

Shri Vishwanath P. G. College Kalan, Sultanpur

(Affiliated)

DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the Program: B.Sc.

Subject: MICROBIOLOGY



SEMESTER-WISE TITLES OF THE PAPERS IN UG MICROBIOLOGY COURSE					
YEAR	SEMESTER	COURSE CODE	PAPER TITLE	THEORY/PRACTICAL	CREDIT
<i>CERTIFICATE</i>					
Microbial Techniques					
FIRST YEAR	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
<i>DIPLOMA</i>					
Microbial Technology					
SECOND YEAR	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
<i>DEGREE</i>					
IN BACHELOR OF SCIENCE					
THIRD YEAR	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

Semester I

Theoretical Paper

B080101T: General Microbiology

Unit	Topics	Total No. of Lectures (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 accharomyces, Aspergillus. Protozoa General characteristics, classification & reproduction of Giardia, Entamoeba.	10
III	Techniques in microbiology I Principles of microscopy, construction and application of- Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM	6
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	<p>Biostatistics</p> <p>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.</p>	8
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 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. 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. 		

Practical

B080102P: Experiments in Basic Microbiology

Unit	Topics	Total No. of Lectures (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 Inoculums. 	12
2.	<ul style="list-style-type: none"> ● 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, colorimeter, spectro photometer. 	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. 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.	<p>Study of permanent slide and life materials</p> <p>Bacteria- Staphylococci, Streptococci, Bacillus sp., Azospirillum</p> <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>Taeniasolium</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> <p>Vibrio,</p>	12

Semester II

Theoretical Paper

B080201T: Agriculture and Environmental Microbiology

Unit	Topics	Total No. of Lectures (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, bio surfactants.	6
VI	Water potability 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. Alexopoulos 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.

Practical

B080202P: Experiments in Agriculture and Environmental Microbiology

Unit	Topics	Total No. of Lectures (60)
1	<ul style="list-style-type: none"> ● To analyse soil- pH, moisture, water holding capacity. 	8
2	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● To determine BOD of waste water sample. ● Bacteriological examination of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test. 	12
4	<ul style="list-style-type: none"> ● Specimen study of plant pathogens. <ol style="list-style-type: none"> 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 <ul style="list-style-type: none"> ● <i>Cladosporium</i> ● <i>Helmithosporium</i> ● <i>Mucor</i> ● <i>Curvularia</i> ● <i>Alternaria</i> ● <i>Geotrichum</i> ● <i>Trichoderma</i> ● <i>Rhizopus</i> 	14

Semester III

Theoretical Paper

B080301T: Basic Biochemistry and Microbial Physiology

Unit	Topic	Total No. of Lectures (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. Physico-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: <ol style="list-style-type: none"> 1. Moat A.G., Foster J.W. and Spector M.P. 2002. <i>Microbial Physiology</i>, 4th edition. A Johan Wiley and sonsinc., publication. 2. Kim B.H. and Gadd G.M. 2008. <i>Bacterial physiology and metabolism</i>. Cambridge University Press, Cambridge. 3. Gilbert H.F. 2000. <i>Basic concepts in biochemistry: A student's survival guide</i>. 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. <i>Brock Biology of Microorganisms</i>. 13th ed. Pearson Education Inc. 5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. <i>Biochemistry</i> 8th edition. W. H. Freeman. 		

Practical

B080302P: Experiment in Basic Biochemistry and Microbial Physiology

Unit	Topic	Total No. of Lectures (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. 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

Semester IV

Theoretical Paper

B080401T: Molecular Biology and Microbial Genetics

Unit	Topic	Total No. of Lectures (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, Alternative 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

Practical

B080402P: Experiment in Molecular Biology and Microbial Genetics

Unit	Topic	Total No. of Lectures (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

Semester V

Theoretical Paper -I

B080501T: Medical Microbiology

Unit	Topic	Total No. of Lectures (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 <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, HepatitisVirus, Influenza virus, Herpes virus	8
IV	Parasitic diseases Diseases caused by protozoa <i>Giardia</i> sp., <i>Plasmodium</i> sp., <i>Leshmania</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 antibioticsubstances.	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 clinicaldiagnostics	6
Suggested Readings: <ol style="list-style-type: none"> 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 MedicalMicrobiology, Lang 		

Theoretical Paper-II

B080502T: Immunology

Unit	Topic	Total No. of Lectures (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; <i>In vitro</i> serological test methods: Antigen-Antibody Reactions: Agglutination and immunodiffusion; ELISA and RIA.	10
Suggested Readings: <ol style="list-style-type: none"> 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. 		

Practical

B080503P: Experiments in Medical Microbiology & Immunology

Unit	Topic	Total No. of Lectures (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

Semester VI

Theoretical Paper- I

B080601T: Food Microbiology

Unit	Topic	Total No. of Lectures (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 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: <ol style="list-style-type: none">1. Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.2. R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill3. Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)4. Varnam A.H. & Evans M G – Food borne pathogens. Wolfe Publishing House, London5. B.D. Singh (2015) Biotechnology, Kalyani Publisher6. Prajapati (2007) Fundamentals of Dairy microbiology, Indian Council of Agricultural Research, New Delhi		

Theoretical Paper-II

B080602T: Industrial Microbiology

Unit	Topic	Total No. of Lectures (60)
I	History & Multidisciplinary nature of Industrial microbiology. A typical Bio process: Introduction, advantages & limitations. Patents and intellectual propertyrights.	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,	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
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 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. 		

Practical

B080603P: Experiments in Food & Industrial Microbiology

Unit	Topic	Total No. of Lectures (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