment. Springer Verlag, New York.

2. Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. PrenticeHall, New Jersey.

Reference Books:

1. Kannaiyan, S. Bioetchnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai . Hand book of Microbial biofertilizers, The Haworth Press, Inc. NewYork.

3. Reddy, S.M. Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

4. Subba Rao N.S Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt.Ltd. NewDelhi.

5. Saleem F and Shakoori AR Development of Bioinsecticide, Lap Lambert AcademicPublishing GmbH KG

Practical Books

1.Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/CummingsPublishing Company, San Francisco.

2.Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown,Dubuque.

3.Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New AgeInternational (P) Limited, New Delhi.

4.Pepper, I.L., Gerba, C.P. and Brendecke, J.W. Environmental microbiology: A laboratorymanual. Academic Press, San Diego.

5.Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L. and Stetzenbach, L.D.Manual of environmental microbiology. ASM Press, Washington, D.C

DIBNS pools of Skill Basedcourses offered by department of Microbiology for all other courses

Sl. No.	Subject	Credits
	Skill Based –	
5.	Fermented Food and Dairy Products	3 Credits
6.	Microbial Products for Agriculture Application (Bio-fertilizer)	3 Credits
7.	Quality Control and Regulatory Affairs in Food	3 Credits
8.	Management of Microbiology laboratory	3 Credits
9.	Microbiological Hazards and Food Safety	3 Credits

Fermented Food and Dairy Products

CREDITS:03

Total hours- 45 h

Course Objectives:

Food Fermentation: The Science of Cooking with Microbes, explore the roles that microbes play in the production, preservation, and enhancement of diverse foods in a variety of culinary traditions and to create a scientific environment among students which make them acquaint for food and fermentation industry.

Course Outcomes (COs)

CO1. Development of scientific knowledge regarding various fermented foods and there health benefits.

CO2. Application and evaluation of microbes in production of different milk product focusing on with their industry and research institution.

CO3. Describing the manufacturing process of some fermented foods with the help of some microbes.

CO4. Acquire knowledge regarding fermentation product formed by using some vegetables.

.Evaluate technical awareness regarding fermentation product prepared by

using by using grains

UNIT-I: Fermetation Methods(9h)

Historical Background of Fermentation; Significance of Fermented Foods; Types of Fermentation and mechanisms involved; Microorganisms involved in Food

UNIT-II: Alcoholic Fermentation(9h)

Importance of ethanol; Production of ethanol from sugar, starch and cellulosicsubstrates; Wines and their importance; Microorganisms involved in WineProduction; Prodcution of White and Red Wine; Apple Cider and Wines from otherFruits.

UNIT-III: Fermented Milk Products(9h)

Past, present and future of milk based fermented foods; Microbiology of Fermented Milk-Starter Lactic Culture; Industrial production and nutritional values of milk based fermented foods like Curd, Yoghurt, Kafir, Butter Milk and Cheeses.

UNIT-IV: Lactic Acid Fermentation(9h)

Importance of Lactic Acid fermentation; Fermentation techniques and Importance of Sauerkraut, Kanji, Cucumber Pickle, Olives and Mixed vegetables pickles.

UNIT-V: Grain Based and Fermented food Products(9h)

Industrial production and nutritional values of Grain based Fermented foods like Soy sauce, Bread, Idli, Dosa, Jalebi and Bhature.

Text Books

1. Adams, M.R., and Moss, M.O. (2000) Food microbiology. Royal Society of Chemistry Publication, Cambridge.

2. Frazier, W.C. and Westhoff, D.C. (1988) Food microbiology. Tata McGraw Hill, New Delhi.

Reference Books:

1. Jay J.M., Loessner, M.J. and Golden D.A. (2005) Modern Food Microbiology, 7 th Edn.Springer, p.782.

2. Matthews K.R., Kniel K.E. and Montville T.J. (2017) Food microbiology: An Introduction,4 th Edn., ASM Press, Washington, DC

3. The Microbiological Safety and Quality of Food. 2000. Barbara M. Lund, Baird-Parker,Gould G.W. An Aspen publication, Maryland, U.S.A

4. Wood, B.J. (2012) Microbiology of fermented foods. Elsevier Applied Sciences,

London.

Microbial Products for Agriculture Application (Biofertilizers, biopesticides)

CREDITS:03

Total hours- 45h

Course Description: This course explores the principles, applications, and advancements in microbial products specifically designed for agricultural purposes, focusing on biofertilizers and biopesticides. Students will gain knowledge into the fundamental concepts of microbiology as it relates to agriculture, emphasizing the roles of beneficial microorganisms in enhancing crop productivity and managing pests sustainably.

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

Course Outcomes (COs)

CO1 Attain basic information regarding biofertilizer and their application for

plant growth.

CO2 Inculcate deep knowledge and understanding of Non - Symbiotic N2 fixers

CO3 Appraising the role ofPhosphate solubilizing microbes microbes in biofertilizer production.

CO4 Demonstrate the scientific knowledge about various types of Mycorrhizal biofertilizers.

CO5 Understand the concept of production, field application of Bacillus

thuringiensis as an important biopesticides.

UNIT-1: Biofertilizers(9h)

General account of the microbes used as biofertilizers for various crop plants and their

advantages over chemical fertilizers; Symbiotic N 2 fixers: Rhizobium (Isolation,

characteristics, inoculums production, mass multiplication and field application).

