

Appendix -

DEPARTMENT OF MICROBIOLOGY
B.Sc. (in Faculty of Life Science)
(Based on Choice Based Credit System)
SUBJECT: MICROBIOLOGY
SYLLABUS
 Under NEP-2020

SEMESTER WISE PAPER TITLES WITH DETAILS

Semester	Course code	Paper/title	CIE	End Semester Examination	Total	Credits	Teaching hours
B.SC. 1ST YEAR/ CERTIFICATE COURSE IN MICROBIAL TECHNIQUES							
I	MBB101T	General Microbiology	25	75	100	4	60
	MBB102P	Experiments in Basic Microbiology	25	75	100	2	60
II	MBB201T	Agriculture and Environmental Microbiology	25	75	100	4	60
	MBB202P	Experiments in Agriculture and Environmental Microbiology	25	75	100	2	60
B.SC. 2ND YEAR/ DIPLOMA IN MICROBIAL TECHNOLOGY							
III	MBB301T	Basic Biochemistry and Microbial Physiology	25	75	100	4	60
	MBB302P	Experiments in Basic Biochemistry and Microbial Physiology	25	75	100	2	60
IV	MBB401T	Molecular Biology and Microbial Genetics	25	75	100	4	60
	MBB402P	Experiments in Molecular Biology and Microbial Genetics	25	75	100	2	60
B.SC. 3RD YEAR/ DEGREE IN BACHELOR OF SCIENCE (IN FACULTY OF LIFE SCIENCE)							
V	MBB501T	Medical Microbiology	25	75	100	4	60
	MBB502T	Immunology	25	75	100	4	60
	MBB503P	Experiments in Medical Microbiology & Immunology	25	75	100	2	60
VI	MBB601T	Food Microbiology	25	75	100	4	60
	MBB602T	Industrial Microbiology	25	75	100	4	60
	MBB603P	Experiments in Food & Industrial Microbiology	25	75	100	2	60

*CIE = CONTINUOUS INTERNAL EVALUATION; T = THEORY; P= PRACTICAL

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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 be 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. 15¹ 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 as beneficial significance to man and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices; and 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.

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Diploma in Microbial Technology

based outcomes

	Students will develop familiarity and understanding of the micro, o
PSO1	Students will exhibit reasonable abilities in the logical strategy and theory testing in the plan
PSO2	Techniques common to microbiology, and application and execution of examinations.
PSO3	Students will be able to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with
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. 3rd year 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 experimental 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.

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Programme/Class: <u>Certificate</u>	Year: <u>First</u>
Subject: <u>MICROBIOLOGY</u>	
Course Code: <u>MBB101T</u>	Course Title: <u>General Microbiology</u>

Course Outcomes:

Students completing this course will be able 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 understanding of bacterial, fungal, cyanobacterial, algal, viral and nucleic acid 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 End Semester Examination:75 Total Max. Marks: 100		Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35
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. 5kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms-bacteria, archaea, eukarya; Introduction to classification of bacteria: Bergey's manual.	8
II	Bacterial morphology Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid and reserve material. Differences between archae bacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cyanobacteria. Theviruses 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, <i>Aspergillus</i> . Protozoa General characteristics, classification & reproduction of Giardia, Entamoeba	10
III	Techniques in Microbiology I Principles of microscopy, construction and application of-	6

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	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; Colorimeter & Spectrophotometer (UV-Vis)	6
V	Sterilization techniques and control of microorganisms Definition 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 bio diagrams.	8

Suggested Readings:

1. Alexopoulos 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. Boh. H. C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
6. Baveja C.P., Text book of microbiology APC 6th edition.
7. Dubey R.C. and Maheshwari D. K., Text book of microbiology, S Chand Publications.
8. Pelczar M.J., Chan E.C. 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.

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11. Sharma P.O., Microbiology, Rastogi Publications.

12. Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9,1 edition, Pearson Education.

