National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities/ Colleges
SUBJECT: MICROBIOLOGY

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Syllabus Developed by:

Name	Designation	Affiliation
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Department of Higher Education
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National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities

Proposed Titles for Theory and Practical Papers
Under Graduate Programme

SUBJECT: MICROBIOLOGY

Syllabus Developed by:

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Department of Higher Education, Government of Uttar Pradesh, Lucknow

National Education Policy-2020

Common minimum syllabus for U.P. State Universities

Certificate Course in Microbial Techniques, Diploma in Microbial Technology and B.Sc. Microbiology

Semester wise titles of the papers for B.Sc. (Microbiology)

Year	Semester	Course Code	Paper Title	Theory /Practical	Credits
1	I	**B080101T**	General Microbiology	Theory	04
		B080102P	Experiments in Basic Microbiology	Practical	02
	II	**B080201T**	Agriculture and Environmental Microbiology	Theory	04
		B080202P	Experiments in Agriculture and Environmental Microbiology	Practical	02
2	III	**B080301T**	Basic Biochemistry and Microbial Physiology	Theory	04
		B080302P	Experiments in Basic Biochemistry and Microbial Physiology	Practical	02
	IV	**B080401T**	Molecular Biology and Microbial Genetics	Theory	04
		B080402P	Experiments in Molecular Biology and Microbial Genetics	Practical	02
3	V	**B080501T**	Medical Microbiology	Theory	04
		B080502T	Immunology	Theory	04
		B080503P	Experiments in Medical Microbiology & Immunology	Practical	02
	VI	**B080601T**	Food Microbiology	Theory	04
		B080602T	Industrial Microbiology	Theory	04
		B080603P	Experiments in Food & Industrial Microbiology	Practical	02

Proposed Year wise Structure of UG Program in Microbiology

Programme/ Year	Sem.	Course code	Paper title	Credits	Teaching hours
1 **Certificate Course in Microbial Techniques**	I	**B080101T**	General Microbiology	4	60
		B080102P	Experiments in Basic Microbiology	2	60
	II	**B080201T**	Agriculture and Environmental Microbiology	4	60
		B080202P	Experiments in Agriculture and Environmental Microbiology	2	60
2 **Diploma in Microbial Technology**	III	**B080301T**	Basic Biochemistry and Microbial Physiology	4	60
		B080302P	Experiments in Basic Biochemistry and Microbial Physiology	2	60
	IV	**B080401T**	Molecular Biology and Microbial Genetics	4	60
		B080402P	Experiments in Molecular Biology and Microbial Genetics	2	60
3 **Degree in Bachelor of Science**	V	**B080501T**	Medical Microbiology	4	60
		B080502T	Immunology	4	60
		B080503P	Experiments in Medical Microbiology & Immunology	2	60
	VI	**B080601T**	Food Microbiology	4	60
		B080602T	Industrial Microbiology	4	60
		B080603P	Experiments in Food & Industrial Microbiology	2	60

Subject prerequisite

To study MICROBIOLOGY at undergraduate, a student must have Biology in Class 12.

Programme Objectives (POs)

1. The programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of Microbiology.
2. The programme includes details of important microorganisms of agricultural, medical and industrial importance, biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.
3. The practical courses have been designed to equip the students with the laboratory skills in microbiology. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data
4. The programme will provide students with the knowledge and skill base that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas that involve microbiology, biochemistry, biotechnology and molecular biology and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students
5. The students will be exposed to a wide range of careers that combine microbiology, environment, industry and medical.

Certificate Course in Microbial Techniques

B. Sc. I Programme Specific Outcomes (PSOs)

PSO1	Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.
PSO2	Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PSO4	Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.
PSO5	The certificate course will enable students to apply for technical positions in government and private labs/institutes.

Diploma in Microbial Technology	
B.Sc. II Programme based outcomes	
PSO 1	Students will develop familiarity and understanding of the microbiology concepts as relevant to various areas such as biochemistry, microbial physiology, molecular biology and genetics.
PSO 2	Students will exhibit reasonable abilities in the utilization of instruments, advances and techniques common to microbiology, and apply the logical strategy and theory testing in the plan and execution of examinations.
PSO3	Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.
PSO4	Students will be able to describe how microorganisms obtain energy, metabolism, reproduction, survival, and interactions with their environment, hosts, and host populations.
PSO5	Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate a broad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.
PSO2	Students will learn about various biotechnological applications of microorganisms as well as industrially relevant substances developed by microorganisms. They'll learn about the special role microbes play in genetic modification technologies.
PSO3	Students will learn and develop good laboratory practices in a microbiological laboratory, as well as be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.
PSO4	Students will learn about experimental methods, hypothesis creation and testing, and experiment design and execution. Students can develop their critical thinking skills as well as their ability to read and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.
PSO5	The Degree courses will enable students to go for higher studies in Microbiology and Allied subjects leading to Post Graduation and Ph.D. degrees.