Unit 2 Non - Symbiotic N2 fixers(9h)

Free living Azospirillum, Azotobacter - free isolation, characteristics, mass inoculum production andfield application.

Unit 3 Phosphate solubilizers(9h)

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, fieldapplication.

Unit 4 Mycorrhizal biofertilizers(9h)

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculumproduction of VAM, field applications of Ectomycorrhizae and VAM.

UNIT-V: Biopesticides(9h)

General account of microbes used as biopesticides and their advantages over synthetic pesticides; Bacillus thuringiensis: Mechanism of biocontrol; Production of bioinsecticide, Field applications, Viruses: Cultivation, Mechanism of biocontrol, Field applications.

Text Books:

1.Satyanarayana, T., Johri, B.N. and Prakash, A. Microorganisms in environmental management: Microbes and environment. Springer Verlag, New York.

3. Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. PrenticeHall, New Jersey.

Reference Books:

1. Kannaiyan, S. Bioetchnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai . Hand book of Microbial biofertilizers, The Haworth Press, Inc. NewYork.

3. Reddy, S.M. Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

4. Subba Rao N.S Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt.Ltd. NewDelhi.

5. Saleem F and Shakoori AR Development of Bioinsecticide, Lap Lambert AcademicPublishing GmbH KG

Quality control and Regulatory affairs in Food

Total Number of Credits: 3

TOTAL HOURS: 45 h

Course Description : This course provides a comprehensive overview of the principles and practices of quality control and regulatory affairs in the food industry. Students will explore the critical components of ensuring food safety, quality, and compliance with regulatory standards.

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

Course Outcomes (COs)

CO1.Describe the principles of food quality and safety and their importance in the food industry.

CO2.Apply regulatory knowledge to ensure compliance with food safety standards and regulations.

CO3.Demonstrate proficiency in implementing QA/QC practices to maintain food quality throughout the supply chain.

CO4.Conduct food testing, interpret results, and make recommendations based on findings.

CO5.Discuss ethical and legal implications in food production and regulatory affairs.

Unit –I : Introduction to Food Quality and Safety:(09 Hrs)

Definition of food quality and safety, Importance of ensuring food safety for public health, Overview of global regulatory frameworks (e.g., FDA, EFSA, Codex Alimentarius), Principles of quality assurance (QA) and quality control (QC) in food production.

Unit 2: Food Safety Management Systems(08 Hrs)

Introduction to Food Safety Management Systems (FSMS), Implementation of Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP), Hazard Analysis and Critical Control Points (HACCP) system: principles and application, Overview of FSMS standards (e.g., ISO 22000, FSSC 22000) and their requirements.

Unit 3: Regulatory Compliance and Standards(09 Hrs)

Role of regulatory agencies in ensuring food safety and quality, Understanding national and international food regulations, Labeling requirements and standards compliance, Regulatory considerations for food additives, contaminants, and residues.

Unit 4: Food Testing and Analysis(09 Hrs)

Overview of different methods used for food testing (chemical, microbiological, physical) Selection criteria for appropriate testing methods based on food type and analyte, Importance of representative sampling in food testing, Sampling plans and procedures (random sampling, composite sampling, grab sampling), Factors influencing sampling design (batch size, lot size, heterogeneity).

Unit 5: Emerging Issues and Practical Applications(09 Hrs)

Current challenges in food safety and quality management, Emerging trends and technologies in the food industry, Case studies on regulatory compliance and crisis management, Ethical considerations in food production and marketing.

Text Books

1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGrawHill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.

Reference Books

1. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals andFrontiers, 4th Edn. ASM press.
2. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn.Springer Publishers.
3. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers.

4. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication,Cambridge.

5. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.

6. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.

7. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.

8. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London.

9. Ayres, J.C., Mundt, O. and Sandinee, W.E. Microbiology of foods. W.H. Freeman andCompany, New York.

10. Jay, M.J., Loessner, M.J. and Golden, D.A. Modern food microbiology. Springer Science andBusiness Media, New York.

Subject- Management of Microbiology Laboratory

Total Number of Credits: 3

TOTAL HOURS: 45 h

Course Description: This skill enhancement course is designed to enable students to understand the management and quality control of microbiology laboratory.

Course Outcomes

CO1.Understand the rules, regulations and record keeping of microbiological laboratory.

CO2. Comprehend laboratory management and quality control.

CO3. Working knowledge of instruments and quality control measures commonly adopted in microbiology laboratory.

CO4. Knowledge of procedures involved in maintenance of microbial cultures.

CO5. Understand the principles and procedure of laboratory waste disposal.

Unit-I: Rules & Records of Microbiology Lab (9h)

Rules and regulations to be followed in a microbiology laboratory – maintenance of records – familiarizing with common chemicals, instruments and equipments of microbiology laboratory.

Unit-II Laboratory Management (9h)

Laboratory management: human resources – logistics and supply – test performance – data management – resource tapping – instruments – water and sources of light and electricity – room– table and benches and space in the laboratory.

Unit - III: Quality control inMicrobiology Lab (9h)

Laboratory quality control assessment: Internal quality control and external quality control.

