

Noakhali Science and Technology University



Syllabus for the
Department of Microbiology
for
Undergraduate Courses (BS)
Session: From 2015-2016 and Onward till notified

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Noakhali-3814, Bangladesh.

hasibul.swcchha@gmail.com (H Hossain Swcchha)

Course Contents

	Course Code	Course Title	Credit
Year 1 Term 1	MBG1101	Introductory Microbiology	3
	MBG1103	Microbial Ecology	3
	MBG1105	Basic Techniques in Microbiology	3
	MBG1107	Fundamentals of Biochemistry	3
	MBG1102	Introductory Microbiology Lab	1
	MBG1104	Microbial Ecology Lab	1
	MBG1106	Basic Techniques in Microbiology Lab	1
	MBG1108	Fundamentals of Biochemistry Lab	1
Total			16

	Course Code	Course Title	Credit
Year 1 Term 2	MBG1201	General Microbiology	2
	MBG1203	Microbial Chemistry	2
	MBG1205	Parasitology	2
	MBG1207	Fundamentals of Chemistry	3
	MBG1209	Computer Applications	2
	MBG1202	General Microbiology Lab	1
	MBG1204	Microbial Chemistry Lab	1
	MBG1206	Fundamentals of Chemistry Lab	1
	MBG1210	Viva Voce	2
Total			16

	Course Code	Course Title	Credit
Year 2 Term 1	MBG2101	Microbial Catabolism	2
	MBG2103	Environmental Microbiology	2
	MBG2105	Basic Human Anatomy and Physiology	3
	MBG2107	Medical Microbiology	3
	MBG2109	Mycology	3
	MBG2102	Microbial Catabolism Lab	1
	MBG2104	Environmental Microbiology Lab	1
	MBG2106	Basic Human Anatomy and Physiology Lab	1
	MBG2108	Medical Microbiology Lab	1
	MBG2110	Mycology Lab	1
Total			18

	Course Code	Course Title	Credit
Year 2 Term 2	MBG2201	Microbial Anabolism	2
	MBG2203	Basic Microbial Genetics	3
	MBG2205	Microbial Pathogenesis	3
	MBG2207	Algology	2

	MBG2209	Biostatistics	3
	MBG2202	Microbial Anabolism Lab	1
	MBG2204	Basic Microbial Genetics Lab	1
	MBG2206	Microbial Pathogenesis Lab	1
	MBG2208	Algology Lab	1
	MBG2210	Viva Voce	2
		Total	19

	Course Code	Course Title	Credit
Year 3 Term 1	MBG3101	Basic Immunology I	3
	MBG3103	Introductory Virology	2
	MBG3105	Microbial Molecular Genetics	3
	MBG3107	Food Microbiology	2
	MBG3109	Enzymology	2
	MBG3111	Industrial Microbiology	3
	MBG3102	Basic Immunology I Lab	1
	MBG3104	Introductory Virology Lab	1
	MBG3106	Microbial Molecular Genetics Lab	1
	MBG3108	Food Microbiology Lab	1
	MBG3110	Enzymology Lab	1
	MBG3112	Industrial Microbiology Lab	1
		Total	21

	Course Code	Course Title	Credit
Year 3 Term 2	MBG3201	Basic Immunology II	3
	MBG3203	Virology	3
	MBG3205	Public Health and Epidemiology	3
	MBG3207	Food Borne Infection and Intoxication	3
	MBG3209	Soil and Agricultural Microbiology	3
	MBG3202	Basic Immunology II Lab	1
	MBG3204	Virology Lab	1
	MBG3206	Public Health and Epidemiology Lab	1
	MBG3208	Food Borne Infection and Intoxication Lab	1
	MBG3210	Soil and Agricultural Microbiology Lab	1
	MBG3212	Viva Voce	2
		Total	22

	Course Code	Course Title	Credit
Year 4 Term 1	MBG4101	Microbial Biotechnology	3
	MBG4103	Genetic Engineering	3
	MBG4105	Advanced Immunology	3
	MBG4107	Analytical Microbiology	3
	MBG4109	Microbiology of Frozen Foods	3
	MBG4111	Diagnostic Microbiology	3
	MBG4102	Microbial Biotechnology Lab	1

	MBG4104	Genetic Engineering Lab	1
	MBG4106	Advanced Immunology Lab	1
	MBG4108	Analytical Microbiology	1
	MBG4110	Microbiology of Frozen Foods Lab	1
	MBG4112	Diagnostic Microbiology Lab	1
	MBG4114	Visit to Industry	1
		Total	25

	Course Code	Course Title	Credit
Year 4 Term 2	MBG4201	Environmental Pollution and Bioremediation	3
	MBG4203	Pharmaceutical Microbiology	3
	MBG4205	Quality Control of Food and Beverages	3
	MBG4207	Fermentation Microbiology	3
	MBG4209	Genomics and Bioinformatics	3
	MBG4202	Environmental Pollution and Bioremediation Lab	1
	MBG4204	Pharmaceutical Microbiology Lab	1
	MBG4206	Microbiological Quality Control Lab	1
	MBG4208	Fermentation Microbiology Lab	1
	MBG4210	Genomics and Bioinformatics Lab	1
	MBG4212	Research Project and Presentation	4
	MBG4214	Viva Voce	2
			Total

Detailed Course Contents

Year 1: Term-1

MBG 1101

3

C

INTRODUCTORY MICROBIOLOGY

1. **Development of Microbiology:** discovery of microorganisms; biogenesis versus abiogenesis; fermentation process; germ theory of disease; Koch's postulates; development of laboratory techniques; vaccination; antiseptics; chemotherapy.
2. **Scope of Microbiology:** in medical, food and dairy, agriculture, industry, health and sanitation, environment and pollution control.
3. **Prokaryotic and Eukaryotic cells:** basic concept of prokaryotic and eukaryotic organisms; functions different of subcellular elements;

distinctive characteristics of the major groups of microorganisms; significance of smallness.

4. **Bacteria:** size, shape and arrangements; characteristics of major groups of Gram-negative and Gram positive bacteria
5. **Archaea:** general characteristics; morphological and physiological diversity
6. **Viruses:** discovery; general characteristics; morphology; chemical composition; viroids; prions; importance.
7. **Fungi:** general morphological characteristics; growth and reproduction; classification; importance in industry and natural process
8. **Algae:** general characteristics; classification; microscopic algae and their importance.
9. **Protozoa:** general characteristics; classification of major groups; importance in natural process.

Books Recommended

1. General Microbiology-II - G. Schlegel *et al.*
2. Biology of Microorganisms – T.D. Brock *et al.*
3. Microbiology – M. J. Pelczar, E.C.S. Chan and N.R. Krieg
4. Microbiology: An Introduction – G.J. Tortora *et al.*
5. Fundamental principles of Bacteriology – A.J. Salle *et al.*

MBG

1103

3 C

MICROBIAL ECOLOGY

1. **Basic concept of microbial ecology:** the scope of microbial ecology; historical overview; relation of microbial ecology to general ecology

2. **Microbial communities and ecosystems:** development of microbial communities; structure of microbial communities; ecosystems; microbial communities in nature
3. **Brief introduction to microorganisms in natural habitats:** atmoecosphere: characteristics and stratification of the atmosphere, the atmosphere as habitat and medium for microbial dispersal, microorganisms in the atmoecosphere; hydrosphere ecology of fresh water, composition and activity of fresh water microbial communities. Physical and chemical factors, estuaries, and marine water environment; characteristics and stratification of the ocean, composition and activity of marine microbial communities, role of microbes in the aquatic environment and lithosphere: introduction to soil formation: rocks and mineral, soil horizon, soil texture, soil organic matter, chemical properties of soil, soil microbial communities
4. **Effect of abiotic factors on microorganisms :** abiotic limitations to microbial growth, Leibig's law of minimum, Shelford's law of tolerance, temperature, radiation, pressure, salinity, water activity, movement, hydrogen ion concentration, redox potential, organic compounds and inorganic compounds
5. **Biological interactions:** microbial interaction within a single microbial populations, positive and negative interaction, interaction between diverse microbial populations. Neutralism, commensalisms, synergism, mutualism, competition. ammensalism, parasitism, predation.
6. **Microbes in extreme environments:** Nature, special feature of the thermophilic, methanogenic and halophilic archea, hot spring, acid springs and lakes, salt lakes

Books Recommended

1. Microbial Ecology fundamentals and applications- R.M Atlas and Bartha
2. Microbial Ecology: a conceptual approach- J.M. Lynch and Poole
3. Microbiology- M.J.Pelczar, Jr. E. C. S. Chan and N. R. Krieg
4. Microbiology: an introduction G. J. Tortora *et al.*

C

BASIC TECHNIQUES IN MICROBIOLOGY

- 1. Microscopes and Microscopy:** light spectrum, resolving power and magnification power; microscopes: light and electron microscopes; microscopy: bright-field, dark-field, fluorescence, phase-contrast, differential interference contrast, transmission electron, scanning, scanning tunnelling and atomic force microscopy
- 2. Observation of Microorganisms under Microscope:** wet-mount and hanging-drop technique; preparation of microorganisms for staining; chemical properties of stains; mechanisms of staining; positive and negative staining; simple, differential and special staining techniques
- 3. Cultivation of Microorganisms:** nutritional requirements; physical and gaseous requirements; media used for cultivation of microorganisms: chemically defined media, complex media, anaerobic growth media, selective and differential media; enriched culture; anaerobic culture method; pure culture techniques
- 4. Characterization of Microorganisms:** morphological characteristics; nutritional and cultural characteristics; metabolic characteristics; antigenic characteristics; pathogenic characteristics; genetic characteristics
- 5. Culture Preservation:** long-term and short-term techniques for preservation of microbial culture
- 6. Measurement of Growth:** direct measurement of microbial growth; estimating bacterial number by indirect methods
- 7. Control of Microbial Growth:** principles of microbial control; the rate of microbial death; the action of microbial control agents; conditions influencing microbial control; physical and chemical methods of microbial control.