Detail Syllabus of

B.Sc. I Year

or

Certificate in Microbial Technology

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

Course Outcomes:

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

- To understand the history, relevance of microbiology and classification of microbes.
- To learn and understand the microbial diversity in the living world.
- To understand the working of various microscopes and their applications.
- To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes.
- To demonstrate and understanding of bacterial, fungal, cyanobacterial, algal, viral and rickettesial classification, culturing, reproduction and significance.
- To learn different methods of staining of microbes.
- To understand, learn and gain skill of isolation, culturing and maintenance of pure culture.
- To enable the students to get sufficient knowledge in principles and applications of bio-instruments.
- To help students gain knowledge about antibiotics and other chemotherapeutic agents.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Introduction, history and scope of Microbiology** History, scope, branches of microbiology and relevance of microbiology; Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De; Position of microorganisms in the living world. 5 kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms- bacteria, archaea, eukarya; Bergey's manual and introduction to classification of bacteria.	**8**
II	**Bacterial morphology** Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria. **The viruses** General properties and structure of animal viruses: Influenza, HIV; plant viruses: TMV; bacterial viruses: Lambda Phage and T4 bacteriophage; general features of Prions and Viroids. **Fungi** General characteristics, classification & reproduction of Saccharomyces, Aspergllus. **Protozoa** General characteristics, classification & reproduction of Giardia, Entamoeba	**10**
III	**Techniques in microbiology I** Principles of microscopy, construction and application of-	**6**

	Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy ,Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM	
IV	**Techniques in microbiology II** Principles, construction and application of centrifuge; bacteriological Incubator & Incubator Shaker; Laminar flow; Colourimeter & Spectrophotometer (UV-Vis)	**6**
V	**Sterilization techniques and control of microorganisms** Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration; Filtration- Seitz filter, membrane filter, HEPA filter; Radiation- Ionizing and non- ionizing; Chemical methods- Alcohols, aldehydes, phenols, halogens, metallic salts, ethylene oxide.	**7**
VI	**Isolation, cultivation and preservation of microorganisms** Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique, and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure culture	**8**
VII	**Stains and staining techniques** Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Ziehl Neelsen staining; Structural staining- cell wall, capsule, endospore and flagella staining.	**7**
VIII	**Biostatistics** Introduction to biostatistics – definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic biodiagrams.	**8**

Suggested Readings:

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

11. Sharma P.D., Microbiology, Rastogi Publications.
12. Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9th edition, Pearson Education.
13. Suggestive digital platforms web links-
    - https:/www.classcentral.com/tag/microbiology
    - https://cmp.berkeey.edu/bacteria/bacteria.html
    - https://www.livescience.com/53272-what-is-a-virus.html
    - https://www.slideshare.net/sardar1109/algae-notes-1
    - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
    - https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
    - https://microbenotes.com/laminar-flow-hood
    - https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf

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

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

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

Further Suggestions: None

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

Course Outcomes:

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

- To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.
- Practical skills in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose.
- To prepare slides and stain to see the microbial cell.

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

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

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1.	● Good labroratory practice in Microbiology and safety measures. ● Cleaning and sterilization of glassware and equipments. ● Study of aseptic technique- preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum.	**12**
2.	● Study of instruments- Microscope, autoclave, hot air oven, laminar airflow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colourimeter, spectro photometer.	**12**
3.	● Preparation of different culture media- nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture. ● Enumeration of bacteria using spread plate and pour plate techniques. ● Isolation of bacteria by pour plate, spread plate and streak plate method.	**12**
4.	● Staining of bacteria- 1. Simple staining- methylene blue 2. Gram's staining 3. Acid fast staining 4. Ziehl Neelsen staining 5. Giemsa staining 6. Structural staining- capsule, endospore. 7. Staining of fungi using lactophenol and cotton blue.	**12**
5.	Study of permanent slide and life materials ● Bacteria- Staphylococci, Streptococococci, Bacillus sp., Vibrio,	**12**

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

Suggested Readings:

1. Microbiology: A laboratory manual by J. Cappucino and C.T. Welsh. 11th edition, Pearson education, USA. 2016
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultiation, New Age International, New Delhi.
3. Dubey R.C.. and Maheshwari D.K., Textbook of practical microbiology, S Chand Publications.
4. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology, 5th edition McMillan.
5. Lab Virtual links-
    - https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32196
    - https://www.labster.com/microbiology-virtual-labs/
    - https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials

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

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

Suggested Continuous Evaluation Methods:

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Further Suggestions: None

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

Course Outcomes:

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

- Get acquainted with natural habitats of diverse protection.
- Understand how microbes interact among themselves and with higher plants and animals with the help of various examples.
- Become aware of the important role microbes play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.
- Gain in depth knowledge of different types of solid waste, liquid waste and their management.
- Get familiar with problems of pollution and applications of clear up technologies for the pollutants.
- Know about the diverse microbial populations in various natural habitats like soil, air, water.
- Gain knowledge of the bio-fertilizer and their types.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Microorganisms and their habitats** Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aeromicroflora and dispersion of microbes; Animal Environment: Microbes in/on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low nutrient level; Microbial succession in decomposition of plant organic matter.	**8**
II	**Microbial Interactions** Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza (types and its applications).	**8**
III	**Biogeochemical cycling** Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle.	**8**

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

Suggested Readings:

1. Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
2. Alexopoulas C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
3. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi
4. Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
5. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi.
6. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
8. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
9. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
11. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.
12. Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.
13. Suggestive digital platforms web links-
    - https://www.classcentral.com/tag/microbiology
    - https://www.mooc-list.com/tags/biotechnology
    - https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques
    - https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health

• https://collegelearners.com/ebooks/agricultural-microbiology-pdf-free-download
This course can be opted as an elective by the students of following subjects: Open for all ……
Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology
Suggested Continuous Evaluation Methods: **House Examination/Test:** 10 marks **Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar:** 10 Marks **Class performance/Participate:** 5 Marks
Further Suggestions: None

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

Course Outcomes:

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

- To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory.
- Practical skill in the laboratory experiments in microbiology.
- Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose.
- To prepare slides and stain to see the microbial cell.

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

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

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	• To analyse soil- pH, moisture, water holding capacity.	8
2	• Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28° C & 45° C) • Isolation of bacteria and fungi from rhizosphere and rhizoplane. • Isolation of bacteria & fungi from air environment by exposure plate method. • Isolation of Rhizobium sp. from leguminous root nodule.	16
3	• To determine BOD of waste water sample. • Bacteriological examinaiton of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test.	12

4	• Specimen study of plant pathogens. 1. Black rust of wheat 2. White rust of crucifer 3. Leaf curl of tomato 4. Downy mildew 5. Red rot of sugarcane	**10**
5	Study of permanent slide and life materials • *Cladosporium* • *Helmithosporium* • *Mucor* • *Curvularia* • *Alternaria* • *Geotrichurn* • *Trichoderma* • *Rhizopus*	**14**

Suggested Readings:

1. Agrios A.G. Plant Pathology, Elsevier Academic Press, New Delhi, 2006.
2. Atlas RM and Batha R (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba Cp (2009). Environmental Microbiology. 2nd edition, Academic Press.
4. Subba Rao NS. (1999). Soil Microbiology, 4th edition. Oxford & IBH Publishing Co. New Delhi.
5. Virtual Lab Links-
   - https://vlab.amrita.edu/?sub=3&brch=73
   - https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
   - https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/

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

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

Suggested Continuous Evaluation Methods

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Further Suggestions: None

Detail Syllabus of

B.Sc. II Year

or

Diploma in Microbial Technology

Programme/Class: Diploma	**Year:** Second	**Semester:** Third
Subject: MICROBIOLOGY		
Course Code: B080301T	**Course Title:** Basic Biochemistry and Microbial Physiology	

Course Learning Outcomes:

Upon successful completion of the course, the student:

- Will have understanding of the basic principles of thermodynamics applied to biological systems
- Will be conversant with the structures of carbohydrates, lipids, proteins and nucleic acids
- Will comprehend the basic concepts of enzyme biochemistry including enzyme kinetics, and will become aware of different variants of enzymes found in living cells.
- Will be acquainted with the diverse physiological groups of bacteria/archaea and microbial transport systems.
- Will have an in-depth knowledge of patterns of bacterial growth, bacterial growth curve, calculation of generation time and specific growth rate, and effect of the environment on growth.
- Will apprehend how biochemical pathways are used by bacteria for energy generation and conservation during growth on glucose under aerobic and anaerobic conditions
- Will be familiar with the physiology of nitrogen fixation and assimilation of inorganic nitrogen by bacteria and understand how interactions between microbes and the environment affect cellular physiology.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of thermodynamics and bioenergetic** Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions and coupled reactions	**6**
II	**Water & Carbohydrates** Structure and properties of water, Handerson Hasselbalch equation, Ionic product of water, pH and buffers. Structure & classification of carbohydrates, carbohydrates metabolism: glycolysis, fermentation, Pentose phosphate pathway (PPP), Entner Doudoroff pathway, Krebs Cycle, Electron transport chain (ETC)- Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis	**12**
III	**Proteins** **Structure & Classification-** Protein structure: primary, secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary-human hemoglobin as an example. Forces involved in protein folding	**6**
IV	**Lipids & Nucleic acids** Structure and classification of lipids. Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physic-chemical properties of DNA. RNA types- rRNA, mRNA, tRNA.	**6**