Unit-IV Maintenance of microbial cultures (9h)

Maintenance of type strains or reference strain of microbes,culture collection centres, catalogue and procedure for procurement of type cultutres, methods for maintenance and preservation of cultures.

Unit-V: Waste disposal in Microbiology Lab (9h)

Laboratory waste disposal system: national and international guidelines for the disposal of waste. Basic concepts of bio-safety and its universal precautions.

Text books

Cappuccino J.G. and Sherman N. (2014) Microbiology a laboratory manual. 10thEdn. Pearson. Gile, T.J. and Scungio D. (2014)

Complete guide to Laboratory safety, 4th Edn. HCPro a division of BLR. Mackie and McCartney Practical Medical Microbiology.J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons

Reference Books

Emmert E. (2013). Biosafety guidelines for handling microorganisms in the teaching. Forbes B.A., Sham D.E. and Weissfeld A.S. (2007) Bailey and Scotts Diagnostic Microbiology 12 th Edn, Mosby Publications.

Koneman EW, Allen SD, Janda WM, Schreckenberger PC, Winn WC. Color Atlas and Textbook of Diagnostic Microbiology, J.B. Lippincott, Philadelphia.

Practical Books

Cappucino J and Sherman N. Microbiology: A Laboratory Manual. Pearson Education Limited

Mackie and McCartney Practical Medical Microbiology.J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons

Aneja K. R. Experiments in Microbiology, Plant Pathology And Biotechnology. New Age International, New Delhi, India

Dubey R. C. and Maheshwari D. K. Practical Microbiology. S. Chand and Company Limited, New Delhi, India

Murray PR, Baron EJ, Pfaller MA, Tenover FC, Yolken RH. Manual of Clinical Microbiology, American Society for Microbiology

Microbial Hazards and Food Safety

Total Number of Credits: 3

TOTAL HOURS: 45 h

Course Objective:

This course explores the microbiological hazards associated with food and the principles and practices of food safety management. Topics include microbial pathogens, their behavior in food environments, risk assessment, regulatory frameworks, and strategies for prevention and control of foodborne illnesses.

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

CO1.Understand the microbiological hazards present in food and their impact on public health.

CO2.UnderstandMicrobial Growth and Factors Influencing Growth in Foods

CO3.Identify major foodborne pathogens, their characteristics, and routes of transmission.

CO4.Develop strategies for preventing and controlling foodborne illnesses in various food production and service settings.

CO5.Apply principles of hazard analysis critical control points (HACCP) in food processing and handling.

Unit –I: Basics of Microbiology in Food Safety(9h)

Definition of microbiology and its significance in food safety**,** Microbial taxonomy: bacteria, viruses, parasites, fungi**,** Differences between prokaryotic and eukaryotic microorganisms, Basic laboratory safety protocols, Techniques for isolation and identification of foodborne pathogens

Unit – II: Microbial Growth and Factors Influencing Growth in Foods(9h)

Microbial growth curve: lag phase, log phase, stationary phase, decline phase, Factors influencing microbial growth: Environmental factors (temperature, pH, water activity, oxygen availability), Intrinsic factors of food (composition, nutrients), Extrinsic factors (storage conditions, packaging), Protective mechanisms of microorganisms (spore formation, biofilm formation).

Unit – III: Spoilage Microorganisms & Toxins Produced by Microorganisms(9h)

Types of spoilage microorganisms (yeasts, molds, bacteria), Signs of spoilage in different food types (meat, dairy, fruits, vegetables), Types of toxins: bacterial toxins (e.g., enterotoxins, neurotoxins), mycotoxins, Effects of toxins on human health, Examples of foodborne illnesses caused by toxin-producing microorganisms

Unit – IV: Foodborne Pathogens, Prevention and Control of Foodborne Hazards(9h)

Definition and characteristics of foodborne pathogens, Major foodborne pathogens: Bacteria (e.g., Salmonella, Escherichia coli, Listeria monocytogenes), Viruses (e.g., Norovirus, Hepatitis A virus), Parasites (e.g., Cryptosporidium, Giardia), Sources and routes of transmission of foodborne pathogens. Control measures at each stage of the food chain: production, processing, distribution, and consumption, Hygiene and sanitation practices in food establishments, risk communication and consumer education

Unit – V: Food Safety Management Systems(9h)

Hazard analysis critical control points (HACCP) principles and applications, Good Manufacturing Practices (GMPs) and Good Hygienic Practices (GHPs), International and national food safety regulations and standards.

Text Books

1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGrawHill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.

Reference Books

1. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals andFrontiers, 4th Edn. ASM press.
2. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn.Springer Publishers.
3. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers.

4. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication,Cambridge.

5. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.

6. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.

7. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.

8. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London.

9. Ayres, J.C., Mundt, O. and Sandinee, W.E. Microbiology of foods. W.H. Freeman andCompany, New York.

10. Jay, M.J., Loessner, M.J. and Golden, D.A. Modern food microbiology. Springer Science andBusiness Media, New York.

DIBNS pools of Multidisciplinarycourses offered by department of Microbiology for all other courses

Sl. No.	Subject	Credits
1.	Introduction to Fascinating World of Microbes	3 Credits
2.	General Microbiology	3 Credits
3.	Food Microbiology	3 Credits
4.	Industrial Microbiology	3 Credits
5.	Human Pathogenic Microbes	3 Credits

Subject- Introduction to Fascinating World of Microbes

Total Number of Credits: 3

Total hours- 45h

Course Description: This subject gives a general insight into the history, basics ofmicrobiology and imparts knowledge about culture media and cultivation techniques used in microbiology.