Books Recommended

1. General Microbiology – Schlegel HG and Kogut M
2. Biology of Microorganisms – Brock TD, Madigan MT, Martinko JM & Parker J
3. Microbiology – Pelczar MJ Jr, Chan ECS & Krieg NK
4. Microbiology: An Introduction – Tortora GJ & Funke BR
5. Fundamental Principle of Bacteriology – Salle AJ

FUNDAMENTALS OF BIOCHEMISTRY

1. **Acid, Base and Buffer:** Ion product of water; acid; base; pH; pH indicator buffer solution and buffer capacity
2. **Thermodynamics:** 1st law of thermodynamics; enthalpy; Hess's law; 2nd law of thermodynamics; entropy; free energy; standard states; spontaneous reversible, irreversible and non-equilibrium reactions; steady state
3. **Carbohydrates:** nomenclature; functions; optical properties; general reactions; colour tests and method of estimation; selection from natural sources and representative examples of each class with note on characteristics
4. **Lipids:** nomenclature; classification; reactions of fatty acids; sterols and methods of estimation; structure and biological functions of different classes of lipids
5. **Amino Acids and Peptides:** structural features optical activity and classification of amino acids ionization of solution; behaviour; colour tests; isolation of amino acids from protein hydrolysates; peptide bonds and biologically important peptides
6. **Proteins:** general introduction; classification based on shape, structure and biological properties; isolation from natural sources; different levels of structural organization (in brief); enzymes chemical nature; K_m value and V_{max} ; enzyme inhibition; digestive enzymes
7. **Nucleosides and Nucleotides:** basic chemistry of nucleosides and nucleotides; polynucleotides
8. **Vitamins:** classification; occurrence; deficiency symptoms; biological functions; vitamins as coenzymes

Books Recommended

1. Principals of Biochemistry – Lehninger
2. Text book of Biochemistry with Clinical Correlations - Devlin
3. Biochemistry - Stryer
4. Text Book of Biochemistry - R.K. Murray
5. Bacterial Metabolism – Gottschalk

6. Chemical Microbiology - A.H. Rose
7. Antibiotics a scientific approach - A.L. Lehninger

MBG

1102

1 C

INTRODUCTORY MICROBIOLOGY LAB

1. Laboratory safety rules
2. Use and function of microscopes
3. Observation of stained cell preparations
 - a) Simple staining and negative staining
 - b) Gram staining
 - c) Acid staining
 - d) Capsule staining
 - e) Spore staining
 - f) Flagella staining
4. Observation of living bacterial cells
5. Observation of living yeasts and molds
6. Micrometry: measurement of microbial cell

MBG

1104

1 C

MICROBIAL ECOLOGY LAB

1. Sampling and quantification and identification of microorganisms in air, soil and water
2. Techniques for isolation of pure cultures (streak plate, pour plate, spread plate)
3. Isolation of bacteria (streak plate, spread plate, pour plate, serial dilution)

MBG

1106

1C

BASIC TECHNIQUES IN MICROBIOLOGY LAB

1. Media preparation & sterilization techniques
2. Culture transfer techniques
3. Techniques for isolation of pure cultures
4. Techniques for preservation and maintenance of pure cultures
5. Observation of cultural characteristics of bacteria on various media
6. Observation of cultural characteristics of yeast on various media

MBG1108

1 C

FUNDAMENTALS OF BIOCHEMISTRY LAB

Analysis of Carbohydrates:

1. General test for carbohydrate;
2. Reducing sugar test,
3. Barfoed's test,
4. Iodine test,
5. Foulgers test and hydrolysis of sucrose and starch
6. Determination of lactose content of milk,
7. Determination of ascorbic acid content of biological sample.

Analysis of Amino acids and Proteins:

1. Precipitation of proteins, colour reactions of proteins and amino acids,
2. Biurete test, Test for cystine & cystein and differentiation of proteins (Paper chromatography)

Analysis of Lipids:

1. Solubility test,
2. Detection of glycerol, saponification and cholesterol test.

Year 1: Term 2

MBG 1201

2

C

GENERAL MICROBIOLOGY

1. **Physical Requirements for Microbial Growth:** temperature; pH; gaseous requirements; osmotic pressure and other conditions
2. **Nutritional Requirements for Microbial Growth:** chemical elements as nutrients; organic growth factors; nutritional classification of microorganisms; nutrient uptake processes
3. **Culture Media:** criteria for an ideal culture medium; complex media; chemically defined media; selective and differential media; enrichment media; anaerobic growth media; special purpose media for eukaryotic microorganisms; tissue culture media
4. **Growth of Bacteria:** bacterial multiplication; generation time; mathematical expression of growth; phases of growth; synchronous growth; batch, fed-batch and continuous culture
5. **Microbial Systematic:** microbial evolution and physiology; endosymbiotic hypothesis; microbial taxonomy and classification; taxonomic hierarchies; classical systems of microbial classification; phenetic and phylogenetic approaches to microbial classification; numerical taxonomy; molecular based classification
6. **Atypical Bacteria:** general characteristics and importance of actinomyces, cyanobacteria, mycoplasmas, rickettsias, chlamydiae and spirochetes; gliding, sheathed, budding and appendage bacteria

Books Recommended:

1. Principles of Microbiology – Atlas RM
2. Biology of Microorganisms – Brock TD, Madigan MT, Martinko JM and Parker J
3. Microbiology – Pelczer MJ Jr, Chan ECS and Krieg NR
4. Microbiology: An Introduction – Tortora GJ & Funke BR

MBG 1203

2

C

MICROBIAL CHEMISTRY

1. **Microbial Elements, Molecules and Polymers:** the major and minor essential elements; important molecules and polymers - water, carbohydrate, lipids, nucleic acids and proteins
2. **Molecular Architecture of Microbial Cells:** chemical composition and function of cellular structures and organelles: capsules, flagella, pili, cell walls, cytoplasmic membranes, pigments, ribosomes, mitochondria, cytoplasmic inclusions and endospores
3. **Control of Microbial Growth:** principles of microbial control; the rate of microbial death; the action of microbial control agents; conditions influencing microbial growth control; physical and chemical methods of microbial control
4. **Chemistry of Antibiotics:** general features; classification, chemistry, mode of action and efficiency; mechanisms of antimicrobial resistance of microbes; properties and effectiveness of penicillin, tetracycline, streptomycin, chloramphenicol, nystatin, gentamicin and griseofulvin; assay of antibiotics by chemical & biological methods

Books Recommended

1. Bacterial Metabolism – Gottschalk G
2. Chemical Microbiology – Rose AH
3. Antibiotics: A Scientific Approach – Agorov NS
4. Lehninger Principles of Biochemistry – Nelson DL & Cox MM

MBG 1205

2

C

PARASITOLOGY

1. **Parasitism in Perspective:** necessity of studying parasites; kinds of parasites and hosts; consequence of host-parasite interactions – a brief outline with examples
2. **Parasite Biogeography:** factors affecting geographical distribution; parasites as biological markers; evolution of host–parasite associations
3. **Morphology, Pathogenesis, Diagnosis and Treatment of the following Parasites:** intestinal flagellates: *Giardia lamblia*, *Trichomonas*; hemoflagellates: *Leishmania*, *Trypanosoma*; intestinal amoebas: *Entamoeba histolytica*; Sporozoans: *Plasmodia*, *Toxoplasma gondii*; Helminths: *Nematodes*
4. **Control of Parasites**

Books Recommended:

1. Microbial Pathogenesis: A Molecular Approach – A.A. Salyers and D.D. Whitt
2. Medical Microbiology – R. Cruickshank, ELBS, E. and S. Livingstone.
3. Review of Medical Microbiology – E. Jawets, J.I. McInick and E.A. Adelbug
4. Medical Microbiology - R.F. Boyd and J.J. Marr
5. Manual of Clinical Microbiology – H. Lennette
6. Medical Microbiology – Mims, Playfair and Roitt
7. Medical Microbiology – Robert F. Boyed and J. Joseph Marr
8. Foundations of Parasitology: Larry Roberts and John Janovy (authors), McGrawHill Publishing

MBG 1207

3

C

FUNDAMENTALS OF CHEMISTRY

1. **The Structure of Atoms:** the discovery of electron proton and neutron; cathode rays; radioactivity; particles scattering; Rutherford model; fraction of atomic masses; isotopes; mass spectroscopy spectrum of atomic hydrogen; Bohre models; dual nature of matter; wave nature of electrons; atomic orbital; electron configuration of atom
2. **Radioactivity and Nuclear Reactions:** nuclear binding energy; fission and fusion reactions
3. **Periodic Classification of Elements:** ionization potential; electro negativity; electron affinity; atomic radius; variation of properties along a period and a

- group; diagonal relationship; representative elements; transition elements; chemical properties of s-, p- and d-block elements
- 4. Chemical Bonds:** electronic theory; valence bonds theory; molecular orbital theory; sigma (δ)- and pi (π) bonds; C-C bonds; catenation; polar molecules, electro negativity and electron affinity; hydrogen bond; shapes of molecules; VSEPR theory; hybridization
 - 5. The Gaseous State:** the gas laws; the perfect gas equation; the kinetic theory of gases; the distribution of molecular velocities; inter molecular attraction; liquefaction of gases; the critical state; the critical constants
 - 6. Vapour Pressure of Liquids:** temperature dependent mixtures of liquids; Raoult's law; fractional distillation; solutions of non-volatile solids; colligate properties of solutions; Henry's law; Nernst distribution law
 - 7. Energy Changes in Chemical Reactions:** the first law of thermodynamics F; the concept of internal energy and enthalpy; measurement of enthalpy changes; enthalpy of formation; Hess's law; lattice enthalpy; Born-Haber cycle; spontaneous process; concept of entropy
 - 8. Chemical Equilibrium:** the equilibrium law; the equilibrium constant; homogeneous and heterogeneous equilibrium; the principle of Le Chatelier and Brown; the dependence of K on temperature
 - 9. Acids and Bases:** the Lewis concept; the Bronsted concepts in strong and weak acids; acid-base equilibrium in aqueous solutions; Ostwald dilution law; pH; its measurement in buffer solutions; neutralisation curves; indicators for acid-base titration
 - 10. The Organic Compounds and Organic Chemistry:** hydrocarbons; aliphatic hydrocarbons; saturated and unsaturated hydrocarbon; alkanes, alkenes and alkynes; the aromatic hydrocarbons; delocalisation in the benzene ring; nomenclature of organic compounds; the IUPAC system; petroleum; natural gas; refining of petroleum; petrochemicals
 - 11. Reactions of Alkanes, Alkenes and Alkynes:** substitution and hydrogen abstraction reactions in alkanes; hydrogenation; hydrohelogenation; ozonolysis of alkenes and alkynes; hemolytic addition of hydrogen halides; geometrical isomers
 - 12. Functional groups:** alcohols, aldehydes, ketones, ethers, epoxides, amines, amides; typical reactions of the functional groups
 - 13. Some Important Reactions of the Aromatic Compounds:** substitution at the benzene ring; Friedel-Craft's reaction; sulphonation and nitration; diazotization and coupling

Books Recommended

1. General Chemistry – Ebbing D
2. First Year Chemistry – Coxon JM, Gergusson JE and Philips IF
3. A-Level Chemistry – Ramsden EN

MBG 1209

2

C

COMPUTER APPLICATIONS

1. **Introduction:** basic organization, types and brief history of computer, general review of input and output media and devices; memory organization storage devices.
2. **Operating Systems and Applicators:** operating system (Windows, Linux and others); application of programs.
3. **MS Office:** Introduction of MS word, Power point and Excel.
4. **Statistical Analysis:** MS excel; means and variance; basic calculation and estimation, standard errors and confidence limit; simple significance test: λ^2 tests of goodness-of-fit and homogeneity; simple experimental design and analysis of variance.
5. **Introduction to Statistical Package for Biological Sciences:** research methodology; hypothesis; sampling; collection and analysis; frequency table; contingency tables analysis; Pearson correlation; regression analysis; T-test and its use; presentation of software: MS power point; graphic design (Photoshop, Corel draw, and illustrator); EPI-Info.
6. **Application to Computer in Web Based Learning:** browsing of web-site, downloading and installation process of important software, usage of web-based learning materials.