V	**Enzymology concepts:** Concepts of holozymes, apoenzyme, cofactors, prosthetic group, coenzyme, metal cofactors; Classification of enzymes; Active site and activation energy; Lock and key hypothesis, induced fit hypothesis; enzyme kinetics; Allosteric enzymes-cooperativity; Enzyme inhibition: competitive and noncompetitive	**6**
VI	**Microbial nutrient uptake and transport:** Microbial classification based on nutrient and energy source; Nutrient uptake mechanisms-passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport, antiport, group translocation; Iron uptake	**8**
VII	**Microbial growth and effect of environmental factors on growth** Bacterial growth curve and kinetics-Generation time and specific growth rate; Diauxic growth and synchronous growth; Batch, Fed batch and continuous cultures; Chemostat and turbidostat	**8**
VIII	**Stress physiology and Nitrogen metabolism** Effect of oxygen, pH, osmotic pressure, heat shock on bacteria; Microbial adaptation to Environment-Temperature, pH, Oxygen, Pressure, Salt, Water activity; Extremophiles application in industry; Dissimilatory nitrate reduction, Nitrogen fixation	**8**

Suggested Readings:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sons inc., publication.
2. Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press, Cambridge.
3. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
4. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.
5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. Biochemistry 8th edition. W. H. Freeman.
6. Suggestive digital platforms web links-
    - https://lipidnanostructuresgroup.weebly.com
    - https://www.labster.com/microbiology-virtual-labs
    - https://www.microbiologybook.org
    - https://www.cpe.rutgers.edu/courses/current/lf0401wa.html
    - https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
    - https://www.futurelearn.com/courses/introduction-to-microbiology

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

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Course prerequisites: To study this course, a student must have had the subject "Agriculture and Environmental Microbiology" in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

House Examination/Test:10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks **Classperformance/Participate:** 5Marks
Further Suggestions: None

Programme/Class: Diploma	**Year:** Second	**Semester:** Third
Subject: MICROBIOLOGY		
Course Code: B080302P	**Course Title:** Experiment in Basic Biochemistry and Microbial Physiology	

Course Outcomes:

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

- Understand the structures of carbohydrates and their main properties, as well as conduct chemical tests to detect their presence in samples.
- Would have acquired practical knowledge of biochemical techniques for proteins and will be familiar with the use of a spectrophotometer.
- Understand the fundamental principles of enzyme biochemistry, including enzyme kinetics, at the end of the course.
- Will have a thorough understanding of bacterial growth patterns, bacterial growth curves, generation time and basic growth rate calculations, and the impact of the environment on growth.
- Will learn about the fermentation process in microbes.

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

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

S. No.	**Objectives**	**Total No. of Lectures/ Hours (60)**
1	Use and calibration of pH meter and preparation of buffers. Preparation of stock and working solutions. Handling of pipettes and micropipettes and checking their accuracy.	**4**
2	**Qualitative tests** Carbohydrates: Molisch's Test, Fehling's Test, Benedict's Test, Iodine Test) Amino acids and Proteins: Ninhydrin test, Biuret test, Lowry test. Lipids: Solubility Test, Translucent Spot Test, Emulsification Test.	**20**
3	Quantitative estimation of carbohydrate by anthrone method. Quantitative estimation of proteins by Lowry's method Determination of the acid value of a fat	**10**
4	Amylase production, H_2S production, Urease production test, IMViC test	**10**
5	Effect of temperature and pH on growth of E. coli, Effect of carbon and nitrogen on microbial growth.	**8**
6	Demonstration of carbohydrate fermentation, indole production, catalase test, oxidase test.	**8**

Suggested readings:

1. Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume 1, 1991, Wiley.
2. S. K. Sawhney, Randhir Singh,Introductory Practical Biochemistry, 2000, Narosa.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring

Harbour Laboratory press.
4. Maloy SR, Cronan JE and Friefelder D, Microbial Genetics 2nd EDITION., 2004, Jones and Barlett Publishers
5. Larry Snyder. Molecular Genetics of Bacteria: 3rd (third) Edition.
6. Digital links
   - http://www.mooc.list.com/tag/molecular-biology
   - http://www.mooc.list.com/course/microbiology.sayloro
   - https://lipidnanostructuresgroup.weely.com
   - http://www.mooc.list.com/microbial
   - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

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

……

Course prerequisites: To study this course, a student must have had the subject "Agriculture and Environmental Microbiology" in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

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Further Suggestions: None

Programme/Class: Diploma	**Year:** Second	**Semester:** Fourth
Subject: MICROBIOLOGY		
Course Code: B080401T	**Course Title:** Molecular Biology and Microbial Genetics	

Course Outcomes:

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

- Distinguish in prokaryotic cellular structure and functional components of cells, as well as the dissimilarities in genome organization between prokaryotes and eukaryotes.
- Describe the replication, transmission, and action mechanisms of chromosomal and extrachromosomal genes and sequences.
- Recognize and distinguish genetic regulatory mechanisms at various levels
- Gain an understanding of how internal and external signals regulate gene expression, influence microbial diversity, and shape microbial communities and their environments.
- Describe the processes that lead to mutations and other genetic changes.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of the genome organization** – DNA/and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cot curves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes.	**6**

II	**DNA Replication in Prokaryotes and Eukaryotes-** Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication, Replication of chromosome ends.	**6**
III	**Transcription in Prokaryotes and Eukaryotes** Concept of transcription unit. General transcription process in prokaryotes and eukaryotes; Post-Transcriptional modification in eukaryotes, Aternative splicing mechanism,RNA interference	**8**
IV	**Translation in prokaryotes and eukaryotes** Ribosome structure, tRNA structure and processing, Mechanisms of translation in both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity of translation	**8**
V	**Regulation of gene expression** in prokaryotes and eukaryotes Overview of regulation of gene expression, Regulation of gene expression by DNA methylation, histone acetylation and histone methylation mechanisms; Transcription control mechanisms, Inducible Operon System, Repressible Operon System, Translation control mechanisms.	**10**
VI	**Plasmids in prokaryotes and eukaryotes** Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids.	**6**
VII	**Bacterial gene exchange processes-** Mechanisms of Genetic Exchange, Horizontal gene transfer, Transformation; Conjugation; Transduction, Complementation.	**8**
VIII	**Mutations, mutagenesis and repair** Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism	**8**

Suggested Readings:

1. Watson, J. et. Al. 2004. Molecular Biology of the Gene,5th Edition, CSHL Press, New York.
2. Conn, E., & Stumpf, P. 2009.Outlines of Biochemistry, 5Th Ed. Wiley India Pvt. Limited.
3. T A Brown.2001. Essential Molecular Biology. Oxford University Press, USA
4. Brock, T.D. 1990. The Emergence of Bacterial Genetics, Cold Spring Harbor Lab Press.
5. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press.
6. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press
7. Suggestive digital platforms web links-
    - https://www.classcentral.com/tag/microbiology
    - http://www.mooc.list.com/tag/molecular-biology
    - http://www.mooc.list.com/course/microbiology.sayloro
    - https://lipidnanostructuresgroup.weely.com
    - http://www.mooc.list.com/microbial
    - https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern

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

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Course prerequisites: To study this course, a student must have had the subject "Basic Biochemistry and Microbial Physiology" in III Semester of Diploma course in Microbial Technology

Suggested Continuous Evaluation Methods **House Examination/Test:**10 marks **Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar:** 10 marks **Class performance/Participate:** 5Marks
Further Suggestions: None

Programme/ Class: Diploma	**Year:** Second	**Semester:** Fourth
Subject: MICROBIOLOGY		
Course Code: B080402P	**Course Title:** Experiment in Molecular Biology and Microbial Genetics	

Course Outcomes:

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

- understand the fundamentals of molecular biology and genetic research.
- use some basic equipment in a molecular biology laboratory.
- extract genomic DNA from microbes using molecular biology techniques
- measure DNA and verify purity using UV spectrometer and electrophoresis.
- understand the basic principle of plasmid isolation and their conformations using electrophoresis.
- understand the mutagenic effect of chemical and physical agents and perform test to identify mutagenic effect of chemicals

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

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

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Isolation of genomic DNA from *E. coli* and analysis by agarose gel electrophoresis.	8
2	Estimation of DNA using diphenylamine reagent.	8
3	Resolution of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) and visualization using coomassie dye.	10
4	Replica plating method: Preparation of master and replica plates. Isolation of Histidine auxotrophs	10
5	Isolation of plasmid DNA from *E. coli*. Study the different conformations of plasmid DNA through agarose gel electrophoresis	8
6	Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on bacterial cells.	8
7	Demonstration of Ames test.	8

Suggested readings:

1. Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TX Wiley-Blackwell.
2. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146.
3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press.
4. Digital links:

- https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/ames-test
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/

This course can be opted as an elective by the students of following subjects: Open for all
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Course prerequisites: To study this course, a student must have had the subject "Basic Biochemistry and Microbial Physiology" in III Semester of Diploma course in Microbial Technology.