Course Outcomes:

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

CO1. Understand theories and concepts of microorganisms.

CO2. Understand microscope and different stains and staining techniques

CO3. Describe the morphology of prokaryotic cells

CO4. Understanding composition and preparations of various liquids and solids Culture Media

CO5. Analyzing specimen of aerobes by inoculation of Culture Media

Unit-I: Historical Aspects and Scope of Microbiology :(8Hrs)

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis.Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming. Role of

microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology.Establishment of fields of medical microbiology and immunology through the work of Ehrlich, Metchnikoff, Jenner.An overview of Scope of Microbiology.

Unit-II: Microscopy and Staining techniques (8Hrs)

Microscopy: Study of compound microscope – magnification, resolution and components of microscope. Introduction and principles of staining, dye and stain, Staining methods such as Gram, Endospore and fungal staining.

Unit-III: Classification and General Bacteriology: (9Hrs)

Microbial Classification: kingdom system .Phenotypic and Genotypic basis of classification .Difference between Prokaryotic and eukaryotic cells, Ultra structure of bacterial cell: Morphology of bacteria, Structure and properties of cell wall , Capsule , flagella, fimbrie, pili and spore.

Unit-IV: Culture Media (8Hrs)

Cultural Media: Classification, Liquid and solid Media, Synthetic media, Selective media, differential media, transport media, culture media for fungi . containers for medias, distribution ofmedias in tubes, bottles and Petri dishes. Composition and preparation of cultural Media, role of ingredients of culture media, Precautions during media preparation.

Unit-V: Cultivation and Sterilization techniques (10Hrs)

Pure culture isolation and preservation: Streaking, serial dilution and plating methods, cultivation, maintenance and preservation/stocking of pure cultures, cultivation of aerobic and anaerobic bacteria.

Various physical methods of sterilization – heat, UV radiation, ionizing radiation, filtration, characters affecting sterilization, auto clave control and sterilization indicators.

Text books:

Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education

Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International

Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.

Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan

Modi H.A, Elementary Microbiology Vol I, Fundamentals of Microbiology

Dubey R. C. and D. K. Maheshwari. A textbook of Microbiology. S Chandand Company. New Delhi, India

Reference books :

Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition

Salle A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education

Powar C. B. and Daginawala H. I. General microbiology Volume I. Himalaya

Publishing House Private Limited, Pune, India.

McDonnell G. E. Antisepsis, Disinfection, and Sterilization: Types, Actionand Resistance. United States: Wiley.

Bergey's Manual of Systematic Bacteriology.Volume Two: TheProteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer.

Atlas R. M. Handbook of Microbiological Media. Ukraine:Taylor andFrancis.

Subject: Genaral Microbiology

Total Number of Credits: 3

Total hours- 45h

Course Discription: Students should understand the principles behind sterilization and disinfection methods and be able to apply appropriate techniques to control bacterial growthand capable of interpreting bacterial growth curves and how different environmental factors affect growth.

Course Outcomes:

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

CO1**.** Applying safety measures and Understand the types and properties of disinfectant in microbiology.

CO2**.**Understand the different methods of bacterial reproduction.

CO3.Understanding theories and applying skills related to growth and Nutrition of Bacteria-

CO4**.** Understand the basic and microbiological instrumentations.

CO5. To learn the basics of Virology, Mycology & Parasitology.

Unit-I: Fundmentals of microbiology lab , Antiseptics & Disinfectants::(8Hrs)

General safety measures used in Microbiology laboratory, Management and quality control of medical microbiology laboratory. Antiseptics & Disinfectants: Definition, types and properties, mode of action, use, qualities of good disinfectants Chemical disinfectants – phenol and its compounds, alcohol, halogen, heavy metals and quaternary ammonium compounds, aldehyde, gaseous compound. Use and abuse of disinfectants. Precautions while using the disinfectants.

Unit-II:Reproduction in Bacteria:(8Hrs)

Vegetative Budding (Fragmentation and Binary fission) and Asexual methods (Endospore formation or sporulation ,Conidia and Zoospore) of reproduction. Genetic recombination (Transformation, Conjugation and Transduction

Unit-II: Growth and Nutrition of Bacteria: (7hrs)

Growth and Nutrition of Bacteria: various phases of growth, typical growth curve, Nutrition of microbes and physical condition required for growth. Effect of Carbon, Nitrogen, Growth factors, Vitamins, Temperature, pH, Osmotic Pressure, Oxygen and Carbon Di Oxide on microbial growth.

Unit-IV: Basic and Microbiological Instrumentation: (8Hrs)

Principle, working, use, care & maintenance of Laminar air flow, Autoclave, hot air Oven, Incubator, Colony Counter,Mac-intos Field-jar .Distillation plant, Centrifuge Machine, Analytical Balance, Hotplate, Magnetic Stirrer, Water Bath.

Unit-V:Introduction to Virology, Mycology &Parasitology :(8Hrs)

Discovery of viruses; Characteristic feature of viruses, viroids, virusoids and prions; Charactersticmorphology, classificationand reproduction of fungi, General characteristics of protozoa with special reference to entamoeba and plasmodium.