Books Recommended

1. The Perspective. 1998 – Hutchinson SE and Sawyer SC

2. SPSS for Windows: Base System User's Guide Release 6.0. 1995 – Norusis MJ
3. Excel 7.0 for Windows' in a Day, 1996 – Stultz RA
4. Introduction to Computer Science – PW Mursil PW and Smith CL
5. Computer Network – Tanenbaun AS
6. An Introduction to Computer Hardware – Cripps M
7. Computer Anatomy – Rub N

MBG 1202

General Microbiology Lab

1C

1. Techniques of pipetting and dilution
2. Determination of quantitative viable cells by serial dilution technique (spread plate and pour plate) and making a growth curve
3. Techniques of enumeration of microorganisms: improved Neubaur counting chamber; Miles and Misra technique
4. Turbidimetric estimation of bacterial growth

MBG 1204

Microbial Chemistry Lab

1C

1. Preparation of different lab solutions (molar, molal, normal and buffers)
2. Determination of citric acid by titrimetric method
3. Determination of antibiotic agents
4. Determinations protein
5. Determinations reducing sugar
6. Detection of cytoplasmic inclusions (PHB and volutin)

MBG 1206

Fundamentals of Chemistry Lab

1C

Physical Chemistry

1. Determination of the molar mass of carbon tetrachloride by Duma's method
2. Determination of enthalpy of neutralization of acid calorimetrically
3. Determination of partition coefficient of 12 between water and carbon tetrachloride
4. Investigation of the variation of conductance of a weak electrolyte with concentration
5. Investigation of the effect of reactant concentration on the rate of the reaction between thiosulphate ion and H^+ ion and determination of the

reaction

Organic Chemistry

1. Determination of the melting point of the organic compound
2. Determination of presence of nitrogen, sulphur and halogens in organic sample
3. Identification of functional groups in organic compounds

MBG 1210

2C

Viva voce

Year 2: Term 1

MBG 2101

2 C

MICROBIAL CATABOLISM

1. **Introduction to Metabolism:** basic aspects and characteristics of metabolism; inter-relationships between anabolic and catabolic mechanisms

in life

- 2. Cell Bioenergetics:** energy production; free energy; energy coupling; biological oxidation; high energy compounds; ATP and its application; ATP generation by different processes
- 3. Membrane Transport System:** basic structure of membrane; active, passive, facilitative and group translocation
- 4. Carbohydrate Catabolism/Aerobic Metabolic processes:** the Embden-Meyerhof-Parnas pathway; tricarboxylic acid cycle; electron transport chain; oxidative and substrate level phosphorylation
- 5. Alternate Pathways of Glucose Catabolism:** hexose monophosphate pathway; Entner-Doudoroff pathway; glyoxylate cycle; methyl-glyoxal bypass; inter linkages of pathways; anapleuretic reactions
- 6. Pathways for Utilisation of Sugars Other than Glucose:** starch, cellulose, maltose, sucrose, lactose, sorbitol and mannitol
- 7. Catabolic Activities of Aerobic Heterotrophs:** growth with organic acids (beta-oxidation), amino acids, aromatic compounds, aliphatic hydrocarbons and 1C (one carbon) compounds
- 8. Anaerobic Metabolic Processes:** fermentation; fermentation of ethanol, acetate-butyrate, acetone-butanol, lactate and methane

Books Recommended

1. Microbial Physiology – Moat AG and Foster JF
2. Bacterial Metabolism – Gottschalk G
3. Microbiology – Pelczer MJ Jr, Chan ECS and Krieg NR
4. Lehninger Principles of Biochemistry – Nelson DL and Cox MM

MBG 2103

2 C

ENVIRONMENTAL MICROBIOLOGY

- 1. Microbial Interaction with plant and animals :** interaction with plant roots;

N₂ fixation in nodules; interaction with aerial plant structure; commensal and mutualistic intestinal symbiont; digestion within the rumen; fungal predation in animals

2. **Techniques for the Studying Environmental Microbes:** sample collection; sample processing; detection of microbial populations; determination of microbial numbers; determination of microbial biomass; measurement of microbial metabolism
3. **Microbiology of Potable Water:** introduction to indicator organisms; water-borne pathogens; isolation and identification of indicator bacteria; water-borne pathogens
4. **Sanitation and Public Health Microbiology with Special Reference to Bangladesh:** water supply; the use of safe water; public tube well coverage; sanitation; disposal of human excreta and refuse
5. **Microorganisms and Some Novel Pollution Problem:** persistence and biomagnification of xenobiotic molecules; recalcitrant halocarbons, polychlorinated biphenyls (PCBS), alkyl benzyl sulfonates and synthetic polymer
6. **Insecticides, Fungicides and Herbicides:** organic compounds: DDT, gammexane, methoxychlor and heptachlor; organophosphorous compounds; malathion, parathion, dimecron and diazinon; carbamates; 2,4-D (2,4-dichloroacetic acid) and 2,3,5-T (trichlorophenylacetic acid)

Books Recommended

1. Microbial Ecology: Fundamentals and Applications – Atlas RM and R Bartha R
2. Microbial Ecology: A Conceptual Approach – Lynch JM and Poole NJ
3. Microbiology – Pelczer MJ Jr, Chan ECS and Krieg NR
4. Microbiology: An Introduction – Tortora GJ and Funke BR
5. Microbial Ecology: Organism, Habitats, Activities – Stolp H

MBG 2105

3 C

BASIC HUMAN ANATOMY AND PHYSIOLOGY

1. **Digestion and Digestive System:** composition of digestive juices; mechanisms and control of the secretion; digestion of different food items

and absorption of the digested ones

2. **Blood and Circulatory System:** composition, formation, destruction and function of blood; blood coagulation; blood groups; tissue fluid; circulatory system with the process of blood circulation
3. **Hepatic Organs and Systems:** structures and functions of lungs, liver, kidney, pancreas, spleen and brain with brief idea about their respective function
4. **Water and electrolytic balance:** brief outline
5. **Lymphoid and lymphatic system:** brief outline
6. **Hormones:** basic characteristics, classifications, functions, mode of action of different hormones - insulin, epinephrine, T₄, T₃, glucocorticoids etc
7. **Reproductive System:** structure and function of testis, ovary, uterus and placenta, menstrual cycle along with hormonal involvement

Books Recommended

1. Introduction to Human Physiology – Griffiths M
2. Human Physiology – Schumddt RF and Thews G
3. Human Anatomy, Physiology and Pathophysiology – Thews G, Mustschler F & Vaupe P

MBG 2107

3 C

MEDICAL MICROBIOLOGY

1. **Infection and Infectious Diseases:** concept of infection and infectious diseases; pathogenesis of infectious diseases; virulence (ID₅₀, and LD₅₀)
2. **Brief Introduction to Virulence factors:** adherence factors; invasion of host

cells and tissues; toxins; enzymes; intracellular pathogenesis; pathogenicity island and pathogen evolution; antigenic heterogeneity; iron acquisition

3. **Identification of microbes that cause disease:** Koch's postulates and their limitations
4. **Host-Microbe Interaction:** normal resident microflora of human body and their role; initial colonization of a new born; introduction to resident flora of skin, mouth, upper respiratory tract, intestinal tract, uro-genital tract and eye
5. **Non-Specific Host Defences against Microbial Pathogens:** primary defenses conferred by tissues and blood
6. **Major Reservoirs of Microbial Pathogens:** acquisition of and mode of transmission of diseases
7. **Progress of an Infection:** true and opportunistic pathogens; portal of entry; size of inoculum; stages in the course of infections and diseases; mechanism of invasion and establishment of the pathogens; signs and symptoms of a disease; portal of exit
8. **Nosocomial Infection:** brief introduction with hospital as a source
9. **Brief Introduction to the Microbiology of Major Infectious Diseases:** skins, respiratory system; nervous system; genito-urinary tract; gastrointestinal tract; circulatory system

Books Recommended:

1. Jawetz, Melnick and Adelberg's Medical Microbiology – Brooks GF, Carroll KC, Butel JS and Morse SA
2. Essential Clinical Microbiology: An Introductory Text – Cooke EM and Gibson GL
3. Manual of Clinical Microbiology – Lennette EH, Ballows A, Hausler WJ Jr and Shadomy HJ
4. Modern Medical Microbiology – Chowdhury MR
5. Medical Microbiology – Duguld JP, Marinian BP and Swain RHA
6. Bacterial Pathogenesis: A Molecular Approach – Salyers AA and Whitt DD

MBG 2109

3 C

MYCOLOGY

- 1. An Introduction to the Fungi:** somatic and reproductive features; growth and nutrition
- 2. Origin and Classification of Fungi**
- 3. General Characteristics of the Following Fungi with the Study of Somatic and Reproductive Features:** *Synchytrium; Saprolegnia; Rhizopus, Mucor; Saccharomyces, Aspergillus, Penicillium; Candida; Agaricus; Fusarium*
- 4. Importance of Micro Fungi:** saprophytes in nature; plant parasites; plant symbionts (mycorrhizae and lichen); producers of important metabolites; Human pathogen (Epidermophyton, Trichophyton, Microsporum, Candida, Aspergillus); Industrial use of Aspergillus, Penicillium, Yeast, Mucor
- 5. Brief Introduction to Mycotic Infections:** cutaneous, sub-cutaneous, systemic and opportunistic mycoses

Books Recommended

1. Introductory Mycology – Alexopoulos CJ, Mims CW and Blackwell M
2. Fungi – Howker J and Lilian E
3. Fungi and Plant Diseases – Mundkar BB
4. Fundamentals of the Fungi – Moore-Landecker E
5. Introduction to Fungi – Webster JG

MBG 2102

Microbial Catabolism Lab

1 C

1. Starch, lipid, casein and gelatine hydrolysis tests
2. Carbohydrate (LDS) fermentation
3. MIU, KIA and IMViC tests
4. Nitrate reduction, oxidise, catalase and litmus milk reaction tests
5. Antimicrobial sensitivity test of microorganisms (qualitative)