Suggested Continuous Evaluation Methods
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Further Suggestions: None

Detail Syllabus of

B.Sc. III Year

Microbiology

Programme / Class: Bachelor of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080501T	**Course Title:** Medical Microbiology	

Course outcomes:

Upon completion the students will learn:

- The historical development of medical microbiology
- The importance of microorganisms in life.
- The microorganisms associated with various infectious diseases.
- The treatment strategies followed for the infectious diseases.
- Antibiotic resistance
- Processes of sample collection and processing

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**History of Medical Microbiology** Contribution of pioneers in the field of Medical Microbiology, Normal Microflora of human body: skin, mouth, alimentary canal and gintourinary tract	7
II	**Bacterial diseases** Diseases caused by certain bacterial pathogens *Staphylococcus aureus, Streptococcus pneumoniae, Mycobacterium tuberculosis, Salmonella typhi, Vibrio cholera*	8
III	**Viral diseases** Diseases caused by certain viruses Human Immunodeficiency Virus, Hepatitis Virus, Influenza virus, Herpes virus	8
IV	**Parasitic diseases** Diseases caused by protozoa *Giardia* sp., *Plasmodium* sp., *Leshmania* sp., and *Entamoeba* sp.	7
V	**Pathogenic fungal disease I** Dermatophytes- *Trichophyton, Microsporum* Filamentous fungi causing subcutaneous infection by Mucor, *Rhizopus* and *Aspergillus*	8
VI	**Pathogenic fungal disease II** Systemic mycoses caused by Blastomyces, Histoplasma and Yeast like fungi: *Candida* and *Cryptococci*	8

VII	**Antibiotics and Chemotherapeutics** Historical development of chemotherapeutic and antibiotic substances, Major antimicrobial agents, Mode of action of chemotherapeutic and antibiotic substances.	8
VIII	**Antibiotic resistance, Sample collection and processing** Drug resistance, Mechanism of antibiotic resistance, Antibiotic susceptibility assay. Collection and transport of appropriate clinical sample specimen for clinical diagnostics	6

Suggested Readings:

1. Annadurai, A. A textbook of Immunology and Immunotechnology. S. Chnd
2. Ananthanarayanan R and Panicker C K. Textbook of Microbiology. Orient Longman.
3. Baveja, CP. Text book of Microbiology. Arya publications.
4. Ken S.Rosenthal, Patrick R.Murray, and Michael A.Pfaller. Medical Microbiology 7th Edition, Elsevier
5. Karen C.Carroll, Geo.Brooks, Stephen Morse, and Janet Butel.Jawetz, Melinck, &Adelberg's Medical Microbiology, Lang
6. Suggestive digital platforms web links-
   https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials
   https://vlab.amrita.edu/?sub=3&rch=73
   https://www.mooc-list.co/tags/pathology
   https://online.creighton.ed/program/medical-microbioogy-and-immunology-ms

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

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Course prerequisites: To study this course, a student must have had the subject "Molecular Biology and Microbial Genetics" in IV Semester of Diploma course in Microbial Technology

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

Suggested equivalent online courses:

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Further Suggestions:
None

Programme / Class: Bachelor of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080502T	**Course Title:** Immunology	

Course outcomes:

Upon completion the students will learn

- The historical development of immunology
- The components of immune system, Immune responses, features of antigen and antibody, hypersensitivity responses
- Applications of antibody in diagnosis and therapy, and antigen-antibody reactions.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Overview of Immunology** History of immunology, Physical and physiological barriers, Innate and Acquired immunity, Organs and Cells of Immune system.	7
II	**Complement System** Complement System Proteins, Complement System Activation by Classical, Alternate and Lectin Pathway	8
III	**Immunity** Humoral and Cell Mediated Immunity, Active And Passive Immunity	8
IV	**Antigen & Immunogens** Antigen Characteristics, Types of Antigens, Adjuvants, Immunogenicity and Antigenicity, Cytokines,	7
V	**Immunoglobulins and MHC and their role** Classes of immunoglobulin, structure and function, Major Histocompatibility Complex: Types, Antigen Presentation through MHC class I and class II molecules	9
VI	**Hypersensitivity** Types of Hypersensitivity, Mechanism of hypersensitivities with examples	5
VII	**Immune Response** Antibody dependent Cell mediated Cytotoxicity, Phagocytosis, Inflammation and Inflammatory response mechanism.	6
VIII	**Applications of Immunoglobulins** Applications of antibody in diagnosis and therapy; *In vitro* serological test methods: Antigen-Antibody Reactions: Agglutination and immunodiffusion; ELISA and RIA.	10

Suggested Readings:

1. Kindt, Goldsby and Osborne. Kuby's Immunology. WH Freeman& Company,
2. Roitt I,Brostoff, J and Male D.Immunology, 6th edition, 2001, Mosby, London.
3. Ramesh SR, Immunology. Mc Graw Hill Publications.
4. Madhavee LP, A Textbook of Immunology, S Chand Publisher.
5. Reddy R, Textbook of Immunology, 3rd edition, AITBS Publisher.
6. Digital links
    - https://www.mcgill.ca/microimm/undergraduate-programs/courses
    - https://oline.creighton.edu/program/medical-microbiology-and-immunology-ms