Text books:

Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education
Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology.

McGrawHillInternational,Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan Modi H.A, Elementary Microbiology Vol I, Fundamentals of MicrobiologyDubey R. C. and D. K. Maheshwari. A textbook of Microbiology. S Chandand Company. New Delhi, India

Reference books :

Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition

Salle A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education

Powar C. B. and Daginawala H. I. General microbiology Volume I. Himalaya

Publishing House Private Limited, Pune, India.

McDonnell G. E. Antisepsis, Disinfection, and Sterilization: Types, Actionand Resistance. United States: Wiley.

Bergey's Manual of Systematic Bacteriology.Volume Two: TheProteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer.

Atlas R. M. Handbook of Microbiological Media. Ukraine:Taylor andFrancis.

FOOD AND DAIRY MICROBIOLOGY (3 credits)
Total hours- 45h

Course Description: The course providesMicrobiology students with a comprehensive understanding of the role of microorganisms in food and dairy products, emphasizing both theoretical knowledge and practical skills essential for careers in food science.

Course Outcomes (COs)

Upon successful completion of the course the student will
CO1.understand the factors affecting the growth of microorganisms in food.
CO2.gain knowledge on the principles of food preservation.
CO3.gain understanding on the spoilage of various foods.
CO4.have knowledge on Food Safety and Quality Assurance

CO5.understand food borne infections, intoxications

Unit - I
Food as a substrate for microorganisms (9h)

microorganisms important in food microbiology:molds, yeasts and bacteria – factors affecting the growth of microorganisms in food.

Unit II: Principles of Food Preservation(9h)

Factors influencing microbial growth in food; Asepsis; Food preservation: Principles, Physicalmethods (Dehydration, freeze drying, heat and irradiation), Chemical methods (Chemicalpreservatives and food additives); Canning; Processing for heat treatment (D, Z and F values)and working out treatment parameters.

Unit - IIISpoilage of food and fermented dairy products.(9h)
vegetables, eggs, milk and milk products, meat and meat products, fishand sea foods and canned foods.

Unit IV: Food Safety and Quality Assurance(9h)

Food sanitation in manufacture and retail trade; Microbiological quality standards of food; Foodcontrol agencies and their regulations: FDA, EPA, CDC and ISI; Good Manufacturing Practice;Plant sanitation (Employees health standards, waste treatment and disposal); Hazard Analysisand Critical Control Point (HACCP) system; Food Safety Act and Trade Regulations.

Unit V: Foodborne Infections and Intoxications(9h)

Bacterial and nonbacterial infections and intoxications of Brucella, Bacillus, Clostridium,Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, Listeria, nematodes, fungi and viruses; Laboratory testingprocedures.

Text Books

1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGrawHill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.

Reference Books

1. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals andFrontiers, 4th Edn. ASM press.
2. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn.Springer Publishers.
3. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers.

4. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication,Cambridge.

5. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.

6. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.

7. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.

8. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London.

9. Ayres, J.C., Mundt, O. and Sandinee, W.E. Microbiology of foods. W.H. Freeman andCompany, New York.

10. Jay, M.J., Loessner, M.J. and Golden, D.A. Modern food microbiology. Springer Science andBusiness Media, New York.

INDUSTRIAL MICROBIOLOGY

3 credits
Total hours- 45h

Course Description : This course prepares Microbiology students for careers in biotechnology companies, pharmaceutical firms, food and beverage industries, environmental agencies, and research institutions where knowledge of industrial microbiology is essential for innovation and product development. Students are expected to gain both theoretical knowledge and practical skills necessary for applying microbiological principles to real-world industrial processes.

Course Outcomes: After completion of this course students will be able to
CO1 gains insight on industrially important microbes and their isolation and screening .
CO2. techniques involved in the development of industrially relevant strains and their preservation,
CO3.differentiate between the design of a laboratory and industrial scale fermenter as well the different types of fermenters and instrumentations associated with it.
CO4. differentiate between batch, fed-batch and continuous cultivation systems arious downstream processing techniques
CO5. learn about process optimization involved in the development of industrilly important commercial products.

Unit I: Introduction to Industrial Microbiology(9h)

Historical aspects ,Introduction to microbial products ,Sources of industrially important microorganisms ,Strategies for isolation and cultivation of desired microorganisms,Criteria of primary and secondary screening, selection and identification of industrially important microorganisms,Primary and secondary metabolites.

Unit2.Microbial strain improvement(9h)

Strategies of strain improvement for primary, secondary metabolites with relevant examples.Recombinant DNA technology in strain improvementProtoplast fusion techniques for strain improvement of primary and secondary metabolite.Preservation of cultures after strain improvement programme

Unit3.Fermentor Design (9h)

Fermentor designing & operationBasic functions of fermentors,Fermentor construction (SealingBaffles Impellers Aeration system (sparger)AgitationSampler designFoam controllerTypes of fermentorsSubmerged fermenter systemsAir lift fermentors,Stirred tank fermenter

Unit4.Operational mode of fermentation and down stream processing(9h)