13. Suggestive digital platforms weblinks-

- <https://www.classcentral.com/tag/microbiology>
- <https://cmp.berkeev.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.swavam2.ac.in/cec19_bt11/preview
- <https://microbenotes.com/laminar-flow-hood>
- <https://physic.ife.uni-lj.si/students/predavanja/MicroscopyKulkaar1J?.ctf>

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

Programme/Class: Certificate		Year:First	Semester:First
Subject: MICROBIOLOGY			
Course Code: MBB102P		Course Title: Experiments in Basic Microbiology	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● 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 CIE: 25 Max. Marks End Semester Examination: 75 Total Max. Marks: 100		Min. Passing Marks CIE: 09 Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2			
S.No.	Suggested Lab Nirtual Experiment		Total No. of Lectures/ Hours (60)
1.	<ul style="list-style-type: none"> ● Good laboratory 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.	<ul style="list-style-type: none"> ● Study of instruments-Microscope, autoclave, hot air oven, laminar air flow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colorimeter, spectrophotometer. 		12
3.	<ul style="list-style-type: none"> ● 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.	<ul style="list-style-type: none"> ● Staining of bacteria- <ol style="list-style-type: none"> 1. Simple staining-methylene blue 2. Gram's staining 3. Acidfast 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 <ul style="list-style-type: none"> ● Bacteria- Staphylococci, Streptococci, <i>E. coli</i> 		12

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	<ul style="list-style-type: none"> • Protozoans-<i>Amoeba</i>, <i>Paramecium</i>, <i>Trypanosoma</i>, <i>Plasmodium</i>, <i>Entamoeba histolytica</i>. • Helminths- <i>Fasciola</i>, <i>Taenia solium</i>, <i>Ascaris</i>. • Fungi-<i>Mucor</i>, <i>Rhizopus</i>, <i>Penicillium</i>, <i>Aspergillus</i>, <i>Alternaria</i>. • Cyanobacteria-<i>Chlorella</i>, <i>Spirulina</i>, <i>Nostoc</i>, <i>Anabaena</i>. 	
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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 Cultivation, 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, 7th 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>

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.



Programme/Class: Certificate	Year:First	1 Semester: Second
Subject: MICROBIOLOGY		
Course Code: MBB201T	Course Title: Agriculture and Environmental Microbiology	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● 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 clean 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 CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100		Min.PassingMarks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passine: Marks: 35
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

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IV	Water Pollution: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: collection and treatment of sewage (BOD & COD), primary, secondary, (oxidation pond, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.	8
V	Water Pollution: Control of common pesticides, organic (hydrocarbon, oil spills) and inorganic matter, biosurfactants.	6
VI	Water Quality: 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 for fecal coliform.	6
VII	Biofertilizer Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative; Mode of application; Advantages and Disadvantages.	8
VIII	Biopesticides Introduction and definition; Types of biopesticides; Integrated pest management (IPM); Mode of action; Factor influencing; Applications, advantages & disadvantages.	8

Suggested Readings:

- Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
- Alexopoulos C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
- Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi
- Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
- Mehrotra A.S., Plant Pathology, Tata McGraw Hill Publications limited, New Delhi.
- Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, McGraw-Hill Book Company, New York.
- Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB McGraw-Hill, New York.
- Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
- Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
- Subbarao N.S., Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.
- Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.
- Suggestive digital platforms web links-
 - <https://www.classcentral.com/tag/microbiology>
 - <https://www.mooc-list.com/tags/biotechnology>
 - <https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques>
 - <https://www.futuredirections.org.au/publication/living-soils-role-in-microorganisms-soil-health>
 - <https://collealearners.co111/ebooks/agricultural-microbiology-free-download>

Suggested Continuous Evaluation Methods:

Total marks: 25

On_eTest/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class discussion of 5 marks.

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Programme/Class: Certificate		Year: First	Semester: Second
Subject: MICROBIOLOGY			
Course Code: MBB202P		Course Title: Experiments in Agriculture and Environmental Microbiology	
Course Outcomes: The student at the completion of the course will be able to:			
<ul style="list-style-type: none"> To understand the instruments, microbial techniques and good lab practices for working in amicrobiology laboratory. Practical skill in the laboratory experiments in microbiology. Develop skills for identifying microbes and using them for industrial, agricultural and environmentalpurpose. To prepare slides and stain to see the microbial cell. 			
Credits: 2		Core: Compulsory	
Max. Marks End Semester Examination:75 Total Max. Marks: 100		Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passini! Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2			
S.No.	Suggested Lab /Virtual Experiment		Total No. of Lectures/ Hours (60)
1	<ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> Isolation of bacteria and fungi from rhizosphere and rhizoplan.e Isolation of bacteria & fungi from air environment by exposureplatemeth ,d Isolation of Rhizobium sp. From leguminous root nodu.le 		16
3	To determine BOD of waste water sample. <ul style="list-style-type: none"> Bacteriological examination of water by MPN test, presumptivecoliform, confirmed coliform and completed coliform test. 		12
4	Specimen study of plant pathogens. <ol style="list-style-type: none"> Black rust of wheat White rust of crucifer Leaf curl of tomato Downy mildew Red rot of sugarcane 		10
5	Study of permanent slide and the materials <ul style="list-style-type: none"> <i>Cladosporium</i> <i>Helmithosporium</i> <i>Mucor</i> <i>Curvularia</i> <i>Alternaria</i> <i>Geotrichurn</i> <i>Trichoderma</i> <i>Rhizopus</i> 		14