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

……

Course prerequisites: To study this course, a student must have had the subject **Molecular Biology and Microbial Genetics** in IV Semester of Diploma course in Microbial Technology

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

Suggested equivalent online courses:

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Further Suggestions:
None

Programme / Class: Bachelors of Science	**Year:** Third	**Semester:** Fifth
Subject: Microbiology		
Course Code: B080503P	**Course Title:** Experiments in Medical Microbiology & Immunology	

Course outcomes:

Upon completion of the practical course in medical microbiology and immunology the students will learn about

- The preparation of culture media, microorganisms associated with human body, characterization of microorganisms associated with disease.
- Antigen- antibody interaction
- Learning of the application of antibodies for diagnostic purposes, antibiotic sensitivity test and resistance transfer.

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

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

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Preparation of blood agar, chocolate agar, and other media required for medically important microorganisms	6
2	Isolation and characterization of skin normal microflora	6
3	Isolation of bacteria from teeth crevices	6
4	Demonstration of α and β haemolysis on blood agar medium.	8
5	Demonstration of serological tests: blood groups, Rh factor determination, pregnancy test, Widal, VDRL, ELISA	12
6	Demonstration of pathogenic fungi in mycoses lesion	8
7	Antibiotic sensitivity test and MIC determination	6
8	Demonstration of antibiotic resistance transfer from resistant to sensitive microorganism	8

Suggested Readings:

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

- http://www.vlab.co.in
- http://www.vlab.iitb.ac.in
- http://www.onlinelabs.in
- http://www.vlab.amrita.edu
- http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

This course can be opted as an elective by the students of following subjects: Open for all
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Course prerequisites: To study this course, a student must have had the subject "Molecular Biology and Microbial Genetics" in IV Semester of Diploma course in Microbial Technology.

Suggested Continuous Evaluation Methods:
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Suggested equivalent online courses:
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Further Suggestions:

Programme/Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B08060IT	**Course Title:** Food Microbiology	

Course outcomes:
- Upon completion the students will learn about the role of Microorganism in food Microbiology.
- Learn the symptoms of deteriorated food.
- Assimilate knowledge about Microbial Examination of food.
- Learn about food preservation techniques.
- Will get sufficient knowledge regarding analysis of milk.
- Will be able to monitor food quality.

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	**Introduction to food & nutrition**. History, Development and Scope of food microbiology; Concept of food and nutrients; Physiochemical properties of food; Importance and types of	8

	microorganisms in food (bacteria, mold and yeast); Food as a substrate for microorganism- Intrinsic and extrinsic factors that affect growth and survival of microbes in food, natural flora and source of contamination of foods in general.	
II	**Microbial spoilage of various foods** Principal; Spoilage of vegetables, fruits, meats, eggs, milk and butter, bread, canned foods.	6
III	**Microbial examination of food** DMC, viable count, examination of faecal Streptococci. Food quality monitoring, Biosensors and Immunoassays.	6
IV	**Food Preservation** Basic Principles, Methods (heating, freezing, dehydration, chemical preservatives, radiation). Modern technologies in food preservation, Packaging material.	8
V	**Fermented foods:** Fermented dairy products (cheese, butter, yoghurt), Kefir; Other Fermented foods- Soya sauce, Saurkraut, Dosa, Tempeh; Probiotics: health benefits, types of microorganisms used, probiotic foods available in market.	8
VI	**Food borne diseases (Causative agents, foods involved, symptoms and preventive measures)** Food intoxication- Staphylococcus aureus, Clostridium botulinum and Mycotoxins; Food infections- E.coli, Salmonellosis, Bacillus cereus, Sheigellosis, Listeria.	8
VII	**Microorganisms and milk** Physical and chemical properties of milk; Milk as a substrate for microorganisms; Microbiological analysis of milk – Rapid Platform test, standard plate count, MBRTtest, alkaline phosphatase enzyme test, DMC; Method of preservation of milk and milk product, pasteurization sterilization and dehydration.	8
VIII	**Food sanitization and control** HACCP, Indices of food sanitary quality and sanitisers; Microbiological quality standard of food.	8

Suggested Readings:

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

Suggestive digital platforms web links –

- Doyle. Michael P, Gonzalez-francisco Diez, Food Microbiology : Fundamentals and frontiers, 5th edition, Hill Colin, available on Wiley online Library.
- http://www.vlab.co.in

- http://www.vlab.amrita.edu
- http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques

This course can be opted as an elective by the students of following subjects: Open for all
But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry & B.Sc. Agriculture, B.Sc. Biology

Course prerequisites: To study this course, a student must have had the subject **Medical Microbiology** & **Immunology** in V Semester of Degree in Bachelor of Science.