Operational modes of fermentation(Batch,fed- batch and continuous) Downstream processing for filtration (DSP) cell disruption ,Liquid-liquid extraction ,Solvent recovery ,Supercritical fluid extraction ,Various chromatography techniques in product recovery Diafiltration ,Ultrafiltration,Reverseosmosis,Drying (lyophilization and spray drying) ,Whole broth processing ,Crystallization ,Product recovery

Unit5.Biotechnological applications of microbes in the commercial production(9h)

Production of Alcoholic beverages: Beer, Whisky, Wines. .Antibiotics:penicillin, tetracycline,D-cycloserine,streptomycin,bacitracinand grieseofulvin .Amino acids: Glutamic acid, lysine.Vitamins :B12 and Riboflavin

Text Books

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.2ndEdition. Panima Publishing Company, New Delhi.84
2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited PublishingCompany Ltd. New Delhi, India

3.Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

Reference Books

1.Richard, H., George, B., Hagemann, D. and Paul, L. Industrial microorganisms: Basic andapplied molecular genetics. ASM Press, Washington, D.C.
2. Flickinger M.C. and Drew S.W. (1999) Encyclopedia of Bioprocess Technology: Fermentation,Biocatalysis and Bioseparation, (Vol 1-5), Wiley publishers.
3. Stanbury P.T., Whitaker A. and Hall S. (2016) Principles of Fermentation Technology,Butterworth-Heinemann.

Subject- Human Pathogenic Microbes

Total Number of Credits: 3

TOTAL HOURS: 45h

Course Description: This course will help the students to understand the concepts of infection process, host-pathogen interactions and medically important pathogens.

Course outcomes:

CO1. Acquire knowledge pertaining to normal microflora of human body and their importance.

CO2.**T**o understand common bacterial diseases.

CO3.Recognize viral pathogens, their symptoms mode of transmission with recent viral outbreak.

CO4.Acquaint the various techniques used inunderstanding Protozoal Diseases.

CO5.Understand the nomenclature and classification system of Fungal Diseases.

UNIT-I: Normal Microflora of the Human Body and Host Pathogen Interaction(9h)

Normal microflora of the human body: Importance of Normal Microflora, NormalMicroflora of Skin, Throat, Gastrointestinal Tract, Urogenital Tract; Host pathogeninteraction: Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity,Carriers and their types

UNIT-II: Bacterial Diseases(9h)

Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms: *Staphylococcus aureus,Streptococcus pyogenes, Streptococcus pneumoniae,Escherichia coli, Shigella, Salmonella, Vibrio cholerae, Mycobacterium tuberculosis*

UNIT-III: Viral Diseases:(9h)

Causative agent, Symptoms, Mode of transmission, Prophylaxis and Control: Polio,Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swineflu, Chikungunya

Unit-IV: Protozoal Diseases (9h)

Clinical features, transmission, pathogenesis, laboratory diagnosis, prevention and control of common protozoal diseases: Amoebiasis, Leishmaniasis, Malaria.

Unit-V: Fungal Diseases(9h)

Classification & brief account of fungal diseases, superficial, sub-cutaneous ,oppurtunistic and systemic mycosis.

Text books

Ananthanarayanan and Paniker's Text book of Microbiology.R. Ananthanarayan and C. K. Jayaram Paniker

Text Book of Microbiology.Apurba S Sastry & Sandhya Bhat. Jaypee Publishers

Textbook Of Microbiology 5th Edition by DR Arora. CBS Publishers & Distributors.

Textbook of Microbiology . CP Baveja. Arya Publications

Reference Books

Forbes B.A., Sham D.E. and Weissfeld A.S. (2007) Bailey and Scotts Diagnostic Microbiology 12th Edn, Mosby Publications.

Brooks G., Carrol K.C., Butel J. and Morse S. (2012) Jawetz Melnick and Adelberg Medical Microbiology, 26th Edn. Lange Medical Publications.

Greenwood D., Slack R.C.B., Barer M.R. and Irving W.L. (2012) Medical Microbiology, 18th Edn. Elsevier Churchill Livingstone.

DIBNS pools of Minor courses offered by department of Microbiology for all other courses

Sl. No.	Subject	Credits
1.	General Microbiology	5 Credits
2.	Environment Microbiology	5 Credits
3.	Soil and agricultural microbiology	5 Credits

General Microbiology

Total Number of Credits: 4+1

Total hours- 60h

Course Description: This subject gives a general insight into the history, basics ofmicrobiology and imparts knowledge about culture media and cultivation techniques used in microbiology.

Course Outcomes:

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

CO1. Understand theories and concepts of microorganisms.

CO2. Understand microscope and different stains and staining techniques

CO3. Describe the morphology of prokaryotic cells

CO4. Understanding composition and preparations of various liquids and solids Culture Media

CO5. Analyzing specimen of aerobes by inoculation of Culture Media

Unit-I: Historical Aspects and Scope of Microbiology :(12Hrs)

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis.Contributions of Leeuwenhoek, Pasteur, Koch, Lister, Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various

microbiological techniques and golden era of microbiology.Establishment of fields of medical microbiology and immunology through the work of Ehrlich, Metchnikoff, Jenner.An overview of Scope of Microbiology.

Unit-II: Microscopy and Staining techniques (12Hrs)

Microscopy: Study of compound microscope – magnification, resolution and components of microscope. Introduction and principles of staining, dye and stain, Staining methods such as Gram, Endospore and fungal staining.