6. Identification of unknown bacterial culture with the help of Bergey's Manual of Systematic Bacteriology

MBG 2104

Environmental

Microbiology

Lab

1 C

1. Effect of temperature on growth
2. Effect of heat on vegetative cells, spores of bacteria and on spores of yeast and mold
3. Effect of osmotic pressure on growth
4. Effects of pH, energy source and buffer on growth

MBG 2106

Human

Physiology

Lab

1 C

1. Circulatory system: total blood cell count; differential count for WBC; determination of serum bilirubin, cholesterol and non-esterified fatty acid, uric acid, glucose, etc. in blood
2. Gastro-enteric system
3. Genito-urinary tract system
4. Respiratory tract system

MBG 2108

Medical

Microbiology

Lab

1 C

1. Microscopic study of parasites
2. Microscopic study of the pathogenic microorganisms presents in air, water and soil (Gram reaction, morphology, motility etc.)
3. Microbial flora of throat and skin
4. Identification of human staphylococcal pathogens
Identification of human streptococcal pathogens

MBG 2110

Mycology

Lab

1 C

1. To acquaint with the techniques for preparing temporary slides of fungal

- specimens for microscopic examinations
2. Laboratory studies of the locally available members of the fungi covered in theory
 3. Techniques of growing fungi on culture media

Year 2: Term 2

MBG 2201

2 C

MICROBIAL ANABOLISM

1. **Carbohydrate Metabolism:** gluconeogenesis and its control
2. **Amino Acid Biosynthesis:** the glutamate and ketoglutarate family; the aspartate and pyruvate families; the serine-glycine family; aromatic amino acids; regulation of amino acid biosynthesis
3. **Lipid Biosynthesis:** biosynthesis of fatty acids; role of cofactors in fatty acid biosynthesis; pathway to biosynthesis of mevalonate, squalene and sterols
4. **Nucleotide Biosynthesis:** biosynthesis of purines and pyrimidines; regulation of purine and pyrimidine biosynthesis
5. **Biological-Nitrogen Fixation:** inorganic nitrogen metabolism; assimilation of inorganic nitrogen; fermentation of nitrogenous compounds; nitrogenase and its features and function; regulation of biological nitrogen fixation
6. **Autotrophic CO₂ fixation:** mechanisms of photosynthesis in green, sulphur and cyanobacteria; physiological groups of aerobic chemolithotroph; hydrogen and CO oxidizers; ammonia, sulphur and ferrous ion oxidizers; facultative obligate chemolithotrophs

Book Recommended

1. Microbial Physiology – Moat AG and Foster IF
2. Bacterial Metabolism – Gottschalk G
3. Microbiology: Concepts and Applications – Pelczer MJ Jr, Chan ECS and Krieg NR
4. Lehninger Principles of Biochemistry – Nelson DL and Cox MM

MBG 2203

3 C

FUNDAMENTALS OF GENETICS AND MOLECULAR BIOLOGY

1. **Mendelism:** Mendel's experiments and the interpretation; the basic principles of dominance, segregation and independent assortment; misinterpretations of Mendelian principles
2. **Chromosomal Basis of Inheritance:** the chromosome theory of heredity; sex chromosomes and sex determination; sex-linked genes in human beings; variation in chromosome number and structure
3. **Chemical Nature of Hereditary Material:** experiments with bacteria and bacteriophages indicating DNA to be the material of heredity; chromosome structure in prokaryotes; the Watson and Crick model of DNA structure; alternate forms of the double helix; properties of DNA, *e.g.*, T_m value, *cot* value and hybridization kinetics
4. **Replication of DNA:** Semi-conservative replication; experiments of Meselson and Stahl; DNA polymerases; proof-reading activities of DNA polymerases; the mechanism of DNA replication; circular DNA replication
5. **Transcription in Prokaryotes and Eukaryotes:** different types of RNA molecules; prokaryotic and eukaryotic RNA polymerases; mechanism of transcription in prokaryotes and eukaryotes; post-transcription modification with mechanism of RNAs; interrupted genes in eukaryotes

- 6. Translation and the Genetic Code:** synthesis of polypeptide chain; the genetic code; Wobble hypothesis; post-translation modification of protein

Books Recommended

1. Genetics – Strickberger MW
2. Molecular Biology of the Gene, 6th Edition – Watson JD *et al.*
3. Molecular Biology – Freifelder D
4. Essential Genetics – Russel PJ
5. Principles of Genetics – Snustad DP, Simmons MJ and Jenkins JB

MBG 2205

3 C

BACTERIAL PATHOGENESIS

1. **Morphological and Cultural Properties, Clinical Manifestation, Pathogenesis, Virulence Factors, Prevention and Treatment of the Following Microorganisms Causing Diseases:** *Streptococcus pyogenes; Streptococcus pneumoniae; Staphylococcus aureus; Corynebacterium diphtheria; Mycobacterium tuberculosis; Clostridium tetani; Vibrio cholerae; Escherichia coli; Salmonella typhi; Neisseria spp.; Treponema pallidum; Bordetella pertussis*

Books Recommended

1. Microbial Pathogenesis: A Molecular Approach – Salyer AA and Whitt DD
2. Jawetz, Melnick & Adelberg's Medical Microbiology – Brooks GF, Carroll KC, Butel JS and Morse SA
4. Medical Microbiology – Boyd RF and Marr JJ
5. Manual of Clinical Microbiology – Lennette EH, Ballows A, Hausler WJ and Shadomy HJ
6. Medical Microbiology – Mims C, Playfair J and Roitt I, Wakelin D and Williams

MBG 2207

2 C

ALGOLOGY

1. **Introduction:** History, habitat and classification, pigments and types of chloroplasts, reproduction and algal perennation, Range of vegetative and reproductive structure and Life cycle pattern; evolutionary trends in algae; factors determining the distribution of fresh and marine algae.
2. **Classification:** General characteristics and reproduction of i) Cyanophyceae ii) Chlorophyceae iii) Xanthophyceae iv) Bacillariophyceae v) Rhodophyceae.
3. **Micro and Macro Algae with Their Economic Importance:** i) *Nostoc* ii) *Oscillatoria* iii) *Volvox* iv) *Chlorella* v) *Oedogonium* vi) *Fritschella* vii) *Vaucheria* viii) *Chara* ix) *Sargassum* x) *Polysiphonia* xi) *Batrachospermum* xii) *Botrydium* xiii) *Navicula*

Books Recommended

1. Text Book of Algae – O.P Sharma.
2. Text book of Algae – B.R Vashista.
3. Algae – G.L Chopra.
4. Algae – B.P Pandey.
5. Text Book of Algae – N.D. Kamath
6. The structure and reproduction in – Fritsch F.E.

MBG 2209

3 C

BIOSTATISTICS

4. **Organizing and Summarizing Data:** some basic concepts: statistics, biostatistics, variables, population and sample, random samples, distribution; tabulation, processing and summarizing of numerical data; the frequency distribution, graphical representation of frequency table, measures of central tendency; measures of dispersion, skewness of kurtoses; measures or exploratory data analysis by plotting
5. **Probability:** introduction; some elementary probability; the binomial distribution; the normal distribution; the Chi-square distribution; the distribution of Student's
6. **Hypothesis Testing/Statistical Inference:** statistical hypothesis: simple and composite hypothesis; significance test; type-1 and type-II errors; power of a

test; p-value; testing hypothesis of a single population mean, proportion, variance; comparison between two population means and between two population variance

7. **Analysis of Frequency using λ^2 Distributions:** the λ^2 criterion; tests of goodness-of-fit; homogeneity of two-cell samples; tests of independence
8. **Correlation, Simple Regression and Multiple Regression:** correlation: linear regression model, evaluating the regression equation, the multiple regression model; evaluating multiple regression model; choosing independent variables for multiple regression model
9. **Analysis of Variance:** experiment; experimental unit; treatment; replication analysis of variance for the completely randomized design; the randomized complete block design; the Latin square design
10. **Statistical Methods in Epidemiology:** basic incidence measures; risk and rate; prevalence measures; measures of association; risk ratio or relative risk; exposure odds ratio; risk odds ratio; measures of potential impact; attributable risk
11. **Survival Analysis:** introduction; basic designs follow-up studies, cross-sectional studies and case control studies; survival function; hazard function; the product limit estimate of survival function; the life table analysis; the log rank test for comparing survival distributions

MBG 2202

Microbial

Anabolism

Lab

1C

1. Relationship of free oxygen to microbial growth
2. Anaerobic culture of bacteria
3. Degradation of polymer by exoenzymes
4. Actions of antiseptics, disinfectants, UV light and photo-reactivation and anti-metabolite

MBG 2204

Basic Genetics Lab

1C

1. Protoplast fusion test
2. Detection of genetic material by staining
3. Test for enzyme induction

4. Isolation or drug resistant mutant

MBG 2206

**Bacterial
1C**

Pathogenesis

Lab

1. Isolation, identification and antibiotic sensitivity pattern of pathogenic microorganisms from clinical specimens: (a) stool, (b) urine, (c) pus, (d) blood, (e) CSF and (f) biopsy

MBG 2208

**Algology
1C**

Lab

1. Preparation of various fixatives used in algae preservation.
2. Study of fresh water algae.
3. Study of marine water algae.
4. Study of museum specimens.

MBG 2210

**2 C
Viva voce**

Year 3: Term 1

MBG 3101

3 C

BASIC IMMUNOLOGY I

1. **History and Introduction to Immunology:** history and development of immunology; introduction to immune system; basic concept of innate and adaptive immunity; cellular and humoral immunity
2. **Cells Involved in Immune Response:** general features and functions of lymphoid cells; mononuclear phagocytes; antigen presenting cells;

polymorphs; mast cells; platelets

3. **Lymphoid Systems:** primary and secondary lymphoid tissue; primary lymphoid organs; secondary lymphoid organs and tissues
4. **Innate Immunity:** phagocytosis: process of phagocytosis; complement systems; activation and biological functions of complements
5. **Immunoglobulins:** basic structure and function of immunoglobulin; immunoglobulin classes and subclasses; physiochemical properties, distribution and functions of different classes and subclasses of immunoglobulin; memory B cell; genetic basis of antibody heterogeneity; antibody class switching.
6. **Antigens:** general properties of antigen; antigenic determinants; haptens
7. **Membrane Receptors for Antigens:** B cell surface receptors for antigens; T cell receptors (TCR) major histocompatibility complex (MHC); antigens structure; functions of MHC class I and class II molecules; gene map of MHC antigens; processing and presentation of peptides by MHC molecule, antigen recognition; antigen-antibody interaction; forces of antigen-antibody binding; haplotype restriction of T cell reactivity
8. **Inflammation:** patterns of cell migration and inflammation and their control
9. **Lymphocyte activation:** interaction of T lymphocytes and APC; signals for T cell activation; B cell response to thymus dependent and independent antigens; B cell activation by surface Ig and T cell

Books Recommended

1. Immunology – Roitt I
2. Roitt's Essential Immunology – Delves P, Martin S, Burton D and Roitt I
3. Advanced Immunology – Male DK, Champion B and Cooke A
4. Text Book of Immunology – Barrett TJ
5. Immunology: An introduction – Tizard TR

MBG 3103

2 C

INTRODUCTORY VIROLOGY

1. **Introduction to Virology:** brief history and development of virology
2. **Nature of Virion:** morphology, physical properties and chemical composition of virion

3. **Nomenclature and Classification of Animal and Plant Viruses**
4. **Virus Cultivation:** cultivation and quantitation of plant, animal and bacterial viruses, purification and identification of virus; one step growth curve; inclusion bodies
5. **Virus Replication:** steps in virus replication; multiplication and gene expression of DNA and RNA viruses
6. **Pathogenesis of Viral Diseases**
7. **Bacteriophages:** overview of bacteriophages; genome organization and multiplication of RNA and DNA bacteriophages; temperate bacteriophages; lytic and lysogenic cycle; transposable phages
8. **Prevention and Treatment of Viral Infections:** viral vaccines; interferon: induction and action of interferons; antiviral chemotherapy
9. **Viroids and Prions:** general properties and diseases caused by viroids and prions

Books Recommended

1. Microbiology: Concepts and Applications – Pelczer MJ Jr, Chan ECS and Krieg NR2
2. Biology of Microorganisms – Brock TD, Madigan MT, Martinko JM and Parker J
3. Fields Virology, Vol. I and II – Knipe DM, Roizman B, Howley PM, Straus SE and Griffin DE
4. Fundamental Virology – Fields BN, Knipe DM and Howley PM

MBG 3105

3 C

MICROBIAL MOLECULAR GENETICS

1. **Mutation:** mutation rate; types of mutations; detection of mutations; mutagenic agents; screening chemicals for mutagenicity; molecular basis of mutagenesis; mutation induced by chemical; radiations and biological agents
2. **DNA Repair Mechanisms:** nature of DNA damage; light-dependent repair; excision repair; mismatch repair; post-replication repair; error-prone repair system; SOS repair
3. **Gene Transmission in Bacteria:** transformation, conjugation and transduction; transformation and gene mapping; conjugation and gene

mapping; transduction and gene mapping; the evolutionary significance of sexuality in bacteria

4. **Plasmids:** basic features of plasmids and integron; size and copy number conjugation and compatibility; classification of plasmid and integron ; role of plasmid and integron in evolution of recombinant microbes; plasmids in organisms other than bacteria
5. **Regulation of Bacterial Gene Expression:** constitutive, inducible and repressive gene expression; lactose operon in *E. coli*; induction and catabolite repression; tryptophan operon in *E. Coli* repression and attenuation; arabinose operon in *E. coli*; positive and negative control; transcriptional, translational and post-translational regulatory mechanisms
6. **Genetic Recombination:** types of recombination, models of general recombination; molecular basis of homologous and non-homologous recombination
7. **Transposable Genetic Elements:** transposable elements in prokaryotes: IS elements; composite transposons, Tn3 element, mutagenic effects of bacterial transposable elements, the medical significance of bacterial transposons; transposable elements in eukaryotes: Ac, Ds and Dt elements in maize; P elements and hybrid dysgenesis in *Drosophila*

Books Recommended

1. Principles of Genetics – Gardner EJ, Simmon MJ and Snustad DP
2. Molecular Biology of Gene – Watson JD *et al.*
3. Gene VI – Lewin B
4. Principles of Genetics – Snustad DP, Simmon MJ

MBG 3107

2 C

FOOD MICROBIOLOGY

1. **Food and Food-Borne Microbes:** introduction to various types of foods; food preparation; food-borne microorganisms.
2. **Factors Affecting Microbial Growth in Foods:** intrinsic and extrinsic parameters
3. **Food Preservation:** general principle; preservation by high temperature, low temperature, drying, using food additives and radiation

4. **Food Spoilage and Preservation:** cereal and cereal products; sugar and sugar products; vegetables and fruits; meat and meat products; fish and other sea-foods; chemical spoilage; autolytic spoilage; poultry; milk and milk products; heated canned foods
5. **Preparation of Fermented Foods:** bakery products; dairy product: cheese, yogurt and curd; vegetable products: cabbage, cucumber; oriental fermented food: miso, idli, tempe and tofu

Book Recommended

1. Food Microbiology – Frazier WC and Westhoff DC
2. Modern Food Microbiology – Jay JM

MBG 3109

2 C

ENZYMOLGY

1. **Properties and Functions of Enzymes:** remarkable properties; catalytic power; specificity and regulation; different forms; cofactors, coenzymes and vitamins
2. **Nomenclature and Classification of Enzymes:** general classification; isoenzymes; multi-enzymes; allosteric enzymes
3. **Structure of Enzymes:** primary, secondary, tertiary and quaternary structure; folding and domains; molecular chaperones
4. **Catalysis and Mechanism of Action of Enzymes:** active site; substrate binding; general acid-base catalysis; covalent catalysis; non-protein catalytic groups and metal ions
5. **Kinetics of Enzyme-Catalyzed Reaction:** factors influencing catalytic activity; simple enzyme kinetics with single and multi-substrate; Michaelis-Menten kinetics; turnover number, K_m and V_{max} ; other influences on enzyme activity; pH, temperature, fluid forces, chemical agents and irradiation
6. **Enzyme Inhibition and deactivation:** competitive, non-competitive and uncompetitive inhibition; deactivation models; strategies for enzyme stabilization
7. **Enzyme Assays and Purification:** unit of enzyme; enzyme activity; continuous and discontinuous enzyme assays; purification methods; testing for purity etc.

Books Recommended

1. Lehninger Principle of Biochemistry – Nelson DL & Cox MM
2. Biochemical Engineering Fundamental – Bailey JE & Ollis DF

MBG 3111

3 C

INDUSTRIAL MICROBIOLOGY

1. **Microorganisms and Industry:** historical development; scope and major classes of microbial products and processes
2. **Industrially Important Microorganisms:** yeasts, molds, bacteria and actinomycetes; screening and selection of microorganisms for useful products; strain improvement
3. **Microbiological Production of Foods:** SCP and MBP; baker's yeast; food additives; fermented sausage
4. **Microbiological Production of Beverages:** beers, wines and distilled spirits
5. **Production of Industrial Chemicals and Pharmaceuticals:** organic acids: acetate (vinegar), citrate, lactate and amino acids; solvents: alcohol, butanol and acetone; enzymes; pharmaceuticals: antibiotics, steroids, vaccines and antibodies
6. **Production of Biogas:** domestic and industrial scale production from waste materials

Books Recommended

1. Industrial Microbiology – Miller BM and Litsky W
2. Industrial Microbiology: An Introduction- Michael J. Waites, Neil L. Morgan, John S. Rockey
3. Microbial Biotechnology: Fundamentals of Applied Microbiology- Alexander N. Glazer, Hiroshi Nikaido
4. Molecular Biotechnology: Principle and applications of Recombinant DNA- Bernard R. Glick, Jack J. Pasternak
5. Prescott and Dunn's Industrial Microbiology – Reed G
6. Applied Biochemistry and Bioengineering – Wingard LB Jr, Katchalski-Katzir E and Goldster L
7. Comprehensive Biotechnology, Vol. I-IV – Moo-Young M

MBG 3102**1 C****Basic Immunology I Lab.**

1. Preparation of bacterial whole cell extract
2. Preparation of outer membrane protein
3. Immunization protocol for animals
4. Collection of serum and plasma
5. Separation of blood leukocytes
6. Test for cell viability
7. Phagocytosis by neutrophils

MBG 3104**1 C****Introductory Virology Lab.**

1. Cultivation and enumeration of bacteriophages
2. Isolation of bacteriophages from raw sewage
3. Detection of HBsAg from patients serum by serological methods
4. Isolation of TMV virus from infecting plants

MBG 3106**1C****Microbial Molecular Genetics Lab.**

1. Isolation of plasmids and chromosomal DNA
2. Detection of DNA by agarose gel electrophoresis
3. Transformation of *E. coli* by plasmid
4. Study of gene expression in *E. coli*

MBG 3108**1 C****Food Microbiology Lab.**

- 1 Quantitative examination of bacteria in raw and pasteurized milk

2. Methylene blue reduction test
3. Microbiological analysis of fermented foods and nonfermented foods
4. Detecting *Salmonella* spp. in poultry

MBG 3110

1 C

Enzymology Lab.

1. Determination of enzyme activity (qualitative and quantitative)
2. Determination of kinetic properties of an enzyme
3. Determination of activators and inhibitors of enzymes
4. Determination of molecule weight and substrate specificity of enzyme

MBG 3112

1 C

Industrial Microbiology Lab.

1. Production of microbial extracellular enzymes
2. Production of SCP
3. Production of antibiotics
4. Production of alcohol from molasses
5. Report on industrial visits (carrying 10% marks)

Year 3: Term 2

MBG 3201

3 C

BASIC IMMUNOLOGY II

1. **Immunological tolerance:** mechanism of tolerance; thymic tolerance to self antigens; B cell tolerance; artificially induced tolerance
2. **Inflammation:** patterns of cell migration and inflammation and their control
3. **Lymphocyte activation:** interaction of T lymphocytes and APC; signals for T cell activation; B cell response to thymus dependent and independent antigens; B cell activation by surface Ig and T cell
4. **Immune regulations:** regulation of immune response by antigens, antibody, antigen presenting cells and lymphocytes; idiotypic regulation of immune

response

5. **Effectors molecules:** cytokines: origin, source and effectors function; cytokine action and network interaction
6. **Immunity to Infections:** immunity to extracellular and intracellular bacteria; bacterial survival strategies; immunity to viral infection; innate and specific immune response to viruses; strategies for evading immune defences by viruses; immunity to parasitic infection
7. **Immunological Techniques:** precipitation reactions; immunodiffusion; immuno-electrophoresis; agglutination; co-agglutination; haemagglutination; complement fixation; direct and indirect immunofluorescence; immunoassay; immunoblotting; immuno-precipitation; fluorescence-activated cell sorter (FACS)
8. **Monoclonal antibodies:** production of hybridoma; screening, cloning and large-scale production of monoclonal antibodies

Books Recommended

1. Immunology – Roitt I
2. Roitt's Essential Immunology – Delves P, Martin S, Burton D and Riott I
3. Advanced Immunology – Male DK, Champion B and Cooke A
4. Text Book of Immunology – Barrett TJ
5. Immunology: An Introduction – Tizard IR

MBG 3203

3 C

VIROLOGY

1. **Animal Viruses:** Brief introduction of different classes of viruses
2. **Viral Infections to the Respiratory System:** common cold; influenza; measles; mumps; rubella; chicken pox; shingles, Nipah
3. **Viral Infections to the Gastrointestinal Tract:** viral diarrhoea
4. **Arthropod-Borne Diseases:** diseases caused by dengue virus, Japanese encephalitis virus, yellow fever virus
5. **Herpes Viruses:** general properties; pathogenesis; diseases caused by HSV-I, EBV and CMV
6. **Hepatitis Viruses:** general properties; pathogenesis; transmission; diseases

caused by HAV, HBV, HCV, HDV, HEV and HGV

7. **Hepatitis B Virus:** detail of virion structure; genome organization; replication; viral proteins; pathogenesis; genetic variants; epidemiology; transmission; prevention; clinical diagnosis
8. **Nononcogenic Retroviruses:** HIV: structure; genome organization; transmission; epidemiology; disease pathogenicity; drugs; treatment strategy; vaccine approaches
9. **Cellular Oncogenes and Oncogenic Viruses:** RNA tumour viruses: general features and classification; retroviridae genome structure; replication of HTLV; T cell transformation; DNA tumour viruses; mechanism of oncogenic transformation by DNA viruses; tumour suppressor gene
10. **Influenza Viruses:** general properties; antigenic shift and drift; pathogenesis; epidemiology
11. **Slow Virus Infection**
12. **Use of Retroviruses as a Vector for Gene Therapy and Genetic Engineering**

Books Recommended

1. Microbiology – Pelczar MJ Jr, Chan ECS and Krieg NR
2. Biology of Microorganism – Brock TD, Madigan MT, Martinko JM and Parker J
3. Fields Virology, Vol. I & II – Knipe DM, Roizman B, Howley PM, Straus SE and Griffin DE
4. Jawetz, Melnick and Adelberg's Medical Microbiology – Brooks GF, Carroll KC, Butel JS and Morse SA

MBG3205

3C

PUBLIC HEALTH AND EPIDEMIOLOGY

1. **Concepts:** Definition and scope of public health; community medicine; health and social problems of Bangladesh and health care in Bangladesh
2. **Epidemiology:** Concept and scopes of epidemiological studies; principles of control and natural history of diseases
3. **Management of Public Health Diseases:** EPI disease (Diarrheal disease, Malaria, Kalajar, Enteric fever, Leprosy, Rabies, Viral hepatitis, chicken pox,

Mumps, Filariasis, STD and AIDS) and common non communicable disease (Cancer, diabetes, Hypertension, Hid, RHD and rheumatic Fever)

4. **Family Health:** family, family health, maternal health, family planning, child health
5. **Personal Hygiene:** define hygiene, importance of hygiene to the individual and community
6. **Occupational Health:** introduction; occupational health hazards; occupational diseases; prevention of occupational disease
7. **Primary Health Care (PHC):** introduction, definition, historical development of PHC, components of PHC, PHC principles, PHC philosophy and strategy
8. **Community Based Health Services:** introduction, community responsibility, community health councils, community involvement in health, team approach in health service-need for the health service team, the health team, leader of the health team

Books Recommended

1. Environment, Health and Sustainable Development- Megan Landon, Open University Press; 1 edition
2. Introduction to Public Health-Ethiopia Public Health Training Initiative, Mekelle University, Ethiopia- Gebrezgi Gidey, Sadik Taju and Ato Seifu Hagos 2006
3. Introduction to Public Health-Mary-Jane Schneider, 2014- Jones and Barlett learning Burlington, MA.
4. Introduction to Public Health – Mary Louise Fleming and Elizabeth Parker 2015
5. Protecting Public Health and the Environment-Carolyn Raffensperger, Joel Tickner, Wes Jackson
6. Food Policy: Integrating health, environment and society-Tim Lang, David Barling, Martin Caraher

MBG 3207

3C

FOOD BORNE INFECTION AND INTOXICATION

1. **Indicators of Food Microbial Quality and Safety:** criteria for selecting indicators; general characteristic of indicator microbes and microbial

products

2. **Food-Borne Diseases Caused by:** Gram-positive bacteria :(*Bacillus* spp., *Staphylococcus* spp., *Yersinia* spp., *Listeria* spp. and *Clostridium* spp.); Gram-negative bacteria: (*Salmonella* spp., *Vibrio* spp., *Aeromonas* spp., *Escherichia coli* and *Pseudomonas* spp.)
3. **Mycotoxins:** aflatoxins and ochratoxin
4. **Recent Trends and Prospects for the Future of Food-Borne Infection and Intoxication:** food poisoning and *Salmonella* infection; new or less common food-borne infections and intoxications: *Campylobacter enteritis*, scombrototoxic fish poisoning, ciguatera poisoning, gastroenteritis of viral or unknown aetiology
5. **Assessment of Food Poisoning Toxins and Infections:** whole animal and cell culture systems; investigation of food-borne disease outbreaks; factors contributing to outbreaks of food poisoning; economic impact of food poisoning; methods for detecting food poisoning toxins; food sanitation; control and inspection

Books Recommended

1. Advances and Prospects – Roberts TA and Sleinna FA
2. Food Microbiology – Frazier WC and Westhofi DC
3. Modern Food Microbiology – Jay JM
4. Prescott and Dunn's Industrial Microbiology – Reed G

MBG 3209

3C

SOIL AND AGRICULTURAL MICROBIOLOGY

1. **Major Groups of Microorganisms in Soil:** bacteria; fungi; actinomycetes; algae; viruses
2. **Role of Microbes in Soil Fertility and Plant Nutrition:** use of microbial metabolites and major nutrients; the effect of growth regulators produced by microorganisms; the liberation of unavailable nutrients from soil organic matter and minerals; suppression of plant pathogens; the production of phytotoxic substances by saprophytes and parasites; the production of enzymes and competition of microorganisms with plants for essential nutrients
3. **Biogeochemical Cycling of Nutrient Elements:** the carbon cycle, the hydrogen cycle, the oxygen cycle, the nitrogen cycle, the sulphur cycle, the

phosphorus cycle

4. **Microbial Degradation of Cellulose, Hemicellulose and Lignin**
5. **Microbial Biofertilizer and Inoculation Techniques**
6. **Microbiological Aspects of Pesticide Behaviour in the Environment:**
purpose and types of uses of pesticide; pesticides in microbial environment;
pesticide in soil and aquatic environment; effect of pesticides; persistence of
pesticides; metabolism of pesticides by microorganisms
7. **Microbes as Plant Pathogens:** the concept of disease in plants; diagnosis
and control of plant diseases

Books Recommended

1. An Introduction to Soil Microbiology – Alexander M
2. Soil Microorganisms – Gray TRG and Williams ST
3. Soil Microorganisms and Plant Growth – Subba Rao NS
4. Plant Microbiology – Campbell R
5. Plant Diseases – Shing RS
6. Plant Pathology – Agrios GN
7. Microbial Ecology: A Conceptual Approach – Lynch JM & Poole
8. Biological Indicators of Soil Health– ankhurs CF, Doube BM and Gupta VSR
9. Pesticide Microbiology – Hill IR and Wright SJL

MBG 3202

1 C

Basic Immunology II LAB

1. Detection of antigen and antibody
 - a) by gel immunodiffusion technique
 - b) by radial immunodiffusion technique
 - c) by Crossed immunoelectrophoresis technique
2. Separation of blood leukocytes
3. Test for cell viability
4. Phagocytosis by neutrophils
5. Complement fixation tests

MBG 3204

Virology LAB

1C

1. Detection of viral Ags/Abs from patients' sera by immunological techniques
2. PCR amplification of HBV core and surface genes
3. Detection of viral DNA by PCR amplification and dot-blot hybridisation
4. Use of RPHA method for the detection of viral Ag/Ab
5. Titration of virus using immunofluorescent microscope

MBG 3206

1C

Public Health and Epidemiology LAB

1. Surveillance Mechanisms and Applications of Epidemiology
2. Public Health Laboratory Techniques: (i) Food Safety and (ii) Environmental Health
3. Bio-safety and blood-borne pathogen training program.
4. Laboratory techniques used in emerging infectious respiratory disease and epidemiologic surveillance.
5. Independent Journal Article Review/ Seminar in Contemporary Public Health Issues/ Visit to any public health organization.

MBG 3208

1C

Food Borne Infection and Intoxication Lab

1. Detection of *B. cereus* and *S. aureus* in fast foods
2. Detection of *E. coli* and *Aeromonas hydrophila* in salad dressings
3. Isolation of *Aspergillus flavus* from oil seeds
4. Detection of haemolysin and phospholipase C (toxins) from *B. Cereus*

MBG 3210

1C

Soil and Agricultural Microbiology LAB

1. Microbial population of soil, rhizosphere and rhizoplane
2. Denitrification and ammonification

3. Nitrogen fixation test
4. Identification of plant pathogens

MBG 3212

2C

Viva voce

Year 4: Term 1

MBG 4101

3 C

MICROBIAL BIOTECHNOLOGY

- 1. Historical Development, Scope and Essential Features of Microbial Biotechnology**
- 2. Energy and Biotechnology:** Biomass fuel; conservation to fuel-ethanol and methane fermentation; biofuel cells and other bioelectrochemical devices
- 3. Food and Biotechnology:** GM food, present and future aspect of food and drinking biotechnology
- 4. Chemistry and Biotechnology:** the current development, generation of chemicals from biomass
- 5. Materials and Biotechnology:** microbial leaching, metal transformation and immobilization; bio-polymers; biodegradation of materials
- 6. Environment and Biotechnology:** microbial waste treatment system; biological processing of industrial wastes
- 7. Genetics and Biotechnology:** conventional routes to strain improvement; *in vivo* genetic manipulation and *in vitro* genetic manipulation, transgenesis: transgenic organism's history; methods of production and use; improving desired characteristics and productivity of domestic animals; transgenic animals in agricultural, nutritional science and research
- 8. Microbial Biotransformation:** D-sorbitol to L-sorbose, Biotransformation of antibiotics and steroids.
- 9. Immobilized Enzyme Technology:** principles, benefits, methods of

immobilization of enzymes and cells.

Books Recommended

1. Biotechnology Principles – Smith JE
2. Prescott and Dunn's Industrial Microbiology – Reed G
3. Comprehensive Biotechnology – Moo-Young M
4. Introduction to Biotechnology – Brown CM, Priest FG and Campbell I
5. Biotechnology: Principles and Applications – Higgins IJ, Best DJ and Jones J

MBG 4103

3C

GENETIC ENGINEERING

1. **Purification of DNA:** preparation of total cell DNA; preparation of plasmid DNA; preparation of bacteriophage DNA
2. **Techniques of Molecular Genetics:** production of recombinant DNA *in vitro*; amplification of recombinant DNA in cloning vector; construction and screening of DNA libraries; molecular analysis of DNA, RNA and protein by blotting techniques; amplification of DNA by PCR; *in vitro* site-specific mutagenesis
3. **DNA Manipulative Enzymes:** restriction endonucleases and other nucleases; ligases; polymerases; DNA-modifying enzymes; topoisomerases
4. **Cloning Vectors:** cloning vectors for prokaryotic organisms; bacteriophage M13; bacteriophage λ ; plasmid pBR322; plasmid pBR325, pUC119; cosmids; phagemids; charomids; cloning vectors for eukaryotic organisms; yeast episomal plasmid (2 μ m circle); cloning vectors for higher plants and mammalian cells, YAC and BAC.
5. **Ligation Systems:** blunt-end ligation; sticky-end ligation; putting sticky ends on to a blunt-ended molecule; homopolymer tailing; use of linkers and adaptors
6. **Nucleic acid sequencing:** transformation of bacterial cells and selection of recombinants; introduction of phage DNA into bacterial cell and selection of recombinant phage; transformation of non-bacterial cells
7. **Expression of Cloned Gene:** requirements for gene expression; expression vectors; transcript of a cloned gene; regulation of gene expression; identifying and studying the translation product of cloned gene

Books Recommended

1. Principle of Gene Manipulation: An Introduction to Genetic Engineering – Old RW and Primrose SB
2. Molecular Biology of the Gene – Watson JD *et al.*
3. Genetic Engineering – Kingsman AJ and Kingsman SM
4. Principles of Genetics – Snustad DP and Simmon MJ
5. Gene Cloning: An Introduction – Brown TA
6. Molecular Cloning – A Laboratory Manual – Sambrook J and Maniatis T
7. Principle of Gene Manipulation: An Introduction – Old RW
8. Current Protocol in Molecular Biology – Smith JA and Struhl K
9. Biology of Microorganisms - Brock T.D.

MBG 4105

3 C

ADVANCED IMMUNOLOGY

- 1. Prophylaxis:** antigens used as vaccines; effectiveness and safety of vaccine; current vaccines; modern approaches; adjuvants
- 2. Immunodeficiency:** primary immunodeficiency; deficiencies of innate immunity; primary B cell deficiency; primary T cell deficiency; combine immunodeficiency; secondary immunodeficiency
- 3. Hypersensitivity:** hypersensitivity type-I, type-II, type-III and type-IV reactions
- 4. Transplantation:** barriers of transplantation; law of transplantation; role of T lymphocytes in rejection; prevention of rejection
- 5. Tumour Immunology:** Surface markers of tumour cell; immune response to tumour cells; lymphoproliferative disorders due to tumour growth; cancer immunotherapy
- 6. Autoimmunity and Autoimmune Diseases:** association of autoimmunity with diseases; genetic factors in pathogenesis; aetiology and treatment of autoimmune diseases
- 7. Diagnostic and Prognostic Value of Autoimmune Diseases**

Books Recommended

1. Immunology – Roitt I
2. Roitt's Essential Immunology – Delves P, Martin S, Burton D and Riott I
3. Advanced Immunology – Male DK, Champion B and Cooke A
4. Text Book of Immunology – Barrett TJ
5. Immunology: An Introduction – Tizard IR

MBG 4107

3C

ANALYTICAL MICROBIOLOGY

- 1. Spectroscopic Techniques:** Visible, ultraviolet and infrared spectrophotometers; spectrofluorometry; luminometry; NMR and mass spectrometry
- 2. Centrifugation Techniques:** principle of sedimentation; centrifuges and their use; density-gradient centrifugation; ultracentrifuge
- 3. Chromatographic Techniques:** principle of chromatography; column, thin-layer and paper chromatography; adsorption, gas-liquid, ion-exchange, exclusion, affinity and high performance liquid chromatography
- 4. Electrophoresis Techniques:** principle; factors affecting electrophoresis; low and high voltage electrophoresis; gel electrophoresis; SDS-PAGE; isoelectric focusing; isotachopheresis; preparative electrophoresis.
- 5. Protein Characterization:** determination of molecular weight; amino acid composition and number of subunit; protein sequencing
- 6. Biosensor:** principle; transducers; bio-component of biosensor; application of enzyme-based, cell-based and organelle-based biosensors; affinity-binding assay; biological reactant pairs; application of immunosensor and receptor-based sensor
- 7. Microbial Growth Rate Measurement Techniques:** enumeration of microorganisms; measurement of biomass, biomass components and biomass environment
- 8. Instrumentation for Monitoring and Controlling bioreactors:** basic variables for in-line and on-line monitoring; fermentation process control
- 9. Radioisotope Techniques:** nature, detection and measurement of radioactivity; application of radioisotopes in the biological sciences; safety aspects of the use of radioisotopes
- 10. Cell Culture:** primary, secondary and continuous animal cell cultures

Books Recommended

1. Protein Purification – Scopes RK
2. Comprehensive Biotechnology, Vol. II – Moo-Young M
3. A Guide to Principle and Techniques of Practical Biochemistry – Wilson K and

Goulding KH

4. An Introduction to Practical Biochemistry – Plummer DT
5. Basic Biochemical Methods – Alexander RR and Griffiths JM

MBG 4109

3C

MICROBIOLOGY OF FROZEN FOODS

1. **Technology of Freezing:** Basic principle of freezing, refrigerant, Systems involving standard refrigeration unit.
2. **Effects of Freezing/Thawing on Foods:** basic concepts of freezing and thawing; influence of frozen temperature and time on foods; thawing methods; freezing preservation: influence on food quality, physical and chemical reactions during freezer storage
3. **Response of Microorganisms to Freeze-Thaw Stress:** factors affecting microbial survival; nutritional status, age and growth rate; freeze injury; mechanisms of freeze damage
4. **Microbiology of Frozen Fish and Fish products:** factors affecting types and load of microflora on fish; factors affecting kind and rate of spoilage; microbial spoilage of fish; control of spoilage; freezing of fish; effects of freezing on fish microorganisms: chill storage and freezing effects on microbial growth and survival
5. **Microbiology of Frozen Meat and Meat Products:** effect of freezing on microorganisms; structure and composite of meat; freezing temperature; changes induced by freezing in meat; spoilage microflora
6. **Microbiology of Frozen Dairy Products:** microbiology of raw and frozen milk; microbial types and load on butter, ice cream and frozen cheese
7. **Isolation and Identification of Pathogenic bacteria from frozen products:** procedure for examination of rotten fish and meat; isolation of disease causing bacteria.
8. **Design of frozen fish industry:** Interior and exterior designing, maintenance of internal environment.

Books Recommended

1. Microbiology of Frozen Foods – Robinson RK
2. Food Microbiology – Frazier WC
3. Food Microbiology – Adams MR and Moss MO
4. Manual for the isolation and Identification of Fish Bacterial Pathogens – Frerichs GN and Miller SD
5. Modern Food Microbiology – Hay J

MBG 4111

3 C

DIAGNOSTIC MICROBIOLOGY

1. **Laboratory Diagnoses of Infectious Agents:** different types of approaches for clinical sample collection, maintenance and laboratory management
2. **Diagnostic Studies:** principle of diagnoses of bacterial, fungal, rickettsial, parasitic, spirochetal, viral and mycoplasmal diseases
3. **Diagnosis of Sexually Transmitted Diseases**
4. **Immunodiagnostic Studies:** collection of serum; antibody titre (such as ASO, Widal); agglutination; double diffusion; counter immunoelectrophoresis; immuno-fluorescence; complement fixation test; fluorescent antibody test (FAT and IFA); radio-immunoassay (RIA); enzyme immunoassay (EIA); enzyme-linked immunosorbent assay (ELISA)
5. **Accessory Detection Systems:** biotin-avidin; amplified detection; chemiluminescence/ bioluminescence; immunoblotting; plasmid fingerprinting; nucleic acid probes for the detection and identification of infectious agents
6. **Nucleic Acid-Based Analytic Methods for Microbial Identification and Characterization:** Nucleic acid hybridization methods; PCR based amplification methods- conventional and real time PCR; Non PCR based signal and target amplification methods; Sequencing and Enzymatic digestion of nucleic acid; Application of nucleic acid based methods- direct detection of microorganisms, identification of microorganisms grown in culture, characterization of microorganisms beyond identification

Books Recommended

1. Diagnostic Molecular Microbiology: Principle and Applications – Persing DH, Smith-Fred TF and Wire TTJ
2. Hand Book of Serodiagnosis in Infectious Diseases –Mathews R
3. A Manual of Laboratory and Diagnostic Tests –Fischbach F
4. Diagnostic Immunology Laboratory Manual – Harbeck RJ and Giclas PC
5. Bailey and Scott's Diagnostic Microbiology, Twelfth Edition, 2003
6. Microbial Biotechnology: Fundamentals of Applied Microbiology, Second Edition, 2007. Alexander N Glazer and Hiroshi Nikaido

MBG 4102

1C

Microbial Biotechnology LAB

1. Whole cell immobilization by Ca-alginate
2. Determination of specific growth rate, substrate utilization constant and biomass in a steady-state batch culture
3. Pesticide degradation: biodegradation of halogenated pesticide by bacterial dehalogenases.

MBG 4104

1C

Genetic Engineering LAB

1. DNA digestion by restriction enzymes
2. Ligation of DNA to appropriate vector
3. Study of genetic map

MBG 4106

1C

Advanced Immunology Lab

1. Detection of antigen and antibody
 - a) by gel immunodiffusion technique
 - b) by radial immunodiffusion technique
 - c) by Crossed immunoelectrophoresis technique
2. SDS-PAGE and immunoblotting of bacterial proteins
3. Complement fixation tests

4. HLA typing

MBG 4108

1C

Analytical Microbiology Lab

1. Thin-layer chromatographic separation of amino acids
2. Separation of sugars by paper chromatography
3. Determination of organic carbon in soil and waste water
4. Estimation of nitrogen in soil and water

MBG 4110

1C

Microbiology of Frozen Fish and Food Lab

1. Identification of microbial flora of frozen food and fish
2. Identification of different fish pathogens
3. Determination of microbial flora of frozen food
4. Identification of different pathogens in frozen foods

MBG 4112

1C

Diagnostic Microbiology Lab

1. Determination of blood grouping
2. Coagulation, agglutination and haemagglutination
3. Determination of anti-streptolysin-O (ASO) titre
4. VDRL test
5. ELISA
6. Direct fluorescent antibody (DFA) detection of microbial pathogens
7. Plasmid finger-printing in clinical diagnosis
8. Gene detection and DNA-hybridization analysis in clinical diagnosis
9. Complement activation
10. Tuberculin test
11. Widal test
12. Determination of C-reactive protein (CRP)
13. Determination of plasma fibrinogen level
14. Determination of fibrin degradation product (FDP)
15. Radioimmuno detection of immunoglobulins (RID)

16. Anti-*Mycobacterium tuberculosis* complex (IgA, IgG and IgM)

MBG 4114

1C

VISIT TO INDUSTRY

Year 4: Term 2

MBG

4201

3 C

ENVIRONMENTAL POLLUTION AND BIOREMEDIATION

- 1. Biodeterioration of Materials:** basic concepts, factors involved in biodeterioration; biodeterioration of leather, fur, feather, stones, plastics and rubber, control of biodeterioration: physical, chemical and biological methods.
- 2. Treatment of Solid Waste:** Landfills and Composting
- 3. Treatment of Liquid Waste:** Primary treatment, secondary treatment, Trickling filter, Activated sludge, Biological removal of Nitrogen and Phosphorous, Lagoons, Anaerobic digester, Tertiary treatment.
- 4. Water Treatment Technology:** Coagulation, flocculation, Sedimentation, Filtration, Chlorine, Ozone, UV, Activated Carbon, Advantages and disadvantages.
- 5. Composition of Domestic Waste water:** Biological oxygen demand (BOD), Carbonaceous BOD (CBOD), Nitrogen Oxygen Demand, Chemical Oxygen Demand (COD), Total organic Carbon (TOC)
- 6. Toxicity testing in waste water:** impacts of toxicity on waste water treatment, heavy metals, organic toxicant; enzymatic assays and microbial bioassay.
- 7. Biodegradation and metabolism of Recalcitrant Industrial Wastes:** xenobiotic chemicals in the environment; biodegradation of persistent and recalcitrant wastes; structure-recalcitrance relationship (ring cleavage: ortho and para cleavage); factors affecting microorganisms to degrade xenobiotic, biodegradation of pesticides, chloroorganics, organic dyes, phenols, petroleum hydrocarbons; biodegradability testing.

8. Biotechnological aspects for effluent treatment and pollution control:

Production of microbial seeds, use of bioaugmentation in waste and effluent treatment, use of enzyme and immobilized microbial cells; isolation, enrichment and genetic modification of chemical resistant microbes for detoxifying the pollutants, removal of metals by microbes,

Books Recommended

1. Microbial Ecology – Atlas RM and Bartha R
2. Current Perspective in Microbial Ecology – Klug MJ and Reddy CA
3. Ecological Systems and the Environment – Foin TC
4. Biotreatment Systems, Vol. II – Wise DL
5. Wastewater Microbiology – Bitton G

MBG 4203

3C

PHARMACEUTICAL MICROBIOLOGY

1. **Ecology of Microorganisms as It Affects the Pharmaceutical industry:** atmospheric, water, raw materials, personnel, building, etc.
2. **Sterilization Methods:** heat, radiation, gases and filtration systems; sterilization kinetics
3. **Microbial Spoilage, Deterioration and Preservation of Pharmaceutical Products:** mixture, suspension, syrups, sterile products, cosmetics and toiletry products
4. **Determination of Potency/Concentration of Antibiotic and Antimicrobial Preservatives in Pharmaceutical of Antibiotics or Products**

5. **Microbiological Tests:** tests for sterility, MIC and MBC; pyrogen tests
6. **Aseptic Techniques:** design and maintenance of an aseptic unit laboratory/processing area
7. **Production of Immunological Products:** vaccines, immunosera, human globulins and their quality control

Books Recommended

1. Pharmaceutical Microbiology – Huge WB and Rusell AD
2. Cooper and Gunn's Dispensing for Pharmaceutical Students – Cooper JW
3. Preservatives in the Food, Pharmaceutical and Environmental Industries – Board RG, Allwood MC and Banks JG
4. Essays in Applied Microbiology – Noris JR and Richmond MH

MBG 4205

3C

QUALITY CONTROL OF FOOD AND BEVERAGES

1. **Introduction:** importance of quality control of food, fish, beverage and mineral water
2. **Organization of Quality Control:** the principles, application, organization, problems and techniques of quality control; the future of quality control
3. **Microbiological Quality Control:** principles and pitfalls; fundamentals of microbiological quality control; chemical and microbiological indicators for quality assurance; standards for monitoring to assess compliance with good practices
4. **Sanitation and Inspection:** sanitation and hygiene of processing plant, water in processing and cleaning; waste/effluent treatment packaging; equipment; handling
5. **Quality Assurance:** sampling, testing panel-sensory assessments in quality control; hazard analyses and critical control point (HACCP) systems; identification of potential hazards; monitoring system for critical control point (CCP); corrective actions; verifications
6. **Public Health Aspect of Bacterial Infection of Fish:** fish quality assurance

research methodology

7. **Food Laws and Regulations:** national and international standards and guideline

Books Recommended

1. Quality Control in the Food Industry, Vol. I – Herschdoerfer SM

MBG 4207

3C

FERMENTATION TECHNOLOGY

1. **Introduction to Fermentation Processes:** range of fermentation processes; chronological development of the fermentation industry; component parts of fermentation process
2. **Inoculum Preparation and Inoculum Development:** development of inocula for yeast processes; development of inocula for bacterial processes; development of inocula for fungal processes
3. **Fermentor/Bioreactor:** types, configuration, mixing and aeration; power requirements; impeller designs; baffle and aeration
4. **Sterilization of Fermentors and Liquid Media:** medium sterilization, the design of batch sterilization processes; the design of continuous sterilization processes; sterilization of the fermentor; sterilization of feed and air
5. **Fermentation Modelling:** rate equations for cell growth, substrate utilization and product formation; transfer across phase boundaries
6. **Mode of Fermentations:** fed-batch and continuous culture processes and their control
7. **Instrumentation and Control:** control systems: manual, automatic and combinations of methods of control; methods of control of process variables: temperature, pH, flow measurement, pressure measurement, pressure control, safety valves, agitation-shaft power, rate of stirring, foam sensing and control weight, measurement and control of dissolved oxygen; exit-gas analysis; redox and carbon dioxide electrodes
8. **Downstream processing of fermentation.**

Books Recommended

1. Fermentation: A Practical Approach – Harvey BM
2. Principle of Fermentation Technology – Stanbury PF and Whitaker A

MBG 4209

3C

GENOMICS AND BIOINFORMATICS

1. **Introduction:** Microbial genome; the human genome; importance of genome project; structure and functional genomics; post genomics; transcriptome; proteome; metabolome and fluxome; system biology
2. **Protocols for the Detection of Polymorphisms:** DNA sequence polymorphisms; Restriction Fragment Length Polymorphisms (RFLP) based protocol; PCR-based protocol; Allele Specific Oligonucleotide (ASO) protocol; Single Sequence Length Polymorphic (SSLP) protocol; Rapid Amplification Polymorphic DNA (RAPD) protocol; protocols for detection microsatellite, minisatellite, deletion, duplication and other insertion and complex haplotype; karyotype analysis; DNA arrays on microchips
3. **Mapping Genome by Genetic and Physical Technique:** Genetic and physical maps; markers for genetic maps; approaches to genetic mapping; high density linkage maps; clone banks; restriction mapping; long range physical maps: Fluorescence In Situ Hybridization (FISH) mapping; Sequence Tagged Site (STS) mapping; Positional cloning: chromosome walks and chromosome jumps; Yeast Artificial Chromosome (YAC); bacterial artificial chromosome (BAC)
4. **Strategies for Assembly of a Contiguous DNA sequence:** Sequence assembly by the shotgun approach; Sequence assembly by the clone cloning approach; the direct shotgun approach
5. **Identifications of Gene Functions in Bacteria:** Transcriptional reporter fusion (replicon ori); mutagenesis strategies - site directed; transposons; viral transduction; linkage; cloning and rapid sequencing of the gene in question
6. **Bioinformatics:** Definition; sequence comparison by computational analysis and gene bank retrieval; pattern matching and automatic discovery; protein motif and putative functions; 2D and 3D protein structure (computer model); protein threading and protein folding; determination of homology and protein identification; genome cartography and genome annotation; evolution and phylogeny; analysis of gene expression; metabolic pathways and regulatory network

Books Recommended

1. Genetics from Genes to Genomes-Harwell L.H; Hood L; Goldberg M.L;

- Renolds A. E; Silver L.M. and Veres R. C.
2. Gene Cloning and DNA Analysis: An Introduction - Brown T.A.
 3. Biotechnology: Genomics and Bioinformatics - Rehm H.J. and Reed G.
 4. Principles of genetics – Sunstad D.P. and Simons M. J
 5. Gene VII-Lewin B.
 6. Molecular Biology and Biotechnology: Mayers R. A

MBG 4202

Environmental Pollution LAB

1C

1. Enrichment and isolation of biodegradative microbes from environment.
2. Non-culturable state of microorganisms (detection by FA or Acridine orange DVC)
3. Detection of indicators and pathogenic microbes in potable water.
4. Water purification (viz, flocculation, chlorination, ozonation etc.)

MBG 4204

Pharmaceutical Microbiology LAB

1C

1. Microbiological assay of pharmaceutical raw material
2. Microbiological assay of pharmaceutical solids, ointments and oral liquids
3. Bioassay of potency of antibiotics
4. Sterilization and sterility test; pyrogen test

MBG 4206

Microbiological Quality Control LAB

1C

1. Test for microbiological quality of water and beverages: standard qualitative analysis of water, MPN and quantitative analysis of water by membrane filter method

MBG 4208

Fermentation Technology LAB

1C

1. Dough fermentation by baker's yeast for bread making
2. Production of acetic acid by *Acetobacter aceti*

3. Demonstration of a fermentor
4. Yogurt production by lactic starter
5. Production of citric acid by *A. niger*

MBG 4210

Genomics and Bioinformatics LAB

1C

1. Genome organization, genome sequencing and genome construction
2. Post genomic application of microbial and human genome sequence
3. Application of Sanger and next generation sequencing technique in genome sequencing
- 2 Identify unknown bacterium from its DNA sequence of 16s RNA using BLAST
2. Multiple sequence alignment using clustralW
3. Phylogenetic tree reconstruction
4. Designing gene specific primer
5. Evolutionary analysis of mutations
6. Homology modelling of protein

MBG 4212

4C

RESEARCH PROJECT AND PRESENTATION

Research Project on any one of the following fields

1. Food Microbiology
2. Microbial Biotechnology
3. Industrial Microbiology
4. Fermentation Technology
5. Molecular Biology and Genetics
6. Environmental Microbiology
7. Clinical Microbiology
8. Immunology
9. Virology

MBG 4214

2C

Viva voce