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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-npte1-labs-biotechnology-and-biomedical-engineering>
 - <http://5//onentextbc.calvirtL1alscienceresourceslchfil.ter/{'nv:rnn111ent<11-scie:1c:ej>

Suggested Continuous Internal Evaluation (CIE) methods**Total marks:** 25

One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD of 5 marks.

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Programme/Class: Diploma	Year:Second	Semester:Third
Subject: MICROBIOLOGY		
CourseCode: MBB30 IT	Course Title: Basic Biochemistry and Microbial Physiology	
Course Learning Outcomes: Upon successful completion of the course, the student: <ul style="list-style-type: none"> • 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 appreciate 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 CIE:25	Min. Passing Marks CIE:09	
Max. Marks End Semester Examination:75	Min. Passing Marks End Semester Examination: 26	
Total Max. Marks: 100	Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No. of Lectures/Hours(60)
	Overview of thermodynamics and bioenergetics Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reaction; 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; nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physico-chemical properties of DNA. RNA types- rRNA, mRNA, tRNA.	6

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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;	
VI	Microbial nutrient up take and transport: Microbial classification based on nutrient and energy source; Nutrient up take 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; Oblique growth and synchronous growth; Batch, Fedbatch and continuous cultures; Chemostat and turbidostat	8
	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 John 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. McGraw-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*. 11th 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.weebiv.com>
 - <https://www.labster.com/microbiology-virtual-labs>
 - <https://www.microbiologybook.org>
 - <https://www.cpe.rutgers.edu/courses/current/1f0401wa.html>
 - <http://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy>
 - <https://www.futurelearn.com/courses/introduction-to-microbiology>

Suggested Continuous Evaluation Methods:
Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: MBB302P	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 CIE: 25	Min. Passing Marks CIE: 09
Max. Marks End Semester Examination: 75	Min. Passing Marks End Semester Examination: 26
Total Max. Marks: 100	Total Min. Passing Marks: 35

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

S.No.	Suggested Lab/Virtual Experiment	Total No. of Lectures/ HvurS (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) Aminoacids 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 ₂ S 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

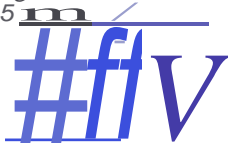
Suggested readings:

1. Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume I, 199 I, 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.lisl.com/tag/molecular-biology>
 - <http://www.mooc.list.com/course/microbiology.savloro>
 - <https://lipidnanostructuresgroup.weebly.com>
 - <http://www.mooc.list.com/microbial>
 - <https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern>

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as suggested by the concerned teacher/HOD) of 5 marks



Programme / Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: MBB401T	Course Title: Molecular Biology and Microbial Genetics	
Course Outcomes: At the end of the course, the student will be able to: <ul style="list-style-type: none"> • 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 CIE: 25 Max. Marks End Semester Examination: 75 Total Max. Marks: 100	Min. Passing Marks CIE: 09 Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
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 /m, d 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.	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

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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. TA 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-
 - <http://www.classcentral.com/tag/microbiology>
 - <http://www.mooc.list.com/tag/molecular-biology>
 - <http://www.mooc.list.com/course/microbiology.sayloro>
 - <https://i12idnanostructuresgroup12.weebly.com>
 - <http://www.mooc.list.com/microbial>
 - http://o12en.um.n.edu/o12en_textbooks/textbooks/biochemistry-free-for-a11-ahern

Suggested Continuous Evaluation Methods:

total marks: 25

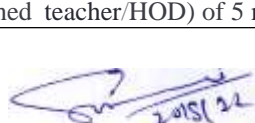
One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class intercy. Total of 5 marks.

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Programme/Class: Diploma		Year:Second	Semester: Fourth
Subject: MICROBIOLOGY			
CourseCode: MBB402P		Course Title: Experiment in Molecular Biology and Microbial Genetics	
Course Outcomes:			
The student at the completion of the course be able to:			
<ul style="list-style-type: none"> • 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 mutageniceffect of chemicals 			
Credits:2		Core:Compulsory	
Max.Marks CIE:25		Min.PassingMarks CIE:09	
Max.Marks End Semester Examination:75		Min.Passing Marks End Semester Examination: 26	
Total Max. Marks: 100		Total Min. Passini:!. Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-2			
S.No.	Suggested Lab /Virtual Experiment		Total No. of Lectures/Hours (60)
1	Isolation of genomic DNA from <i>E. coli</i> 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 <i>E.coli</i> . 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:			
<ol style="list-style-type: none"> 1. Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TXWiley-Blackwell. 2. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146. 3. Sambrook J and Russell OW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold SpringHarbour Laboratory press. 4. Digital links: <ul style="list-style-type: none"> • http://www.sciencedirect.com/loRics/gharmacology-toxicology-and-gharmaceutical-sc iencc/amcs- test • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/ 			
Suggested Continuous Internal Evaluation CIE methods			
otalmarks: 25			
One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks.			

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Programme/ Class: Degree	Year:Third	Semester: fifth
Subject: Microbiology		
CourseCode: M8850IT	Course Title: Medical Microbiology	
Course outcomes: Upon completion the students will learn: <ul style="list-style-type: none"> • 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 CIE:25 Max Marks End Semester Examination:75 Total Max. Marks: 100	Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination: 36 Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
	History of Medical Microbiology Contribution of pioneers in the field of Medical Microbiology, Normal Microflora of human body: skin, mouth, alimentary canal and genitourinary tract	7
II	Bacterial diseases Diseases caused by certain bacterial pathogens <i>Staphylococcus aureus</i> , <i>Streptococcus pneumoniae</i> , <i>Mycobacterium tuberculosis</i> , <i>Salmonella typhi</i> , <i>Vibrio cholera</i>	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 <i>Giardia</i> sp., <i>Plasmodium</i> sp., <i>Leishmania</i> sp., and <i>Entamoeba</i> sp.	7
V	Pathogenic fungal disease I Dermatophytes - <i>Trichophyton</i> , <i>Microsporum</i> Filamentous fungi causing subcutaneous infection by <i>Mucor</i> , <i>Rhizopus</i> and <i>Aspergillus</i>	8
VI	Pathogenic fungal disease II Systemic mycoses caused by <i>Blastomyces</i> , <i>Histoplasma</i> and Yeast like fungi: <i>Candida</i> and <i>Cryptococci</i>	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

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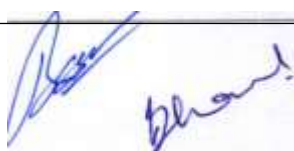
Suggested Readings:

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

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc. (as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.



Programme/ Class: Degree		Year:Third	Semester: Fifth
Subject: Microbiology			
CourseCode: MBB502T		Course Title: Immunology	
Course outcomes: Upon completion the students will learn <ul style="list-style-type: none"> • 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 CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100		Min.Passing Marks CIE:09 Min.Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
TotalNo.otLectures-Tutorials-Practical(inhoursperweek): L-T-P:4-0-0			
Unit	Topics	TotalNo.of Lecture s/Hours (60)	
I	Over view of Immunology History of immunology, Physical and physiological barriers, Innate and Acquired immunity, Organs and Cells of Immune system.	"	
II	ComplementSystem 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	ImmuneResponse Antibody dependent Cell mediated Cytotoxicity, Phagocytosis, Inflammation and Inflammatory response mechanism.	6	
VIII	Applications of Immunoglobulins Applications of antibody in diagnosis and therapy; <i>In vitro</i> serological test methods: Antigen-Antibody Reactions: Agglutination and immune diffusion; ELISA and RIA.	10	

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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. Madhava 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://online.creighton.edu/program/medical-n1crob_iology-and-immunology--ms

Suggested Continuous Evaluation Methods:**Total marks: 25**

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.



Programme/Class: Degree	Year:Third	Semester: Fifth
Subject: Microbiology		
CourseCode:MBB503P	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 <ul style="list-style-type: none"> • 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 CIE:25 Max.Marks End Semester Examination:75 Total Max. Marks: 100	Min. Passing Marks CIE:09 Min.Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
S.No.	Suggested Lab /Virtual Experiment	TotalNo.of Lectures/H ours(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: <ol style="list-style-type: none"> 1. Hudson L, and Hay FC, Practical Immunology, 3rd edition, Wiley. 2. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology, 3rd edition,ASM. Ed.3; 1986. 3. Talwar GP and Gupta SK, A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi 4. Aneja KR, Experiments in Microbiology, Plant Pathology and Biotechnology, 1st edition, New Age International Publisher 5. Randhawa VS, Practicals and Viva in Medical Microbiology, Harcourt India Pvt. Ltd. 6. Digital Links <ul style="list-style-type: none"> • 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-microbiology-techniques 		
Suggested Continuous Internal Evaluation (CIE) methods		
totalmarks: 25 One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher/HOD) of 5 marks. ...		

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Programme/Class: Degree	Year:Third	Semester: Sixth
Subject:Microbiology		
CourseCode:MB8601T	Course Title: Food Microbiology	
Course outcomes: <ul style="list-style-type: none"> • 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 CIE:25 Max. Marks End Semester Examination:75 Total Max. Marks: 100	Min. Passing Marks CIE:v>' Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	TotalNo.ofLectures/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 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.	8
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 fecal coliforms. 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. 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 botulinumand Mycotoxins; Food infections- E.coli, Salmonellosis, Bacillus cereus. Sheigellosis, listeria.	8

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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, MBRT test, 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 MG - 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, NewDelhi
7. Andrew Proctor (2011) Alternatives to conventional food processing. RSC Publisher
8. Anun 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, 5thedition, 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-microbiology-techniques>

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments(hand written or typed 500 -1500 words)/Quizzes/ Presentationetc.(as decided by the teacher)carrying Maximum Marks 20 and a Viva-Voce/Class interaction of 5 marks.

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Programme/Class: Bachelor of Science	Year:Third	Semester: Sixth
Subject: Microbiology		
Course Code: MBB602T	Course Title: Industrial Microbiology	
Course outcomes : <ul style="list-style-type: none"> • 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 CIE:25 Max. Marks End Semester Examination:75 Total Max. Marks: 100	Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passin?. Marks: 35	
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 Bioprocess: 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 (inter cellular and extra cellular 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 8).	6
vm	Biofuel (Methane), Production of Biofertilizers & Biopesticides, Biotransformation of steroids.	8

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Suggested Readings:

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

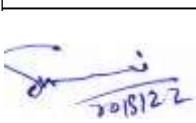
Suggestive digital platforms web links

- <http://100.jhaccp.com/foodsafety/micro/0111incindc:x.html>
- <http://www.cpe.rutgers.edu/courses/current/1ffi401wa.html>

Suggested Continuous Evaluation Methods:

Total marks: 25

One Test/Assignments (hand written or typed 500 -1500 words)/Quizzes/ Presentation etc.(as decided by the teacher) carry in Maximum Marks 20 and a Viva-Voce/Class* eraction of 5 marks.



Programme/Class: Degree		Year:Third	Semester:Sixth
Subject: Microbiology			
Course Code: MBB603P		Course Title: Experiments in Food & Industrial Microbiology	
Course outcomes:			
<ul style="list-style-type: none"> • 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 CIE:25 Max. Marks End Semester Examination:75 Total Max. Marks: 100		Min. Passing Marks CIE:09 Min. Passing Marks End Semester Examination: 26 Total Min. Passing Marks: 35	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2			
S.No.	Suggested Lab Practical Experiment		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:			
<ol style="list-style-type: none"> 1. Aneja, K.R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi. 2. Dubey, R.C. and Maheshwari. D.K. 2012. Practical Microbiology, S.Chand & Company, Pvt. Ltd., New Delhi. 3. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi. 4. W.F. Harrigan, Laboratory methods in Microbiology, Publisher - Elsevier 5. Lynne Mc Landsborough, Food Microbiology Laboratory, CRC Press 6. Brain McNeil & Harvey (2008), Practical Fermentation Technology, John Wiley & Sons Ltd. 			
<ol style="list-style-type: none"> a. http://www.vlab.co.in b. http://www.vlab.iitb.ac.in c. http://www.onlinelabs.in d. http://www.vlab.amrita.edu e. http://asm.org/alliances/2020/december/virtual-resources-to-teach-microbiology-techniques f. http://foodhaccp.com/foodsafety/micro/onlineindex.html 			
7. http://www.careers.ed/courses/current/1f0401/wa.html			
Suggested Continuous Internal Evaluation (CIE) methods			
Total marks: 25			
One Practical Tests/Record/Chart/Model carrying Maximum Marks 20 and a Viva-Voce/Practical Class Interaction as decided by the concerned teacher(s) of 5 marks.			