Unit-III: Classification and General Bacteriology: (12Hrs)

Microbial Classification: kingdom system .Phenotypic and Genotypic basis of classification .Difference between Prokaryotic and eukaryotic cells, Ultra structure of bacterial cell: Morphology of bacteria, Structure and properties of cell wall , Capsule , flagella, fimbrie, pili and spore.

Unit-IV: Culture Media (12Hrs)

Cultural Media: Classification, Liquid and solid Media, Synthetic media, Selective media, differential media, transport media, culture media for fungi . containers for medias, distribution ofmedias in tubes, bottles and Petri dishes. Composition and preparation of cultural Media, role of ingredients of culture media, Precautions during media preparation.

Unit-V: Cultivation and Sterilization techniques (12 Hrs)

Pure culture isolation and preservation: Streaking, serial dilution and plating methods, cultivation, maintenance and preservation/stocking of pure cultures, cultivation of aerobic and anaerobic bacteria.

Various physical methods of sterilization – heat, UV radiation, ionizing radiation, filtration, characters affecting sterilization, auto clave control and sterilization indicators.

Practicals

1. To demonstrate safe code practice for microbiology laboratory.

2. To demonstrate glassware used in microbiology.

3. To demonstrate working and handling of Microscope.

4. To demonstrate method of sterilization by autoclave.

5. To demonstrate method of sterilization by Hot air oven.

6. To perform Gram staining

7. To perform Indian ink staining

8. To prepare the basic culture media

9.To perform the pure culture techniques for isolation of bacteria.

Text books:

Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. Pearson Education

Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International

Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.

Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. General Microbiology. McMillan

Modi H.A, Elementary Microbiology Vol I, Fundamentals of Microbiology

Dubey R. C. and D. K. Maheshwari. A textbook of Microbiology. S Chandand Company. New Delhi, India

Reference books :

Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition

McDonnell G. E. Antisepsis, Disinfection, and Sterilization: Types, Actionand Resistance. United States: Wiley.

Bergey's Manual of Systematic Bacteriology.Volume Two: TheProteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer.

Atlas R. M. Handbook of Microbiological Media. Ukraine:Taylor andFrancis.

Environmental Microbiology

Total Number of Credits: 4+1

Total hours- 60h

Course Description: Environmental microbiology is a dynamic field that bridgesfundamental microbiological principles with real-world applications in environmental management and sustainability. This course equips Microbiology students with the knowledge and skills to understand and manipulate microbial communities for beneficial environmental outcomes.

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

CO 1. developed a fairly good knowledge and understanding of different typesof environments and habitats where microorganisms grow.

CO 2. Understand how microbes interact among themselves and with higher plants and animals with the helpof various examples.

CO3.aware of the important role microbes play in bio-geochemical cycling of essential elementsoccurring within an ecosystem and its significance.

CO4.Gain in depth knowledge of different types of solid waste, liquid waste and their management.

CO5. Have practically assess the portability ofdrinking water by the use of standard microbiological tests.

Unit 1 Microorganisms and their Habitats(08 Hrs)

Structure and function of Ecosystems.Terrestrial Environment: Soil profile and Soil Microflora.Aquatic Environment: Microflora of fresh water and marine habitats.Atmosphere: Aeromicroflora and dispersal of microbes.Microbes in extreme environment.

Unit 2 Microbial Interactions(12 Hrs)

Microbeinteractions:Mutualism,Synergism,Commensalism,Competition,Amensalism, Parasitism, Predation. Microbe-Plant interaction: Symbiotic and Non-symbiotic interactions. Microbe-animal interaction: Microbes in Ruminants,Nematophagus fungi and Symbiotic luminescent bacteria.

Unit 3 Biogeochemical Cycling(12Hrs)

Carbon cycle: Microbial degradation of Cellulose, Hemicelluloses, Lignin and Chitin.

Nitrogen cycle: Nitrogen fixation, Ammonification, Nitrification, Denitrification and

Nitrate Reduction.Phosphorus cycle: Phosphate Immobilization and Solubilisation.

Sulphur cycle: Microbes involved in Sulphur cycle other elemental cycles: Iron and Manganese.

Unit 4 Waste Management(12Hrs)

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (Composting and Sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (Oxidation ponds,Trickling filter, Activated Sludge process and Septic tank) and Tertiary Sewage treatments.

Unit 5 Water Potability(12 Hrs)

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique

Practicals

1. Analysis of Soil- pH, moisture content, Water holding capacity.
2. Isolation of Microbes (Bacteria & Fungi) from Soil
3. Isolation of Rhizobium from Root nodules.
4. Assessment of Microbiological quality of Water.
5. Determination of BOD of waste water sample.
6. Study the presence of microbial activity by detecting (qualitatively) Enzymes (Amylase, Urease) in Soil.
7. Isolation of Microbes (Bacteria & Fungi) from Rhizosphere and Rhizoplane.

Text Books:

1.Satyanarayana, T., Johri, B.N. and Prakash, A. Microorganisms in environmental management: Microbes and environment. Springer Verlag, New York.

4. Madigan, M.T., Martinko, J.M. and Parker, J. Brock biology of microorganisms. PrenticeHall, New Jersey.

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.5.

6. Chapman, J.L. and Reiss, M.J. Ecology: Principles and applications. Cambridge UniversityPress, Cambridge.

7. Heywood, V.H. and Watson, R.T. Global biodiversity assessment. Cambridge UniversityPress, Cambridge.

8. Kormondy, E.J. Concepts of ecology. Prentice-Hall, New Delhi.

9. Odum, E.P. Basic ecology. Saunders, Philadelphia.

10. Mitchell, R. and Gu, J.D. Environmental microbiology. Wiley-Blackwell, New Jersey.

11. Maier, R., Pepper, I. and Gerba, C. Environmental microbiology. Academic Press, SanDiego.

12. Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. JohnWiley and Sons, New York.

13. Satyanarayana, T., Littlechild, J. and Kawarabayasi, Y. Thermophilic microbes in environmental and industrial biotechnology. Springer Science and Business Media, Dordrecht.

Practical Books

1.Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/CummingsPublishing Company, San Francisco.

2.Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown,Dubuque.

3.Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New AgeInternational (P) Limited, New Delhi.

4.Pepper, I.L., Gerba, C.P. and Brendecke, J.W. Environmental microbiology: A laboratorymanual. Academic Press, San Diego.

5.Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L. and Stetzenbach, L.D.Manual of environmental microbiology. ASM Press, Washington, D.C.

Soil and agricultural microbiology

Total Number of Credits: 4+1

Total hours- 60h

Course Description: Soil and agriculturalMicrobiology as a course deals with soil is a medium for microbial growth, therelation of microbes to important mineral transformations in soil, importance ofbiological equilibrium and significance of soil microbes to environmental quality.

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

CO 1understand the diverse groups of microorganisms in soil and its role in soil fertility.

CO2 Understanding the abiotic and biotic components of Soil.

CO3 gain knowledge on the microbial association

CO4 aware of the important role microbes play in bio-geochemical cycling of essential elementsoccurring within an ecosystem and its significance.

CO5 understand the role of biofertilizers and biopesticides and their importance.

Unit-I**Introduction to soil microorganisms (12 Hrs)**

Introduction to soil microorganisms – bacteria (cyanobacteria and actinobacteria), algae,fungi, protozoans, nematodes and viruses – Role of microbes in soil fertility.Plant growth promoting rhizobacteria

Unit 2:Organic and Inorganic Matter Dynamics in Soil:(12 Hrs)

Microbial decomposition of cellulose, hemicellulose and lignin, Factors affectingorganic matter decomposition. Mechanism of nitrogen fixation, Mechanism of phosphate solubilization and phosphate mobilization, Mechanism of iron chelation, Production of plant growth promoting hormones from bacteria and fungi,

Unit 3 Microbial Associations(12 Hrs)

MicrobialAssociations:Mutualism,Synergism,Commensalism,Competition,Amensalism, Parasitism, Predation. Microbe-Plant interaction: Symbiotic and Non-symbiotic interactions. Microbe-animal interaction: Microbes in Ruminants,

Unit 4 Biogeochemical Cycling(12 Hrs)

Carbon cycle: Microbial degradation of Cellulose, Hemicelluloses, Lignin and Chitin.

Nitrogen cycle: Nitrogen fixation, Ammonification, Nitrification, Denitrification and

Nitrate Reduction.Phosphorus cycle: Phosphate Immobilization and Solubilisation.

Sulphur cycle: Microbes involved in Sulphur cycle other elemental cycles: Iron and

Manganese.

Unit 5: Biopesticides and Biofertilizers:(12 Hrs)

General account of microbes used as biopesticides and their advantages over syntheticpesticides; Bacillus thuringiensis: Mechanism of biocontrol; Production ofbioinsecticide, Field applications, Viruses: Cultivation, Mechanism of biocontrol,Field applications.Biofertilizers; Isolation, purification, mass multiplication, inoculum production and method of application of biofertilizers: *Azospirillum*, *Azotobacter*, *Rhizobium*, Cyanobacteria, AM fungi, Phosphate solubilizer, Algal biofertilizers; Storage, shelflife, qualitycontrol and marketing of biofertilizers.

Practicals
1. Isolation of bacteria, fungi and actinobacteria from soils.
2. Isolation of nitrogen fixing bacteria from root nodules of legumes.
3. Isolation of antagonistic Pseudomonas from soil.
4. Isolation of P solubilizing microorganisms.

5.Isolation and biochemical identification of PGPR from plant rhizosphere.

6.Determination of siderophore production by PGPR.

Text Books

1. Sylvia D.M., Fuhrmann, J.J., Hartel P.J. and Zuberer D.A. Principles and Applicationsof Soil Microbiology, 2nd Edn. Pearson, Prentice Hall.
2. Subba Rao N.S. Soil Microorganisms and plant growth, Oxford and IBH PublishingCo.Pvt. Ltd.

3. Dubey, R.C., A Text book of Biotechnology S.Chand & Co, New Delhi.

Reference Books

1. Glick B.R. Beneficial Plant Bacterial Interactions, Springer.

2. Paul E.A. (Ed.) Soil Microbiology, Ecology and Biochemistry, 4thEdn, Academic Press.

3. Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A.BrockBiology of Microorganisms, 15thEdn. (Global Edn.) Pearson Education.

Practical Books

1.Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/CummingsPublishing Company, San Francisco.

2.Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown,Dubuque.

3.Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New AgeInternational (P) Limited, New Delhi.