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

Suggested equivalent online courses:

Further Suggestions:
None

Programme/Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B080602T	**Course Title:** Industrial Microbiology	

Course outcomes :
- Develop understanding about IPR in industry
- Understand role of microorganism in industry
- Know about Processing & selection of best microbial strains for the industry
- Gain fundamental knowledge of fermentation process
- Gain knowledge about production of various pharmaceutical products or industrially important product

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

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

Unit	Topics	Total No. of Lectures/ Hours (60)
I	History & Multidisciplinary nature of Industrial microbiology. A typical Bio process: Introduction, advantages & limitations. Patents and intellectual property rights.	7

II	Taxonomic diversity of industrially useful bacteria & fungi. Important characteristics of microbes used in Industrial Microbiology, Isolation techniques. Concept & examples of microorganisms classified as Generally Regarded as Safe (GRAS).	8
III	Exploitation of microorganism and their products, Screening, Strain development strategies, Immobilization methods.	8
IV	Fermentation: Media, Raw material, Antifoaming agents, Buffers. Equipments, Fermenter design. Types of fermentation – Single, Batch, Continuous.	7
V	Down-stream processing steps: Detection and assay of the product, Recovery (intercellular and extracellular product). Purification (solvent extraction & chromatography)	9
VI	Production of Alcohol (industrial alcohol, wine, beer, whiskey), Organic acid (Citric acid), Antibiotic (Penicillin)	7
VII	Production of Vitamin (B12), Enzyme (Amylase), Amino acid (Glutamic acid), Hormones (Insulin), Vaccine (Hepatitis B).	6
VIII	Biofuel (Methane), Production of Biofertilizers & Biopesticides, Biotransformation of steroids.	8

Suggested Readings:

1. Industrial Microbiology (2000) by AH Patel, Macmillan Publishers India
2. Biology of Industrial microorganism (1981) by Arnold L. Domain, Bejamin/ cummings Pub. Co.
3. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
4. Industrial Microbiology by Casida LE, New age International (P) Ltd.

Suggestive digital platforms web links

- http://foodhaccp.com/foodsafetymicro/onlineindex.html
- http://www.cpe.rutgers.ed/courses/current/If0401wa.html

This course can be opted as an elective by the students of following subjects: Open for all
But special for B.Sc. Math, B.Sc. Statistic, B.Sc. Nutrition, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Biology & B.Sc. Agriculture

Course prerequisites: To study this course, a student must have had the subject "Medical Microbiology & Immunology" in V Semester of Degree in Bachelor of Science.

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

Suggested equivalent online courses:
https://www.classcentral.com/course/swayam-food-microbiology-and-food-safety-17609

Further Suggestions:
None

Programme/ Class: Bachelor of Science	**Year:** Third	**Semester:** Sixth
Subject: Microbiology		
Course Code: B080603P	**Course Title:** Experiments in Food & Industrial Microbiology	

Course outcomes:

- Understand the instruments, techniques & Lab discipline
- Develop skill for identifying microbes used in industry
- Upon completion student will learn about the process of fermentation & design of bioreactors, a major part of pharmaceutical industry
- Will learn about the culture of microorganisms used in Food & Industrial microbiology.

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

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

S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Study of Bioreactor & its essential parts	4
2	Necessity & procedure of writing SOPs for instruments used in large scale production	6
3	Isolation and microscopic observation of industrially important microorganism	8
4	Isolation and characterization of microorganism used in Dairy industry	8
5	Isolation and characterization of Yeast used in Bakery/distillery/winery	8
6	Isolation & identification of important microorganism of food microbiology	8
7	Bacteriological analysis of food products	8
8	Determination of the quality of milk by MBRT	2
9	Bacterial examination of milk – Alcohol test	4
10	Preservation methods	4

Suggested Readings:

7. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
8. Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., New Delhi.

9. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
10. W.F. Harrigan, Laboratory methods in Microbiology, Publisher – Elsevier
11. Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press
12. Brain McNeil & Harvey (2008), Practical Fermentation Technology, John Wiley & Sons Ltd.
13. Digital links
    - http://www.vlab.co.in
    - http://www.vlab.iitb.ac.in
    - http://www.onlinelabs.in
    - http://www.vlab.amrita.edu
    - http://asm.org/articles/2020/december/virtual-resources-to-teach-microiology-techniques
    - http://foodhaccp.com/foodsafetymicro/onlineindex.html
    - http://www.cpe.rutgers.ed/courses/current/If0401wa.html

This course can be opted as an elective by the students of following subjects: Open for all
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Course prerequisites: To study this course, a student must have had the subject "Medical Microbiology and Immunology" in V Semester of Degree in Bachelor of Science.

Suggested Continuous Evaluation Methods:
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Suggested equivalent online courses:
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Further Suggestions: