

Syllabus

B.Sc. (Honours) Program

Session: 2015-2016

**DEPARTMENT OF BIOTECHNOLOGY AND GENETIC ENGINEERING
COURSES FOR THE DEGREE OF B. Sc. (HONOURS)
(UNDER INTEGRATED GRADING SYSTEM)
SESSION: 2015-2016
FINAL EXAMINATION: 2019**

The integrated grading system of B.Sc. (Hons.) courses in Biotechnology and Genetic Engineering shall be offered over the period of four academic years. The integrated courses shall consist of 44 courses (Theoretical and Practical) of 100 marks each. Out of the 44 courses the student shall be required to complete minimum 8 (eight) courses from at least two other allied or related subjects as suggested by the committee of courses. There shall be 100 marks in fieldwork, 100 marks in project and 200 marks in Viva-Voce Examination with a total of 4800 marks. Also one noncredit course namely Islamic Studies/Bangladesh Studies carrying 100 marks to be completed within the first two academic years. The B.Sc. (Hons) Examination in Biotechnology and Genetic Engineering under Integrated Grading System shall consist of (i) First Year B.Sc. (Hons.) Examination of 1050 marks (35.0 credits) (ii) Second Year B.Sc. (Hons.) Examination of 1150 marks (38.5 credits) (iii) Third Year B.Sc. (Hons.) Examination of 1250 marks (41.0 credits) and (iv) Fourth Year B.Sc. (Hons.) Examination of 1350 marks (45.5 credits). The corresponding Examination will be held at the end of each academic year. The Examination of one unit theoretical course shall be of four hours duration and practical Examination in Biotechnology and Genetic Engineering shall be of 12 (twelve) hours duration for each unit course of 100 marks.

DEPARTMENT OF BIOTECHNOLOGY AND GENETIC ENGINEERING

B.Sc. (Honours) Program

Session: 2015-2016

DISTRIBUTION OF COURSES AND MARKS

FIRST YEAR (2015-2016) EXAMINATION- 2016

Course no	Course title	Theoretical Marks	Tutorial/ Note Book Marks	Class attendance	Total marks	Credits
BT-101	Fundamentals of Biotechnology	75	15	10	100	3.5
BT-102	Microbiology-I	75	15	10	100	3.5
BT-103	Fundamentals of Biochemistry	75	15	10	100	3.5
BT-104	Basic Botany	75	15	10	100	3.5
BT-105	Basic Zoology, Cell and Developmental Biology	75	15	10	100	3.5
BT-106	Basic Genetics	75	15	10	100	3.5
BT-107	Organic Chemistry	75	15	10	100	3.5
BT-108	Physical & Inorganic Chemistry	75	15	10	100	3.5
BT-109 (Practical)	Lab in Biochemistry-I	80	05	10 + 05=15 (Attendance+Performance)	100	3.0
BT-110 (Practical)	Lab in Biology-I	80	05	10 + 05=15 (Attendance+Performance)	100	3.0
Non credit course	Bangladesh Studies or Islamic Studies				100	00
BT-111	Viva-Voce				50	1.0
Total Marks and Credits					1050	35.00

SECOND YEAR (2016-2017) EXAMINATION- 2017

Course no	Course title	Theoretical/ Practical Marks	Tutorial/ Assignment/ Note Book Marks	Class attendance	Total marks	Credits
BT-201	Human Physiology	75	15	10	100	3.5
BT-202	Microbiology-II	75	15	10	100	3.5
BT-203	Metabolism	75	15	10	100	3.5
BT-204	Plant Breeding	75	15	10	100	3.5
BT-205	Plant Cell and Tissue Culture	75	15	10	100	3.5
BT-206	Molecular Biology-I	75	15	10	100	3.5
BT-207	Immunology- I	75	15	10	100	3.5
BT-208	Enzymology	75	15	10	100	3.5
BT-209	Plant Physiology	75	15	10	100	3.5
BT-210 (Practical)	Lab in Biochemistry-II (Analytical and Preparation)	80	05	10 + 05 =15 (Attendance+Performance)	100	3.0
BT-211 (Practical)	Lab in Biology- II (Physiology, Tissue culture & Microbiology)	80	05	10 + 05 =15 (Attendance+Performance)	100	3.0
BT-212(VivaVoce)					50	1.0
Total Marks and Credits					1150	38.5

THIRD YEAR (2017-2018) EXAMINATION- 2018

Course no	Course title	Theoretical Marks	Tutorial/ Assignment/ Note Book Marks	Class attendance	Total marks	Credits
BT-301	Virology	75	15	10	100	3.5
BT-302	Microbial Biotechnology - I	75	15	10	100	3.5
BT-303	Immunology-II	75	15	10	100	3.5
BT-304	Agricultural Biotechnology	75	15	10	100	3.5
BT-305	Animal Biotechnology	75	15	10	100	3.5
BT-306	Molecular Biology II	75	15	10	100	3.5
BT-307	Genetic Engineering	75	15	10	100	3.5
BT-308	Biostatistics	75	15	10	100	3.5
BT-309 (Practical)	Lab. in Immunology & Clinical Biochemistry	80	05	10 +05 =15 (Attendance+ Performance)	100	3.0
BT-310 (Practical)	Lab in clinical Microbiology & fermentation technology	80	05	10 +05 =15 (Attendance+ Performance)	100	3.0
BT-311 (Practical)	Lab in Plant Tissue Culture	80	05	10 +05 =15 (Attendance+ Performance)	100	3.0
BT-312	Field work/Industrial tour				100	3.0
BT-313 (Viva-voce)					50	1.0
Total Marks and Credit					1250	41.0

FOURTH YEAR (2018-2019) EXAMINATION-2019

Course no	Course title	Theoretical Marks	Tutorial/ Assignment/ Note Book Marks	Class attendance	Total marks	Credits
BT-401	Medical & Pharmaceutical Biotechnology	75	15	10	100	3.5
BT-402	Oncology	75	15	10	100	3.5
BT-403	Industrial Biotechnology	75	15	10	100	3.5
BT-404	Environmental Biotechnology	75	15	10	100	3.5
BT-405	Techniques in Molecular Biology	75	15	10	100	3.5
BT-406	Bioinformatics	75	15	10	100	3.5
BT-407	Cell signaling	75	15	10	100	3.5
BT-408	Food Biotechnology and Biosafety Regulation	75	15	10	100	3.5
BT-409	Molecular Biology of Diseases	75	15	10	100	3.5
BT-410 (Practical)	Lab. in Fermentation Technology	80	05	10 +05 =15 (Attendance+ Performance)	100	3.0
BT-411 (Practical)	Lab. in Animal & Plant Biotechnology	80	05	10 +05 =15 (Attendance+ Performance)	100	3.0
BT-412	Field work/Industrial Tour/Industrial Training				100	3.0
BT-413	Project				100	4.0
BT- 414 (Viva-Voce)					50	1.0
Total Marks and Credits					1350	45.5

B.Sc. (Honours) Syllabus for Session: 2015–2016
Department of Biotechnology and Genetic Engineering
Islamic University, Kushtia

MARKS DISTRIBUTION FOR EACH THEORETICAL COURSE:

Year- end theoretical final examination : 75 marks

Internal evaluation of each theoretical course

Tutorial /assignment : 15 marks

Class attendance : 10 marks

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Course detailed for first academic year

Course: BT-101

Course name: Fundamentals of Biotechnology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introductory Biotechnology:

Definition; history; multidisciplinary nature of biotechnology; applications of biotechnology. Introduction to some important components of tissue culture and genetic engineering. Scope and opportunity of biotechnology.

2. Recombinant DNA technology:

Basic concept, Application of microorganisms in genetic engineering, Key tools of gene cloning.

3. Agricultural Biotechnology:

Agriculture related applications, plant character amenable to change by biotechnology-seed quality, herbicide resistance, biocontrol of plant pathogens, insects, pests and weeds, mushroom production, Single Cell Protein (SCP).

4. Animal Biotechnology:

Scope and application of biotechnology in medicine and pharmaceuticals hormones, vaccines, gene therapy and disease diagnosis, product from animal, cell culture products, pharmaceuticals from transgenic animals.

5. Environmental Biotechnology:

Biotechnology in service of environment related applications- pollution control, waste disposals and biogas production, marine biotechnology.

6. Current trends:

Microbial application- large scale preparation of organic chemicals (i.e. ethanol, acetic acid etc.), livestock improvement- dairy products, meat quality, animal disease control and food development.

7. Industrial Biotechnology:

Bioreactors, fermentation process, fermentation product, biological regulation and process Control, product recovery in biotechnology.

Books recommended

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|---------------------------------|---|------------------------------|
| 1. Smith J. E. | : | Biotechnology |
| 2. Glick B. R., Pasternak J. J. | : | Molecular biotechnology |
| 3. Dubey, R.C | : | A text book of biotechnology |
| 4. Ignacimuthu, S | : | Plant biotechnology |
| 5. Chopra, V.L | : | Biotechnology in agriculture |

Course: BT-102

Course name: Microbiology-I

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Definition, a brief history of microbiology, germ theories of diseases, characteristics of prokaryotic & eukaryotic cells, Whittaker's five kingdom concept, scope of microbiology in human welfare, sanitation & environmental pollution control, applications of microbiology in medicine, agriculture, food & dairy industry.

2. Microscopy and microscopic examination:

Microscopy- components, functions and types of microscopes, basic principle, the path of light, magnification & resolution, calculation of total magnification, micrometry (measurement of cell size), applications, advantages and limitations of light (bright-field, dark-field, fluorescence, phase-contrast and confocal) and electron (transmission and scanning) microscopy.

Staining-definition, staining procedure, different types of staining, types of dyes used in staining, mechanism of gram-staining.

3. Major groups of microorganisms:

Bacteria- typical bacterial cell, size, shape and arrangement, structures(external & internal), structure and chemical composition of cell wall, concept of spores and cysts, classification, taxonomy, nutritional requirement, nutritional types of bacteria, physical conditions required for growth (temperature, gaseous requirements), oxygen-toxicity, reproduction and growth, synchronous growth, oxygenic & anoxygenic phototrophic bacteria.

Fungi- characteristics, morphology, classification, growth & reproduction, importance in natural process.

Virus- Major groups of viruses, Viral structure, nature of viruses, classification with representative examples, bacterial, plant and animal viruses with their nomenclature and classification.

Others: Salient features of algae, protozoa, cyanobacteria and actinomycetes.

4. Culture techniques:

Definition of culture media, types of media, preparation of media, composition of media, pure culture and mixed culture, methods of isolating pure cultures, different methods for preservation of pure culture, quantitative measurement of growth.

5. Control of Microbial Growth:

Principles and mechanism of microbial control (sterilization, pasteurization, disinfection, antisepsis, degermation, sanitization), physical methods of microbial control (heat, moist heat, autoclave, pasteurization, dry heat sterilization, filtration, low temperature, desiccation, osmotic pressure, radiation), chemical methods of microbial control (various disinfectants and antiseptics).

Books recommended

1. T. D. Brock et al.: Biology of microorganisms.
2. M. J. Pelzer, Chan, N. R. Kreig : Microbiology.
3. G. J. Tortora, et al.: Microbiology: an introduction.
4. G. Schlegel: General Microbiology.

Course: BT-103

Course name: Fundamentals of Biochemistry

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Definition, scope and achievement of biochemistry.

2. Carbohydrate:

Definition, classification, properties, chemical reactions, mutarotation, ring structure, invert sugar, reducing sugar, structure, properties and functions of disaccharides and polysaccharides, qualitative test for carbohydrates, biological function of carbohydrates.

2. Lipid:

Definition, classification, and properties of lipids, fatty acids- general formula, nomenclature and properties, essential and nonessential fatty acids, properties of fats and oils, phospholipids and their classification, lipid bilayer, biological function of lipid.

3. Amino acids:

Definition, structure, classification, and properties of amino acid, titration curve of amino acids, general reaction and qualitative test of amino acids, essential, nonessential and nonstandard amino acids.

4. Peptide and Proteins:

Definition of peptide and protein, formation of peptide bond, chemical synthesis of a peptide, classification of proteins, structure of proteins, denaturation and renaturation of proteins, and biological functions of protein.

5. Vitamins:

Sources, RDA, structure, physiological functions, deficiency symptoms of fat soluble vitamins, sources, RDA, structure, active forms, biochemical function and deficiency symptoms of water soluble vitamins (Vit.C and Vit.B complex), absorption and storage of vitamins.

7. Minerals:

Classification, sources, biochemical and physiological function, deficiency symptoms of some important minerals(e.g; Ca, Fe, Mn, Mg, Co, Na, K, P, Cl, Zn, Ni), absorption of minerals.

8. Food & Nutrition:

Food, Nutrition, malnutrition and sub nutrition, balanced diet, diet chart, Humanisation of cow's milk, Calorie value, energy expenditure, nutritional disease.

Books Recommended

1. A.L.Lehninger, David L. Nelson, Michael M. Cox: Principles of Biochemistry.
2. A.C. Deb: Fundamentals of Biochemistry.
3. Jain: Biochemistry.
4. Lehninger: Text Book of Biochemistry.
5. Stryer: Biochemistry
6. R.K.Murray: Harper's Biochemistry
7. U. Satyanarayana : Biochemistry

Course: BT-104

Course name: Basic Botany

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction: Scope and branches of Botany

2. Systemic Botany:

Taxonomy, definition, objectives and uses of taxonomy, units, systems and basis of classification, naming of plant, classification of plant, systemic study and economic importance of the following families of angiosperms- *Gramineae*, *Leguminosae*, *Orchidaceae* and *Verbenaceae*, practical implications of systemic study of families in biotechnology.

3. Economic Botany:

Study of angiospermic plants as source of cereal, fibre, medicine, oil, beverage, rubber, sugars and narcotics.

4. Anatomy:

Tissue and tissue systems, compact and classification, characteristic, functions and distribution of different types of plant tissues, importance of studying tissue and tissue system in biotechnology.

5. Embryology:

Reproduction, alternation of generation, gametogenesis (micro and megasporogenesis, micro and megagametogenesis), types of embryo sac and their development, pollination and fertilization, parthenogenesis and apomixes.

6. Plant Ecology:

Books Recommended

1. P. Maheshwari: An introduction to Embryology of Angiosperm.
2. K. Esau: Anatomy of seed plants.
3. A. Fahn.: Plant Anatomy.
4. G. H. M. Lawrence: Taxonomy of Vascular Plants.
5. B. P. Panday: Economic Botany
6. C Leveque, J.C Mounolou: Biodiversity.

Course: BT-105

Course name: Basic Zoology, Cell & Developmental Biology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction: Scope and branches of Zoology

2. Invertebrates:

Definition, diversity of invertebrates, major and minor phyla, lower and higher invertebrates, contrast between lower and higher invertebrates, invertebrates versus vertebrates, phylogeny of invertebrates, major characteristics of invertebrates, outline classification of animals.

3. Chordata:

Definition, diversity of chordates, three fundamental chordate characters, origin and ancestry of chordate, major subdivisions of chordate, general characters of chordate, brief classification of chordata with characters.

4. Wildlife Biology:

Definition, introduction to the wildlife and broad classification of wildlife in Bangladesh, wildlife preservation and its importance in Bangladesh, wildlife order of 1973.

5. Fundamental of Animal Life:

Origin of living system, Lamarckism and Darwinism, neo-Darwinism, modern synthetic theory.

6. Palaeontology:

Geological time scale, process of fossilization.

7. Vertebrate Embryology:

Introduction, fertilization, parthenogenesis, egg types, cleavage, blastulation, gastrulation, gametogenesis, development of chick, placentation in mammals.

8. Cell Biology:

Definition, History, Cell theory, Units of measurement of cell, Ultra structure and functions of cell organelles (cell wall, plasma membrane, mitochondria, lysosome, nucleus, chloroplast, ribosome, microbodies), Chemical organization of cell, Cell cycle and cell division.

9. Developmental biology

Basic types of animal development, developmental potential, determination and differentiation, cell interaction and induction, mesoderm induction in xenopus, introduction to the development in *Dictyostelium* and *Drosophila*. Experimental model animal: Mouse, Rat, Zebrafish

Books Recommended

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| 1. Kotpal | : | Modern textbook of Zoology (Invertebrates) |
| 2. Kotpal | : | Modern textbook of Zoology (Vertebrates) |
| 3. E. L. Jordan and P. S. Verma | : | Invertebrate zoology |
| 4. Ganguly and Shinha | : | Biology of animals (Vol. 1, 2 & 3). |
| 5. Parker and Haswall | : | Textbook of zoology (Vol. 1& 2) |
| 6. K.Z.Hossian | : | Wild life of Bangladesh |
| 7. Darnell, J., Lodish, H. and Baltimore | : | Molecular cell biology |
| 8. Alberts B. Bray, D. Lewis, J | : | Molecular biology of the cell |

1. Introduction:

Nucleotide, nucleoside, purine and pyrimidine bases, bases occur in DNA and RNA, structure of DNA and RNA, Chargoff rules, gene, genome, genetics, genotype, phenotype, test cross, backcross, reciprocal cross, dominant gene, recessive gene, lethal gene, mutation and mutant gene, allele and pseudoallele-definition, characteristics, examples and importance.

2. Mendelism:

Mendelian principles, experiments and achievements, monohybrid and dihybrid inheritance, Mendelian genetics in humans, pleiotropism and phenocopy, deviation of Mendel's law-dominant (12:3:1) and recessive (9:3:4) epistasis, duplicate dominant (9:7) and duplicate recessive (15:1) genes, dominant and recessive interaction (13:3), duplicate gene with cumulative effect (9:6:1).

3. Linkage and recombination:

Types of linkage, discovery of linkage- autosomal and sex, detection of linkage, genetic linkage and gene mapping, detection and estimation of genetic linkage in human, genetic mapping of human chromosome, genetic interference and coincidence.

4. Sex determination:

Mechanism of sex determination in man, grasshopper, Drosophila and fowl, Balance theory of sex determination, sex-linked inheritance, sex influence and sex limited characters.

5. Cytoplasmic inheritance:

Variation in leaves of higher plants, inheritance of extranuclear genes, maternal inheritance

6. Chromosomal aberration:

Variations in the number and structure of chromosomes- haploids; missing or extra chromosomes (euploids, aneuploids), deletion, duplication, aberrations, translocation and other structural rearrangements, chromosomal studies – FISH, Karyotyping.

7. Human Genetics:

Pedigree analysis, amniocentesis, twins, human traits, disorders due to mutant genes.

Books Recommended

1. Monooe W.Strickberger : Genetics.
2. Adrian M.SRB : General Genetics.
3. Enmund W. Sinnott : Principles of Genetics.
4. Gupta : Genetics.

Course: BT-107

Course name: Organic Chemistry

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

IUPAC nomenclature of organic compounds, characteristics and type of organic reactions- addition, elimination, substitution and rearrangement reactions.

2. Aliphatic Compounds:

Aliphatic alcohols, aldehyde and ketone, carboxylic acids and amides, aliphatic amines- preparation and chemical reactions.

3. Aromatic Compounds:

Phenol and aromatic alcohol, quinone, aromatic aldehydes and ketones- preparation and chemical reactions; amine and diazonium salts- preparation and chemical reactions.

4. Mechanisms of organic reactions:

Generation of carbonium ions, carbanions, nucleophiles and electrophiles, mechanism of some important reactions with examples i.e., aldol condensation, Friedel-Crafts alkylation & acylation, Diels-Alder reaction, Hofmann degradation, Wurtz-Fittig reaction, Reimer-Tiemann reaction and benzoin condensation.

5. Heterocyclic Compounds:

Definition, nomenclature, synthesis & chemical reactions of furan, pyrrole, thiophene and pyridine.

6. Alkaloids:

Definition, sources, classification, extraction, structure determination, synthesis and uses of some biologically important alkaloids (i.e. nicotine, quinine, atropine, morphine, heroine)

7. Polymers:

Definition, classes of synthetic addition polymers, condensation polymers, fibers and fabrics, natural and synthetic rubbers, copolymers, polymer structure and properties.

Books recommended

1. B.S.Bahl and Arun Bahl : Advanced organic chemistry
2. Morrison and Boyd : Organic chemistry
3. Finner : Organic chemistry
4. Atkins and Carey : Organic chemistry
5. Solomon : Organic chemistry.

1. Acids, Bases and Buffers:

Various concepts of acids and bases, pH measurement and pH scale, ionization of acids and bases, acid –base titration reactions and indicators, common ion effect, acidic and basic properties of biological important molecules, acid base balance and its maintenance, buffer solution, mechanism of buffer action, buffer capacity, some important biological buffers, Henderson-Hasselbatch equation.

2. Thermodynamics:

Systems and surroundings, reversible and irreversible process, molar heat capacities, isothermal and adiabatic expansion with work equation; state and path function, first and second law of thermodynamics, enthalpy, entropy, free energy, free energy changes and spontaneous bio-reactions, relationship between free energy change and equilibrium constant, third law of thermodynamics, applications of thermodynamics to biochemistry.

3. Colligative properties of solution:

Dilute solutions, Raoult's law and its derivation, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmosis and osmotic pressure.

4. Colloids and adsorption:

Definition, classification and general properties of colloid, Brownian movement, coagulation, gel and emulsion, definition, causes and classification of adsorption, classical and langmuir adsorption isotherm, phase rule, phase diagram of water.

5. Inorganic Chemistry:

Atomic structure, Bohr and Rutherford atom models, electronic configuration, ionization potential, electron affinity, electro negativity, ionic bonds, types of ions, covalent bond, coordinate covalent bond, valence bond approach, sigma (σ) and pi (π) bonds, bond length, bond order, hydrogen bond, Van der wall's forces, metallic bond, role of inorganic elements in some vital complexes of biological importance e.g. hemoglobin, cytochromes, ferredoxin, chlorophylls.

Books Recommended

1. Bhal & Tuli : Essential of Physical Chemistry.
2. S. Glasstone : A Text Book of Physical Chemistry.
3. Sharma and Sharma : Physical Chemistry.
4. D. Freifelder : Physical Chemistry.
5. Morris, J. G. A. : Biologist's Physical Chemistry.
6. Stryer : Biochemistry.
7. Atkins, P.W. : A General Chemistry

PRACTICAL: Examination duration 12 hours

▪ **Marks distribution for practical course**

Year-end practical final examination : 80 marks

Internal evaluation of each practical course

Laboratory performance/assignment/
oral test during laboratory hours : 05 marks
Laboratory attendance : 10 marks
Laboratory note book on experiment : 05 marks

Course: BT-109 (Practical) Lab in biochemistry-I (Qualitative & Quantitative)

Full Marks: 100

Unit: 1

Credit: 3.0

Exp.-1: General Accuracy and precision of Research laboratory.

Exp.-2: Preparation of standard solutions using solid and liquid solutes.

Exp.-3: Preparation of 0.1N solution of Na₂CO₃ and determination of the strength of HCl solution.

Exp.-4: Estimation of acetic acid content of vinegar.

Exp.-5: Estimation of iron content of Mohr's salt by the dichromate method.

Exp.-6: Estimation of copper by iodometry.

Exp.-7: Preparation of buffer and determination of pK of acetic acid.

Exp.-8: Determination of pH, preparation of buffer and demonstration of buffer action.

Exp.-9: Determination of pKa of ethanoic acid.

Course: BT-110 (Practical) Lab in biology-I (Zoology, Botany & Microbiology)

Full Marks: 100

Unit: 1

Credit: 3.0

1. Observation of living bacterial cells, Yeasts & Molds
2. Different staining (Gram staining, Acid fast staining, Acid fast staining, Capsule staining, Spore staining, Flagella staining)
3. Media preparation & sterilization techniques
4. Techniques for isolation of pure cultures
5. Techniques for preservation and maintenance of pure cultures
6. Observation of cultural characteristics of bacteria on various media
7. Observation of cultural characteristics of yeast on various media

Non credit course: Bangladesh studies or Islamic studies

Full Marks: 100

Course: BT-111

Viva-voce

Full Marks: 50

Unit: 1

Credit: 1.0

Course detailed for second academic year

Course: BT-201

Course name: Human Physiology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Muscular system:

Structure of a skeletal muscle, skeletal muscle fibers, neuromuscular junction, motor units, skeletal muscle contraction, oxygen supply and cellular respiration, oxygen debt, muscle fatigue, smooth muscles, cardiac muscles.

2. Circulatory System:

Body fluid, volume, types, compartmentalization of fluid (ICF, ECF), composition of blood, blood plasma, blood serum, plasma protein, origin of blood cells, development of blood cells (R.B.C, W.B.C & Platelets), properties and function of RBC & PMN, structure and function of hemoglobin, myoglobin, thalasemia, sickle cell anemia, blood coagulating factors & coagulation process, blood group and Rh factor, blood transfusion.

3. Cardiovascular System:

Anatomy and physiology of heart, conduction and regulation of heart beat, cardiac cycle, heart block, heart sound, blood pressure, regulation of blood pressure.

4. Liver:

Anatomy and structure of liver, physiological function, hepatic, vascular and lymph systems, liver disorders.

5. Respiratory System:

Physiology of lungs, mechanism and control of breathing, transport of O₂ and CO₂, oxygen dissociation curve of hemoglobin and myoglobin, Bohr effect, chloride shift, human respiratory disorders.

6. Nervous System:

General functions of the nervous system, structure of neuron, classification of neurons and neuroglia, membrane potential, action potential, refractory period, impulse conduction, synapse, neurotransmitters, neuropeptides, structure and functions of spinal cord, structure and functions of cerebellum, structure of peripheral nerves, general characteristics of autonomic nervous system, autonomic neurotransmitters.

7. Urinary and Reproductive system:

Structure and function of kidney, physiology of urine formation, role of the kidney in the regulation of water, salt and acid-base balance, renal disorders. Male and female reproductive system, spermatogenesis and action of male hormones, ovulation, menstrual cycle, hormonal regulation of menstrual cycle, contraceptives, pregnancy, human development, lactation, menopause.

8. Endocrinology:

Introduction to endocrinology, endocrine glands and their hormones, classification, chemistry and function of hormones, mode of action of hormones. classification, structure, synthesis, secretion, transport and function of pancreatic hormones, biosynthesis of steroid hormone, hormonal disease.

Books Recommended

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| 1. Guyton | : | Medical physiology |
| 2. C.C.Chatterjee | : | Human Physiology |
| 3. Gannong | : | Physiology |
| 4. Davson, W. H. | : | A text book of general physiology |
| 5. Randal | : | Physiology |
| 6. G. Tortora | : | Human anatomy and physiology |

1. Public health Microbiology

Introduction of indicator organism. Coliform, Faecal coliform, Total coliform and Faecal coliform detection method. Airborne and waterborne pathogen.

2. Introduction of some important microorganisms:

Characteristics of some enteric pathogens (*Escherichia*, *Salmonella*, *Shigella*), gram-negative rods (*Pseudomonas*, *Neisseria*), gram-negative cocci (*Mycoplasmas*), gram-positive rods (*Bacillus*, *Clostridium*) and gram-positive cocci (*Staphylococcus*, *Streptococcus*).

3. Identification of Microorganism:

Microscopic, cultural and biochemical tests, serological tests, phage typing.

4. Antibiotics and Drugs:

Definition of antibiotics, sources of antibiotics, classification of antibiotics, synthetic & semi-synthetic antibiotics, narrow and broad-spectrum antibiotics, bactericidal & bacteriostatic actions of antimicrobial drugs; structure & mechanism of action of antibiotics (penicillin, tetracycline, streptomycin, erythromycin, cephalosporin, chloramphenicol), definition of sulphadugs, structure and mode of action of sulfamides, drug-resistance.

5. Microbes and diseases:

Origin of normal flora, distribution, occurrence & importance of microbiota, factors influencing the normal flora, concept of infectious diseases, natural resistance, pathogenicity and virulence, reservoirs of infections, transmission of diseases, mechanism of infection, infection of blood and lymphatic system, microbial virulence factors, microbial toxins, classification of exotoxins, mechanism of action of exotoxins.

6. Common and Emerging infectious diseases:

Causative agents, symptoms, prevention and treatment of common cold, flu, dengue, malaria, rabies, pertussis, tuberculosis, diarrhea, cholera, tetanus, small pox, chicken pox, pneumonia, pertussis, bird flu and Nipah virus.

Books Recommended

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| 1. | T. D. Brock et al | : | Biology of microorganisms |
| 2. | M. J. Pelzer, Chan, N. R. Kreig | : | Microbiology |
| 3. | G. J. Tortora, et al | : | Microbiology: an introduction |
| 4. | E. J. Jawetz; et al | : | Review of medical microbiology |
| 5. | Atlas and Bartha | : | Microbial ecology |
| 6. | Fields | : | Virology, volume I &II. |
| 7. | J. M Jay | : | Modern food microbiology |
| 8. | F. C. Blank | : | Handbook of food and agriculture |
| 9. | B. C. Hobbs and J. H. B. Christian | : | The microbiological safety of food |
| 10. | Talaro, P.K and Talaro, A | : | Foundations in microbiology |

1. Metabolism of carbohydrates:

Catabolism, anabolism, intermediary metabolism, major pathways of glucose utilization, glycolysis, regulation, fate of pyruvate, fermentation, respiration, glycogenolysis and glycogenesis, control of glycogen metabolism, gluconeogenesis and its regulation; biosynthesis of di, oligo and polysaccharides, regulation of carbohydrate metabolism, disorders of carbohydrate metabolism.

2. Tricarboxylic Acid Cycle:

TCA cycle and its reaction, amphibolic nature of the TCA cycle, anaplerotic reactions, regulation of the TCA cycle.

3. Electron Transport and Oxidative Phosphorylation:

Mitochondrial structure and the compartmentation of respiratory metabolism, electron transport through mitochondrial electron carriers; organization of complexes in ETC, oxidative phosphorylation, substrate level phosphorylation, chemiosmotic model, shuttle systems, generation of free radicals, Q cycle.

4. Lipid Metabolism:

Transport of fatty acid from cytosol to mitochondria, β -oxidation of even and odd number fatty acid, ω -oxidation, fatty acid biosynthesis, regulation of fatty acid metabolism, biosynthesis of prostaglandins, ketone body formation and utilization, disorders of lipid metabolism.

5. Protein Metabolism:

Biosynthesis of amino acids, transamination, oxidative deamination and decarboxylation of amino acids, toxicity of ammonia, urea cycle, disorders of protein metabolism.

6. Nucleic acid metabolism:

Importance of nucleotides; biosynthesis and regulation of purine and pyrimidine nucleotides, degradation of nucleotides, disorders of nucleic acid metabolism.

7. Bioenergetics:

Biological energy transformation, laws of thermodynamics, free energy, free energy changes, cAMP biosynthesis and degradation, biochemical and physiological function, cAMP as second messenger, cytochromes and cytochrome P450, NADH, NADPH and FADH₂ as electron carriers.

Books Recommended

1. R.K.Murray : Harper's Biochemistry.
2. A.L.Lehninger : Principles of Biochemistry
3. L.Stryer : Biochemistry.
4. T.M.Devlin : Text Book of Biochemistry with clinical correlation
5. U. Satyanarayana : Biochemistry

Course: BT-204
Full Marks: 100

Course name: Plant Breeding
Unit: 1 **Credit: 3.5**

1. Introduction:

Introduction, history nature of plant breeding, origin and evolution of cultivated crop-wheat and rice, sources of variation, different breeding system, quantitative and qualitative character, heritability, genetic structure of population, gene frequency, biometrical technique in plant breeding, ideotype concept, national and international institute for crop improvement, quality traits of selected crops including rice, wheat and potato.

2. Mode of reproduction and pollination:

Mode of reproduction and pollination control, male sterility and incompatibility in breeding, introduction and self acclimatization, polyploid in breeding,

3. Breeding methods of self and cross pollinated crops:

General concept of selection, self pollinated and cross pollinated crops, pure line selection, pedigree selection, mass selection, bulk method, back cross method, population improvement, hybrid and synthetic variety, single seed descent method, recurrent selection, etc.

4. Heterosis and inbreeding depression:

Introduction, inbreeding depression- history, effect and degree of inbreeding depression, heterosis and hybrid vigor, genetic basis of heterosis and inbreeding depression.

5. Breeding for abiotic stress resistance:

Abiotic stress- drought, salt-tolerant, flood tolerant.

6. Breeding for diseases and insect resistance:

Some common diseases, host- pathogen relationship, resistance and related term, source of diseases and insect resistance, genetics of diseases and insect resistance, breeding methods of diseases and insect resistance.

7. Hybridization:

Introduction, history of hybridization, objectives of hybridization, types of hybridization, procedure of hybridization.

8. Improved Seeds:

Improve seed- its production, maintenance and handling, release of new variety in developing countries.

Books Recommended

1. Shukla, R.S . : Cytogenetics, Evolution and Plant Breeding.
2. Singh, R.K & Singh, R.K : Genetics and Plant Breeding.
3. Singh, B.D : Plant Breeding
4. Pirchner : Population Genetics in Animal Breeding.

1. Introduction:

History of tissue culture, cellular totipotency, laboratory organization, media preparation and techniques in tissue culture, phytohormons, organ culture-root culture, shoot tip or meristem culture, flowerbud or complete flower culture, culture of isolated ovary, embryo culture and rescue in agricultural and horticultural crop, *in vitro* pollination and fertilization, prospects of PTC in Bangladesh and other countries, Micropropagation, Preparation of virus free plants.

2. Callus culture:

Establishment and maintenance, cytology of callus, organogenesis from callus culture and its importance.

3. Somatic embryogenesis and production of artificial seed:

Different stages of somatic embryogenesis and artificial seed, Importance of somatic embryogenesis, encapsulation.

4. Single cell culture:

Factor affecting single cell culture and its importance, growth pattern of cell in suspension culture.

5. Anther and pollen culture:

Anther and pollen culture for haploid production, application of haploid, diploidisation procedure.

6. Protoplast Culture:

Isolation, culture, somatic hybridization and cybridization, importance of somatic hybridization.

7. Somaclonal Variation:

Origin and causes of somaclonal variation, improved varieties through somaclonal variation genetic and epigenetic basis, establishment of cell lines and evaluations.

8. Cryopreservation:

Definition, different steps, merits – demerits of germplasm and *in vitro* conservation, *in vitro* pollination and fertilization.

Books recommended

1. Bajaj, Y. P. S. : Biochemistry in Agriculture and Forestry.
2. Islam, S. A. : Plant Tissue Culture.
3. Pierik R.L.M. : In vitro culture of higher plants. Kluwer Academic Publishers
4. Razdan : Plant Tissue Culture

1. Introduction:

Chemical nature of hereditary materials, experiment with bacteria and bacteriophage indicating DNA to be the material of heredity, central dogma of molecular biology, gene-phenotype relationship.

2. Structure and function of DNA & RNA:

Different physico-chemical properties of DNA (i.e. T_m value, C_{ot} value; hybridization kinetics), homoduplex and heteroduplex, tandem sequence; palindrome sequence; structure (primary, secondary and tertiary) of RNA, types of RNA; role of different RNAs.

3. Replication:

DNA replication, experiment in favor of semi-conservative replication, DNA polymerases, mechanism of replication, control of DNA synthesis in prokaryotic and eukaryotic system, reverse transcription, mechanism of telomere replication.

4. Transcription:

Structural organization of a gene, components of a gene, cis-acting element, trans-acting element, response element, promoters, enhancers, silencers, terminators and transcriptional factors; prokaryotic and eukaryotic RNA polymerases; Mechanism of transcription-initiation, elongation and termination of RNA synthesis in both prokaryotic and eukaryotic systems, regulation of transcription.

5. Translation:

Organization of prokaryotic and eukaryotic ribosomes, the genetic code and their characteristics, clover leaf structure of tRNA, wobble hypothesis; mechanism of translation-initiation, elongation and termination; control of translation both in prokaryotes and eukaryotes; post-translational modifications.

Books Recommended

1. B. Dewis : Genes.
2. Benjamin Lewin : Genes IX.
3. J. Watson : Molecular Biology of the Gene.
4. Lehninger : Principles of Biochemistry.
5. D. Freifelder : Molecular Biology.
6. Prescott : Cell: Principle of Molecular Structure and Function.
7. Geoffrey M. Cooper, Robert E. Hausman : The cell, A molecular approach.
8. Bruce Alberts et al : Molecular Biology of the cell.

1. Introduction:

Components of immune system; Types of immunity - innate and adaptive immunity; humoral and cell-mediated immunity, features of immune response: memory, specificity and recognition of self and non-self; clonal selection.

2. Cells involved in immune response:

Cell surface markers, T cells, B cells, natural killer cells, antigen presenting cells; polymorphonuclear granulocytes- neutrophils, eosinophils, basophils; platelets; mast cells and its triggering, primary and secondary lymphoid organs and tissues.

3. Structure and function of antibody:

Immunoglobulin classes and subclasses, structural features and biological properties of immunoglobulin, antigen- antibody interaction, affinity and avidity.

4. Immunogens and antigens:

Requirements for immunogenicity, epitope, primary and secondary responses, major sources of antigens, characteristics and determinant.

5. T-cell receptors and major histocompatibility complex:

T-cell receptors, major histocompatibility complex (MHC) antigens, antigen processing and presentation to T cells, T cell-B cell interaction, lymphocyte activation, cytokine action on B cells and T cells, cell- mediated cytotoxicity.

6. Complement system:

Complement proteins, classical, alternative and lectin activation pathways, regulation of complement pathways, biological effects.

7. Regulation of the Immune Response and Immunological Tolerance:

Regulation by antigen, antibody, lymphocytes; idiotypic and neuroendocrine modulation of immune responses, genetic control of immune responses; experimental induction of tolerance; Central thymic, peripheral or post-thymic and B cell tolerance to self antigens; potential therapeutic application of tolerance.

Books recommended

1. Ivan M. Roit et al : Essential Immunology.
2. Ivan M. Roit et al : Immunology.
3. T. J. Barrett : Text book of Immunology.
4. I. R. Tizard : Immunology, An Introduction.
5. Abul K. Abbas, Andrew H. Lichtman: Cellular and Molecular Immunology.
6. Colonel M.R.Choudhury : Immunology
7. Abul K. Abbas, Andrew H. Lichtman: Basic Immunology: functions and disorders of immune system.

Course: BT-208

Course name: Enzymology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction to enzymes:

Definition, classification, nomenclature, apoenzyme, holoenzyme, co-enzyme, prosthetic group; cofactors, specificity of enzymes; specific activity; active site, common features of active site; evidences in support of enzyme- substrate complex formation, factors influencing the rate of enzyme-catalyzed reactions such as substrate concentration, enzyme concentration, pH, temperature, coenzyme and cofactors; factors contributing to the catalytic efficiency of enzyme such as proximity, orientation, strain.

2. Enzyme kinetics:

Mono-substrate reactions; Michaelis-Menten equation and its derivation, definition, determination and significance of K_m and V_{max} .

3. Inhibition of enzyme:

Reversible and irreversible inhibition; competitive, non-competitive and uncompetitive inhibition with specific examples from metabolism.

4. Regulatory and catalysis strategies:

Regulation by proximity and orientation, covalent modification, feed-back inhibition, allosteric inhibition; acid-base catalysis, regulation by proteolysis, characteristics and biological importance of isoenzymes, basic catalytic principles, mechanism of enzyme action- proteases, chymotrypsin, lysozyme, ribonuclease A, carboxypeptidase, carbonic anhydrases.

5. Enzyme technology:

Therapeutic, analytical, manipulative and industrial uses of enzyme, Microbial screening for the production of enzyme, technology of enzyme production, genetic engineering and protein engineering of enzymes.

6. Immobilization of enzymes:

Definition, supporting materials, properties of supporting materials, techniques of immobilization with their advantages and disadvantages.

Books Recommended

1. Boyer : The enzymes
2. Dixon : Enzymes
3. Lehninger, A.L : Text Book of Biochemistry
4. Voet & Voet : Biochemistry:
5. F.C.Engle : Enzyme kinetics
6. Stryer : Biochemistry
7. Fersht : Enzymatic reaction mechanism
8. R.K.Murray : Harper's Biochemistry
9. Guyton. H : Text book of medical physiology
10. A.L.Lehninger : Principles of Biochemistry

1. Photosynthesis:

Definition, most important and accessory pigments in prokaryotic and eukaryotic system, different kinds of photosystems, mechanism of photosynthesis, C₃, C₄ and CAM pathways, photorespiration, photophosphorylation, cyclic and non cyclic photophosphorylation, bacteriorhodopsin, the importance of photosynthesis for the existence of the biological world.

2. Respiration:

Definition, mechanism of aerobic and anaerobic respiration, conversion of pyruvate into acetyl-CoA, fermentation, factors affecting the rate of respiration, conversion of seed lipids into glucose- glyoxylate cycle, secondary metabolism of glucose- pentose phosphate pathway, production of L-ascorbic acid (VitaminC) and D-glucuronate.

3. Nitrogen Metabolism:

Mechanism of nitrogen fixation by nitrogenase complex, steps of nitrogen cycles with involved microorganisms and/or enzymes, symbionts, nonsymbionts and function of leghemoglobin, practical importance of nitrogen fixation.

4. Plant Hormones:

Definition, classification, sources, structure, physiological functions, deficiency symptoms and practical applications plant hormones and related compounds- auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids.

5. Mineral Nutrition of Plants:

Sources, physiological functions and deficiency symptoms of micro- and macro nutrients, mechanism of absorption of water & mineral salts by plants.

6. Reproductive growth:

Physiology and flowering, seed germination factors, germination test, evaluation of germinated seedling, normal and abnormal seedling and dormancy, photoperiodism and vernalization, mechanism of flowering, florigen and its role in flowering, types, causes, artificial breaking of dormancy.

Books recommended

1. Lehninger : Principles of Biochemistry.
2. A. C. Deb : Fundamentals of Biochemistry.
3. Jain : Plant physiology
4. Devlin : Plant physiology
5. S.N. Verma : Plant Physiology

PRACTICAL: Examination duration 12 hours

▪ **Marks distribution for practical course**

Year end practical final examination : 80 marks

Internal evaluation of each practical course

Laboratory performance/assignment/
oral test during laboratory hours : 05 marks
Laboratory attendance : 10 marks
Laboratory note book : 05 marks

Course: BT-210

Lab in biochemistry-II (Analytical)

Full Marks: 100

Unit: 1

Credit: 3.0

- Exp.-1: Chemical synthesis of oil of wintergreen.
Exp.-2: Chemical synthesis of aspirin.
Exp.-3: Estimation of ascorbic acid content of biological samples.
Exp.-4: Determination of saponification number of fat or oil.
Exp.-5: Determination of iodine number of fat or oil.
Exp.-6: Determination of lactose content in milk.
Exp.-7: Verification of Beer-Lambert law and determination of unknown concentration of supplied sample by photometric method.
Exp.-8: Determination of λ_{\max} .
Exp.-9: Effect of pH on protein solubility (precipitation of serum albumin and globulin at their respective pI).
Exp.-10: Isolation of casein by precipitation at its isoelectric point.

Course: BT-211

Lab in Biology II (Physiology, Tissue culture & Microbiology)

Full Marks: 100

Unit: 1

Credit: 3.0

- Exp.-1: Effect of temperature and pH on growth
Exp.-2: Effect of heat on vegetative cells and spores of bacteria and spores of yeast and mold
Exp.-3: Effect of osmotic pressure of growth, MIU, KIA & IMVIC test
Exp.-4: Nitrate reduction, oxidase, catalase & litmus milk reaction test
Exp.-5: Identification of unknown bacterial culture with the help of Bergey's manual of systematic bacteriology
Exp.-6: Microscopic study of the pathogenic microorganisms present in air, water & soil (Gram reaction, morphology, mobility, etc)
Exp.-7: Microbial flora of throat & skin
Exp.-8: Identification of human staphylococcal pathogens
Exp.-9: Identification of human streptococcal pathogens
Exp.-10: Detecting *Salmonella spp.* on poultry
Exp.-11: Identification of microbial flora of frozen food and fish
Exp.-12: Identification of different fish pathogens
Exp.-13: Detection of pathogenic microbes in potable water
Exp.-14: Blood group testing

Course: BT-212

Viva-voce

Full Marks: 50

Unit: 1

Credit: 1.0

Course detailed for third academic year

Course: BT-301

Course Name: Virology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Cultivation, detection and assay of virus:

Serological and molecular detection, plaques assay (PFU), infectious center assay, one-hit kinetic and two-hit kinetics of virus cultivation.

2. Host virus interaction:

Attachment, entry and uncoating, replication, assembly and maturation, exit of virus from host cells.

3. Bacterial virus, phage:

Multiplication of T-even bacteriophages (lytic & lysogeny cycle), bacteriophages λ , gene expression and assembly of bacteriophages.

4. Animal virus:

Classification based on gene expression, studies on virion structure, infectivity, mode of gene expression and virus assembly of representative member of each class – herpes virus, papovavirus, hepatitis virus (HBV and HCV), picornavirus, vesicular stomatitis virus (VSV), rabies virus, reovirus, retrovirus (HIV).

5. Effect of animal viruses on host cells:

Cytolytic effects, morphological and biochemical observations, inhibitions of proteins, RNA and DNA synthesis, pattern of viral infection- acute, chronic, persistent and latent viral infection.

6. Plant virus:

Structure, genomic organization and molecular aspects of tobacco mosaic virus (TMV), cotton leaf curl geminivirus (CLCuV) and potato virus X, Y, Papaya ring spot virus (PRSV).

7. Prevention and control of viral infection:

General prevention strategies, Immunization with vaccines and antiviral drugs, mechanism of action and limitations of use of these drugs.

Books Recommended

1. Micael J. Pelezer, Jr. ECS, Chan & Noel R. Krieg : Microbiology Concept & Application
2. B.N. Fields, D. M. Knipe : Fundamental virology
3. Bruce Alberts, etal : Molecular biology of the cell
4. Geoffrey M. Cooper, Robert E.Hausman : The cell, A molecular approach.
5. Benjamin Lewin : Genes IX

1. Introduction:

History, scope and application of modern microbial biotechnology, fermentation concept, fermentor / bioreactor, stages of fermentation, solid substrate and submerged fermentation process, downstream processing.

2. Primary metabolites:

Alcohols, microbes used in alcohol production, fermentable substrates, medium, methods of ethanol fermentation by yeasts and bacteria, alcoholic beverages, wines, beer, cider and distilled beverages, uses of alcohols.

3. Secondary metabolites:

Synthesis of antibiotics, chemical nature of some important antibiotics, narrow and broad spectrum antibiotics, semi-synthetic antibiotics, general mode of antibiotic action, strain improvement for penicillin, fermentation medium and process of penicillin production. Production of Toxin.

4. Vaccines:

Definition, types, recombinant vaccines-hepatitis virus, subunit vaccines-herpes simplex virus, foot and mouth diseases, tuberculosis, peptide vaccines, genetic immunization, attenuated vaccine, vector vaccines, live attenuated vaccine, DNA vaccine, tumor vaccine.

5. Single cell protein:

Definition, importance, sources of single cell protein (SCP), prospects of SCP in Bangladesh, substrates for SCP, production of single cell protein from carbohydrates, n-alkanes, methane and methanol, food and feed grade SCP, drawback of SCP, some available SCP products.

6. Microbial production of therapeutic agents:

Isolation of interferon cDNA, engineering human interferon and human growth hormone, enzymes-DNaseI and alginate lyase against cystic fibrosis, monoclonal antibody as therapeutic agents, production of antibodies in E. coli., HIV therapeutic agents.

7. Microbial Production of Enzyme and Organic acid:

Microbial production of enzyme (Amylase, Protease, Xylanase, Lipase, Penicillin acylase, glucose isomerase, lactase). Microbial production of citric acid, Acetic acid, lactic acid. synthesis and importance of small biomolecules – L-ascorbic acid, indigo, amino acids, adhesive protein, melanin.

Books recommended

1. Smith J. E. : Biotechnology
2. Glick B. R., Pasternak J. J. : Molecular biotechnology.
3. Laskin : Enzymes and immobilized cells in biotechnology.
4. Davis : Single Cell Protein.
5. Fogerty : Microbial enzymes and biotechnology.
6. Primrose : Modern biotechnology.
7. Bu'lock : Basic biotechnology.
9. Morgan, Rockey & Highton: Industria Microbiology, An Introduction by Waites.
10. Alexander N. Glazer, Hiroshi Nikaido: Microbial Biotechnology.

1. Immunoglobulin (Ig) Genetics:

Generation of antibody diversity, Antibody diversity & VDJ recombination, Immunity to infection- bacterial, viral & parasitic infection, evasive strategies by the pathogens.

2. Hypersensitivity:

Classification of hypersensitivity reaction, Disease associated with hypersensitivity reactions, Mechanisms of damage in hypersensitivity reaction, Methods for diagnosing conditions due to hypersensitivity, Modes of treating disease due to hypersensitivity & their rationale.

3. Transplantation and rejection::

Barriers of transplantation, laws of transplantation, role of T-cell in rejection, genetic predisposition to graft rejection and prevention of rejection.

4. Autoimmune diseases:

Autoimmunity, association of autoimmunity with disease, genetic factors, pathogenesis, etiology, diagnosis and treatment.

5. Immunodeficiency

Primary and Secondary immunodeficiency. Immunodeficiency in AIDS & other conditions. Major primary immunodeficiency and their features. Relationship between site of lesion and resulting immunodeficiency. Diagnostic test for different immunodeficiency.

6. Tumor immunology:

Evidence for immune reactivity to tumor. Changes in cellular characteristics due to malignancy. Host components which affect tumor progression. Tumor cell components which protect it from the immune system. Rationale for tumor immunotherapy & know the approaches.

Books recommended

1. Roitt, Brostoff and Male : Immunology
2. Ivan M Roitt and peter J. Delves : Essential Immunology.
3. Abul K. Abbas, Andrew H. Lichtman : Cellular and Molecular Immunology.
4. Abul K. Abbas, Andrew H. Lichtman: Basic Immunology: functions and disorders of immune system

Course: BT-304

Course Name: Agricultural Biotechnology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Plant genome:

Nuclear genome, chloroplast genome, mitochondrial genome, structure of plant gene, inter relationship of different genome.

2. Gene transfer system for plant:

Ti plasmid, Ri plasmid, T-DNA, *Agrobacterium*- mediated gene transfer, direct methods of gene transfer, use of reporter and marker gene in transformed plant cell, transposable genetic elements, production of marker free transgenic plants.

3. Marker aided selection in plant breeding:

Morphological, biochemical and molecular marker, advantages and disadvantages, procedure and application of RFLP, RAPD and AFLP marker.

4. Application of biotechnology in agriculture:

Development of diseases, insect and herbicide resistant plant, development of stress (salt and submergence) tolerance in plant, antisense RNA technology and fruit ripening, genetic manipulation of flower pigmentation, improvement of protein quality of seed by genetic engineering, modification of food plant taste, appearance and yield, plants as bioreactor- antibodies, polymers and foreign protein products.

5. Plant-microbe interaction:

Basis of plant-microbe interaction(symbiosis), role of plant-microbe interaction in promoting plant growth and health, mechanism of plant defense, microorganisms and biocontrol / biological benefits of plant-microbe interaction, rhizoremediation, molecular mechanism of plant immunity, disease resistance gene-form and function.

6. Biofertilizers:

Definition, types of biofertilizers, benefits of different types of biofertilizers.

7. Biopesticides:

Definition, integrated pest management (IPM), application, advantages and disadvantages of biopesticides.

Books recommended

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|------------------------|--|
| 1. R. C. Dubey | : A Text book of Biotechnology. |
| 2. M. K. Razdan | : An Introduction to Plant Tissue Culture. |
| 3. Sickevitz | : Plant Biotechnology. |
| 4. Purohit | : Agricultural biotechnology |
| 5. Glick and Pasternak | : Molecular Biotechnology |
| 6. Primrose | : An introduction to gene manipulation |

Course: BT-305

Course Name: Animal Biotechnology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Definitions, major techniques of animal biotechnology, biosensors, biochips, biofilms and biosurfactants, bioinformatics, application of animal biotechnology, aquaculture improvement through biotechnology, animal diseases, livestock production, ruminal bacteria, improvement in nutritive value of low quality feeds,

2. Principles of animal cell and tissue Culture:

Origin, types of cells, primary culture, cell lines (Hela cell, CHO, COS, HepG₂, HEK) and cloning, somatic cell fusion, flask culture, organ culture and whole embryo culture, techniques of cell and tissue culture, application of animal tissue culture.

3. Animal tissue culture media:

Blood plasma, blood serum, serum free media, tissue extracts, complex natural media, chemically defined media, and other tissue culture media.

4. Culture of specific cell types:

Epithelial cells, mesenchymal cells, hemopoietic cells, culture of tumor tissue.

5. Transgenic Animal Technology:

Transgenic mice, transgenic swine, transgenic cattle, methods for the introduction of recombinant DNA into chicken and mammalian embryos, problems after developing transgenic animals.

6. Human and Animal Health:

Hybridomas technology and production of monoclonal antibodies and its role in treatment and diagnosis of diseases, neoplasia, HIV and AIDS, gene therapy.

7. Embryo transfer technology & IVF: Definition, collection of embryo, culture and transfer of embryos, Potential use of IVF, mechanism involved in IVF.

8. Cloning: Definition, history of animal cloning, cloning of sheep, cattle, monkeys and human cloning.

Books recommended

- | | |
|---------------------------------|---------------------------------|
| 1. Bullock J. and Kristiansen B | : Basic Biotechnology. |
| 2. Wisenan A | : Principles of biotechnology. |
| 3. Smith John E | : Biotechnology. |
| 4. Dubey, R. C | : A Text book of Biotechnology. |

1. Molecular Organization of Chromosome:

Molecular concept of gene & chromosomes, centromere, telomere, nucleosome and its organization in eukaryotic chromosome, histone and nonhistone proteins, super coiling of DNA; chromatin structure and gene activity, structural gene sequence, protein coding genes, tandemly repeated and simple sequence DNA, Mobile DNA, Retroposon.

2. Recombination and repair:

Detail mechanism of recombination; holliday model, bacterial recombination, specialized recombination, site specific recombination, phase strategy, conjugation, transformation, bacterial and eukaryotic transposons, repair systems (i.e. excision repair, mismatch repair, retrieval systems), triggering of the SOS system. DNA repair defects.

3. Post transcriptional events:

Splice junctions, mechanism of nuclear splicing, self-splicing of group I and group II introns, alternative splicing; capping and polyadenylation, other events, Cis and trans splicing, RNA processing, catalytic activities of ribozymes.

Post transcriptional regulation:

RNAi, si RNA, microRNA, nonsense mediated mRNA decay, RNA editing.

4. Epigenetics: Introduction, Propagation of heterochromatin and its interaction with histone protein, chromosome condensation, DNA methylation, inheritance of epigenetic effect, factors for influencing the epigenetic modification.**5. Mutation:**

Classification, molecular basis of mutation, *in vitro* mutagenesis, site-directed mutagenesis, correlation between mutagenicity and carcinogenicity, Mutation rate and its measurement. practical applications of mutation; Ames test, Xeroderma pigmentosum, Fanconi's anemia, Retinoblastoma etc. and their relationship with cancer.

6. Regulation of Gene Expression:

Autogenous control, positive and negative control; the operon: *lac* operon, *ara* operon, *trp* operon; DNA binding domains of regulatory proteins, interaction of regulatory proteins with other proteins, repressors, genes with multiple promoters, gene silencing, heat shock genes. Quorum sensing regulated gene expression.

Books recommended

- | | |
|--|---|
| 1. Benjamin Lewin | : Genes IX. |
| 2. Robert F. Muller, Ian D Young | : Emery's Elements of Medical Genetics. |
| 3. Watson | : Molecular Biology of gene. |
| 4. Sudbery | : Human molecular genetics. |
| 5. R. M. Twyman | : Advanced Molecular Biology. |
| 6. J.Sambrook and T. Maniatis: Molecular cloning | : A laboratory Manual(Vol I,II,III) |
| 7. Istavari Rasko and C. Stephen Downes | : Genes in Medicine. |
| 8. Strachan, T. A. and Read A. P. | : Human molecular genetics. |

1. Introduction:

Gene-cloning concept and basic steps, definition of genetic engineering, tools of genetic engineering, multiple applications of genetic engineering.

2. Amplification of target gene: Restriction site tagged primers, DNA sequence and restriction map, process and mechanism of PCR, isolation of PCR product.**3. Gene cloning Vector:**

Molecular biology of *E.coli* and bacteriophages in the context of their use in genetic engineering, definition & properties of plasmid, types, size, copy number, replication, regulation of replication, incompatibility groups; host controlled restriction and modification; isolation of plasmid DNA, other gene cloning vectors-bacteriophage λ and other phage vectors; cosmids, phagemids, virus vectors for animals-YAC, BAC.

4. Gene cloning:

Principles of cutting DNA molecules, host controlled restriction and modification, restriction endonucleases- definition, types, nomenclature, recognition sequences and cutting site, sticky end and blunt ends, isoschizomers, DNA ligase, linkers, adaptors, transformation methods of recombinant DNA-physical and biological methods, selection and screening; other enzymes used in genetic engineering-exonucleases, ribonucleases, DNA polymerases, ligases, kinases, phosphatases, reverse transcriptase, DNAases, proteinases, S1 nuclease.

5. Gene Library:

Construction of genomic library and cDNA library; screening of gene libraries by DNA hybridization, immunological assay and protein activity.

6. Mammalian Cell Expression Vectors:

Selectable and screenable markers; Two-vector expression system; two-gene expression vector, Gene targeting and site-specific recombination.

7. Gene Expression in Prokaryotes:

Tissue specific promoter, wound inducible promoters; strong and regulatable promoters; increasing protein production; fusion proteins; translation expression vectors, DNA integration into bacterial genome, increasing secretion, metabolic load.

Books recommended

1. J. Sambrook, and T. Maniatis: Molecular cloning. A laboratory Manual (Vol I,II,III).
2. R. W. Old: Principles of Gene Manipulation, An Introduction to Genetic Engineering.
3. J. A. Smith, K. Struhl: Current protocols in Molecular Biology.
4. Alberts, Johnson: Molecular biology of the cell
5. Lodish, Berk, Matsudaira: Molecular cell Biology

1. Elementary biometry:

Definition, Scope of biostatistics, problems in measurements; Populations and parameters: Samples and statistics; data and information, presentation of data, distribution of data.

2. Variables:

Discrete and continuous variables.

3. Central tendency:

Calculation of the mean, variance and standard deviation. Machine method of calculating the variance and standard deviation, Estimation of standard deviation from the range, Standard deviation of the mean, Confidence limit of the mean.

4. Test of Hypothesis:

t-test: The t test in paired experiments, the t test in non-paired experiments, selection of appropriate method of calculating t, confidence limits of a difference between means.

chi-square (x²) test:

The 1 x n table, the 2 x n table, the use of x² with occurrence-nonoccurrence data, x² analysis of a 2 x 2 or four fold table, alternate methods of calculating x², tests of significance when cell frequencies are small, general remarks.

5. Correlation analysis:

Correlation analysis- Karl Pearson's methods, Spearman rank method, concurrent deviation method, least square method, partial and multiple correlation.

6. Regression analysis:

Regression analysis-simple linear regression, curve fitting standard error estimation, multiple regressions.

7. Analysis of variance:

Analysis of variance components, use and utility of analysis of variance, one, two and three way classification. Duncan's multiple range test: Least significance difference test The relationship between t and F test, General remarks.

8. Experimental design:

Introduction, complete block design, Randomized complete block design, Latin square design, Fixed and random effect and interaction, Population base experimental design, Epidemiological experimental design.

9. Factorial analysis:

Factorial design and orthogonal comparison among treatment total.

10. Research Methodology & Data transformation:

SPSS

Books Recommended

- | | | | |
|----|-----------------------|---|--|
| 1. | Fisher, R. A | : | The design of Experiments |
| 2. | Fisher, R. A. & Yates | : | Statistical table for biology, agriculture and medical research. |
| 3. | Goodman, R.C | : | Teach yourself statistics |
| 4. | Manning A | : | The elements of biometry |
| 5. | Jerrold H. Zar | : | Biostatistical analysis |

PRACTICAL: Examination duration 12 hours

Marks distribution for practical course

Year end practical final examination: 80 marks

Internal evaluation of each practical course

Laboratory performance/assignment/
oral test during laboratory hours : 05 marks
Laboratory attendance : 10 marks
Laboratory note book on experiment : 05 marks

Course: BT-309

Course Name: Lab in Immunology & Clinical Biochemistry

Full Marks: 100

Unit: 1

Credit: 3.0

- Exp.-1: Collection of serum and plasma from human peripheral blood.
- Exp.-2: Liver glycogen extraction and estimation.
- Exp.-3: Determination of protein content by the Lowry method.
- Exp.-4: Determination of glucose content of serum by the nelson-Somogyi method.
- Exp.-5: Determination of creatinine of a urine sample.
- Exp.-6: Isolation and determination of cholesterol from chicken egg.
- Exp.-7: Determination of serum glucose by the glucose oxidase method.
- Exp.-8: Determination of serum alanine aminotransferase by the enzymatic method.
- Exp.-9: Determination of serum total bilirubin by colorimetry.
- Exp.-10: Determination of serum creatinine by colorimetry.
- Exp.-11: Determination of serum GOT and GPT activity.
- Exp.-12: Study on the activity of salivary amylase.
- Exp.-13: Determination of K_m and V_{max} of bovine kidney alkaline phosphatase.

Course: BT-310

Course Name: Lab in clinical microbiology & fermentation technology

Full Marks: 100

Unit: 1

Credit: 3.0

- Exp.1: Quantitative examination of bacteria in raw & pasteurized milk
- Exp.2: Microbiological analysis of fermented foods and non fermented foods
- Exp.3: Production of Microbial extracellular enzymes
- Exp.4: Production of alcohol from molasses
- Exp.5: Microbiological assay of Pharmaceutical raw materials
- Exp.6: Bioassay of potency of antibiotics
- Exp.7: Dough fermentation by Baker's yeast for bread making
- Exp.8: Yogurt production by lactic starter
- Exp.9: Determination of specific growth rate substrate utilization constant and biomass in a steady state batch culture
- Exp.10: Antimicrobial sensitivity test of microorganisms (Qualitative)
- Exp.11: Action of antiseptics, disinfectants, UV light & photo reactivation & antimetabolites

Course detailed for fourth Academic Year

Course: BT-401

Course Name: Medical & Pharmaceutical Biotechnology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Unit process, design and unit operation in pharmaceutical industry, sterile products, pilot -plant scale up techniques, packaging and managements of products.

2. Drug manufacturing process:

Pharmacopoeia, manufacturing facilities, sources of biopharmaceuticals, production of final products and analysis of final products.

3. Quality assurance and organization model:

Definition of QA, system of QA appropriate to the manufacture of pharmaceutical products; organization of QA department.

4. Quality control:

Definition, good QC practices; quality control practices; responsibility of the head of QC department, QA/OC activities (GMP, GLP, GDP, HACCP), quality audit and self inspection, environmental monitoring and control; cleaning validation; self-inspection; in-process inspection, quality management-GMP vs ISO 9000, 14000, 18000, ISO/IEC17025, WHO/PICs.

5. Documentation system:

All documents used in QA including SOP, FDA regulation; product registration, process and criteria; specifications for raw materials, packaging materials, finished products.

6. Calibration and validation:

Instrumental calibration, instrumental validation; validation of analytical methods, handling of complaint and product recalls.

7. Application of biotechnology to medicine:

Biosynthesis of some important medical and pharmaceutical products such as chemotherapeutic agents, enzymes, steroids and vitamins etc.

8. Human gene therapy:

Ex vivo and *in vivo* gene therapy, practice of gene therapy, viral gene delivery systems, pro-drug activation therapy; nucleic acid therapeutic agents.

9. Ethical dilemmas in clinical genetics:

Major ethical issues in developed and developing nations, needs of medical geneticists in the study of ethics, resources for ethical guidance, special position of women and children, responsibilities of health professionals with family genetic information.

10. Production of the pharmaceutically useful biopharmaceuticals by rDNA technology

Books recommended

1. Burger : Medical chemistry.
2. Remington's Pharmaceutical Science.
3. Rosenberg : Chemistry and physiology of vitamins.
4. Robert F. Muller, Ivan D. Young : Emery's Elements of Medical Genetics.
5. Leon Lachman : The theory and Practice Industrial Pharmacy.
6. Williams : Recombinant DNA.
7. B. K. Sharma, N., and P. K. Sigal. : Adaptation Biology and Medicine.
8. Gray Walls : Biopharmaceuticals

Course: BT-402

Course Name: Oncology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Definition, terminologies of benign and malignant tumors, tumor cell growth, clonality and kinetics of tumor cell growth, host factors affecting tumor cell growth, *in vitro* tumor cell growth, karyotypic changes in tumors.

2. Metastasis:

Pathways and mechanisms of metastasis of some cancer cells.

3. Carcinogenic agents and their cellular interactions:

Chemical carcinogenesis-carcinogenic chemicals, mechanism of chemical carcinogenesis.

Radiation carcinogenesis - UV rays, ionizing radiation, mechanism of radiation carcinogenesis, viral carcinogenesis.

Oncogenesis - DNA and RNA oncogenic viruses, mechanism of viral oncogenesis.

4. Oncogenes and cancer:

Proto-oncogenes and their functions, oncogenes, activation of proto-oncogenes, tumor suppressor genes, control of cell cycle check points.

5. Host tumor interactions:

Effect of tumor on host, host defense against tumors.

6. Human cancer: Biochemical tests and laboratory diagnosis of cancer, treatment of cancer.

Books Recommended

1. Micael J. Pelezer, Jr. ECS, Chan & Noel R. Krieg : Microbiology Concept & Application
2. B.N. Fields, D. M. Knipe : Fundamental virology
3. Bruce Alberts, etal : Molecular biology of the cell
4. Geoffrey M. Cooper, Robert E.Hausman : The cell, A molecular approach.
5. Benjamin Lewin : Genes IX

Course: BT-403

Course Name: Industrial Biotechnology

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

Definition of industrial biotechnology, white, red and green biotechnology, importance of industrial biotechnology. Isolation and screening of industrially useful microorganisms, characteristics of an ideal industrial microorganism, techniques for isolation of microorganisms.

2. Bioreactors:

Basic concept of bioreactors, Instrumentation of a typical bioreactor, batch, ideal continuous flow stirred tank reactors (CSTR), packed bed, fluidised bed bioreactors, relationship between batch and continuous biological reactors, tubular and tower reactors, scale up of bioreactors, reactors sterilization process.

3. Bioprocessing and bioprospecting:

Media design for fermentation process, strategies for seed culture maintenance and build up for inoculation of large scale processes, process engineering and instrumentation, Definition of bioprospecting, general approach in bioprospecting.

4. Product Kinetics and Recovery Operation:

Product formation kinetics, effect of inhibitors and activators in batch and chemostat culture of growth linked and non-growth linked product formation. Mechanical separation of cells from fermentation broth, distribution of cells, extraction and other methods of product recovery.

5. Uses of Immobilized biocatalysts:

Applications of immobilized cells and enzymes to industrially important chemicals, food, pharmaceuticals, etc.

6. Uses of Biomass:

Definition and chemical composition of biomass, utilization of biomass for food, fuel and chemicals i.e., commercial production of fructose, silage fermentation, utilization of cellulose.

7. Recombinant Protein Production in Bacteria and Yeast:

Escherichia coli, *Bacillus subtilis*, *S. cerevisiae* expression systems.

Books recommended

1. Smith J. E. : Biotechnology
2. Glick B. R., Pasternak J. J. : Molecular Biotechnology.
3. Laskin : Enzymes and immobilized cells in Biotechnology.
4. Fogerty : Microbial enzymes and Biotechnology.
5. Bailay J. E. and Ollis D. F. : Biochemical Engineering Fundamentals.
6. Stansbury P. F, Whitaker, A. and Hall S. J.: Principles of Fermentation Technology.
7. S. J. Pirt: Principles of Microbes and Cell Cultivations.
8. T.D.Brock, Smaeur associates: Biotechnology: A text book of industrial microbiology
9. L.E.Casida, Willey Eastern Lad: Industrial Microbiology.
10. Prescott & Dunn: Industrial Microbiology
11. S.O.Enfors &L.Hagstrom: Bioprocess Technology-Fundamentals and application
12. E.J.Dasilva,C Ratledge and A. Sasson: Biotechnology, economic & social aspects.
13. Smith: Industrial Microbiology
14. W.Crueger and A.Crueger: Biotechnology-a hand book of industrial microbiology

1. Introduction:

Definition of environmental biotechnology, history of environmental biotechnology, environmental factors, principles of microbial ecology, terrestrial environments, aquatic environments, energy sources for ecosystem, productivity, adaptation, interaction between plants, animals and microorganisms.

2. Biodiversity:

Biological diversity-definition, terminology, diversities in plant kingdom, importance of Biological diversity, benefits and services provided by ecosystems, causes for the losses of biodiversity, convention on biological diversity (CBD), obligations under CBD, Biodiversity of Bangladesh, biodiversity conservation.

3. Environmental Pollution:

Origin of pollution, pollutants, air, soil and water pollution, pesticides and herbicides pollution, heavy metal pollution and, oil pollution, crude oil biodegradation.

4. Microbial community:

Structure, diversity and stability of microbial communities, measurement of microbial metabolisms, microbial interactions with some inorganic pollutants, microbial recovery of petroleum and fuel production.

5. Water and Waste treatment:

Liquid and solid waste treatment, waste water and sewage treatment, water treatment and testing, landfills technologies, composting, microbes and geological environment, environmental sustainability.

6. Bioremediation:

Bioremediation of materials: basic concepts; factors involved in bioremediation; Bioremediation of leather, wool and plastics; biodegradation of recalcitrant industrial wastes and its treatment, structure-recalcitrant relationship, factors affecting the microorganisms to degrade xenobiotics pollutant, biodegradation and metabolism of pesticide and aromatic compounds.

7. Microbial Control:

Microbial control of insect, pest, animal pastes, weeds and cyanobacterial blooms, genetic engineering in biological control.

8. Environmental laws and standards:**Books recommended**

1. Smith, John E : Biotechnology.
2. Atlas and Bartha : Microbial Ecology.
3. Scragg : Environmental Biotechnology.
4. Triedi, R. N. : Biotechnology and Environment.
5. Dara, S.S : A Text Book of Environmental Chemistry and Pollution Control

- 1. Techniques for isolation:** DNA isolation from bacteria and different biological systems (blood, soft tissue, semen, swabs, bones etc.), RNA isolation, protein isolation from liver, rat tail and bacteria.
- 2. Electrophoresis:**
Agarose, SDS-PAGE; pulse field gel electrophoresis.
- 3. Principles and methods of some techniques:** Gel filtration; ion-exchange and affinity chromatography; HPLC; colony hybridization, southern and northern hybridization, western blotting, *in situ* hybridization, combinatorial chemistry.
- 4. Labelling of Nucleic Acid and Probes:**
Radioactive and non-radioactive labeling techniques- nick translation, end labeling, primer extension, methods based on RNA polymerases; choice of label.
- 5. Analytical methods in biotechnology:** DNA microarrays / DNA chips; variable number of tandem repeats (VNTRs), short tandem repeats (STRs), DNA fingerprinting, hybridization and PCR based DNA fingerprinting, applications of fingerprinting in various fields (i.e., criminal detection, immigration, paternity testing, identification of missing / dead person, varietal identification of plants), reverse transcriptase PCR (RT-PCR), real time PCR, western blot.
- 6. Molecular diagnosis of diseases:**
Molecular diagnosis of some diseases caused by viral and bacterial species (TB, STD, HIV, Hepatitis, diarrhoea causing microbes etc). β -thalassemia mutation using ARMS-PCR; bone marrow engraftment- DNA analysis using HLA typing.

Books recommended

1. Williams and Fleming : Spectroscopic Methods in Organic Chemistry.
2. Walker : Techniques in Molecular Biology.
3. Hamilton and Swell : Introduction to HPLC.
4. Ausubel : Short protocols in Molecular Biology.
5. J. Sambrook and T. Maniatis : Molecular Cloning, A laboratory Manual.
6. R.W. Old: Principles of Gene Manipulation: An Introduction to Genetic Engineering.

1. Bioinformatics:

Definition of bioinformatics, development of bioinformatics, tools of bioinformatics, internet and biologists, gene bank sequence database, structure databases, sequence analysis using GCG. Information retrieval from biological databases, NCBI data model, 3D structural comparisons, predictions and modeling.

2. Applications of computer in biotechnology:

Demo of some PC based educational package in genetic engineering, presentation of results in text and graphic mode – harvard graphics/MS excel, analysis robustness of clusters using WINBOOT, labeling autorads and polaroid photographs using microsoft excel and presentation of nucleic acid sequences using power point, scanning of DNA, protein and isozyme profiles using computers and scanner.

3. Genomics:

Introduction, genetics to genomics, whole genomes sequencing, genome sequence acquisition and analysis, evolution and genomes, biomedical genome research- genomic sequences to make new vaccines, new types of antibiotics, new types of medications.

4. Genomic variations:

Variation in the human genome, known examples of SNPs that cause diseases, pharmacogenomics, ethical consequences of genomic variations.

5. Expression Data Analysis:

DNA/RNA microarrays, oligo microarray/chip technology, affymetrix protocol and data generation, spotted microarray technology, cDNA and oligo spotted arrays, biomedical applications; cancer and genomic microarrays, nanotechnology.

6. Proteomics:

Introduction, protein 3D structures, protein sequencing, protein identifications (2-hybrid system, 2-D gel electrophoresis, mass spectrometry/MALDI-TOF, other arrays), statistical models and stochastic processes in proteomics, signal processing for proteomics, protein interaction networks, measuring protein interactions, large-scale databases of information for protein sequences, structures, functions and interactions; mining of protein databases, applications to human disease studies.

7. Structural and functional genomics studies:

Plant genome: arabidopsis genome covering identification and characterization of genes controlling- flowering, vernalization, photoperiod, circadian clock.

Books recommended

1. Campbell & Heyer : Discovering Genomics, Proteomics, & Bioinformatics
2. Baxevanis & Ouellette, John Wiley & Sons: Bioinformatics, Methods of Biochemical Analysis Series Vol. 43,
3. Pevzner, P.A. :Computational Molecular Biology.
4. Andreas D. Baxevani & B. F. Francis Ouellette, John Wiley & Sons :Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.

Course: BT-407

Course Name: Cell signalling

Full Marks: 100

Unit: 1

Credit: 3.5

1. Introduction:

General principles of cell signaling; extracellular signal molecules and their receptors, cellular response to specific combinations of extracellular signal molecules, different response by different cells to same extracellular signal molecules, NO signaling by binding to an enzyme inside target cell, nuclear receptor, G-protein-linked and enzyme-linked receptors.

2. Signaling through G-protein-linked cell surface receptors:

cAMP and G-protein signaling, role of cAMP-dependent protein kinase (PKA) in mediating effects of cAMP, inositol phospholipids signaling pathway, role of Ca⁺/calmodulin –dependent kinases in mediating actions of Ca⁺.

3. Signaling through enzyme –linked cell surface receptors:

Receptor tyrosine kinases, docking sites for proteins, activation of ras, ras cycles between active and inactive states, signals from activated ras to a cascade of protein kinases including MAP-kinases, PI3-kinase/ protein kinase B signaling pathway, insulin receptor acts through PI3-kinase pathway, cytokine receptors and the JAK-STAT pathway, two components signaling pathway of bacterial chemotaxis.

4. Signaling pathways that depends on regulated proteolysis:

Activation of notch receptor by cleavage, binding of wnt proteins to frizzled receptors, stressful and proinflammatory stimuli act through NF_κB-dependent signaling pathway.

5. TGF α signaling receptors:

Activated type ITG α receptors phosphorylate Smad transcription factors, Smad signaling via negative feedback loop, TGF α signaling and abnormal cell proliferation.

Books recommended:

1. Glick, B.R. and Pasternak, J.J: Molecular biotechnology
2. J. Sambrook, E. F. Fritsch and T. Maniatis: Molecular cloning- A laboratory manual (Vol I, II, III).
3. Williams: Recombinant DNA.
4. Watson: Molecular biology of gene.
5. R. W. Old and S.B. Primrose, Principles of gene manipulation
6. Robert F. Muller, Ian D Young: Emery's elements of medical genetics.
7. Istavari Rasko and C. Stephen Downes: Genes in medicine.
8. Strachan, T. A. and Read A. P.: Human molecular genetics.
9. Alberts, Johnson: Molecular biology of the cell
10. Lodish, Berk, Matsudaira: Molecular cell biology

- 1. Introduction:** Biotechnology: Its role and future in food industry, Importance of microorganism in food Biotechnology.
- 2. Impact of Biotechnology on major food ingredients:** Physical/chemical changes and improvement of sweeteners, fats, carbohydrates, proteins, bulking agents. Mushroom production and its importance.
- 3. Biotechnology of milk and Dairy products:** Composition of food value of milk, Pasteurization of milk and methods of pasteurization, Starter culture, yogurt cultured, fermented foods.
- 4. Food spoilage and Food preservation.**
- 5. Transgenesis:** Concept of transgene and transgenics, production of transgenic mice, transgenic and transgenic cattle, application of transgenics. Problems after developing transgenic animals. Transgenic animals in agriculture and nutritional science, Transgenic mice for biomedical research. Animal cell culture: Concept, history, Cell culture, limitation and condition.
- 6. GM food risk for health, agriculture and environment:** Allergies, Antibiotic resistance. Alteration of nutritional value, Loss of biodiversity. Environmental and health impacts of GM crops.
- 7. Biosafety regulations to protect nature:** Growers and consumers interest and national interest.
- 8. Biosafety Guidelines of Bangladesh.**

Books recommended:

1. Modern Food Biotechnology, Human Health & Development: An Evidence Based Study. Food Safety Department, World Health Organization. 2005
2. King R D, Food technology, John will and Sons, USA.
3. Kosikowskim F, Cheese and fermented milk product, Comel University, Ithaka, NY.
4. M.M. Ranga. Animal Biotechnology, 2003 Agrobios (India)
5. James Jay, Food Microbiology.

1. Diabetes mellitus:

Type I, type II and other major clinical classes; genetic basis of type I DM; HLA-DQ, HLA-DR and MHC, pattern of inheritance in type II DM; MODY (Maturity onset diabetes mellitus in young); insulin gene; biosynthesis of insulin; mechanism of insulin action; complications of DM; diagnosis and treatment (brief treatment), *diabetes insipidus*

2. Cardiovascular diseases:

Dyslipidemia, atherosclerosis- molecular mechanism of atheromatous plaque formation, involvement of LDL & foam cells; ischemic heart disease; myocardial infarction (MI); biochemical markers for the diagnosis of MI; coronary heart disease (CAD), heart failure; hypertension, heart attack, stroke, disorders of lipoprotein metabolism.

3. Liver diseases:

hyperbilirubinemia, Dubin-Johnson syndrome, criglar-najjar syndrome, viral hepatitis- types of hepatitis virus and their genomic organization, acute hepatocellular carcinoma, chronic hepatocellular carcinoma, liver cirrhosis, liver function tests.

4. AIDS:

Definition, molecular and biological features of HIV; genomic organization; origin, mode of transmission; HIV and immune system; pathogenesis of AIDS, asymptomatic carriers- PGL, ARC – full blown AIDS; diagnostic test, anti-AIDS drugs; vaccine possibilities.

5. Renal disease:

6. Neurodegenerative diseases:

Neuropathological features and molecular mechanisms, therapeutic approaches in Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease, multiple sclerosis and prion diseases.\

7. Genetic basis of some metabolic disorders:

Phenylketonuria, alkaptonuria, maple syrup urine disease, nieman-pick disease, gaucher's disease, glycogen storage disease, gout.

Books recommended

1. John Macloed., Davidson's principles and Practice of Medicine
2. Gillham, B., Despo, K.P., Thomas, J.H., Will's Biochemical Basis of Medicine.
3. R.K.Murray: Harper's Biochemistry.
4. Devlin: Textbook of Biochemistry with clinical correlations.

PRACTICAL: Examination duration 12 hours

Marks distribution for practical course

Year end practical final examination :	80 marks
<u>Internal evaluation of each practical course</u>	
Laboratory performance/assignment/ oral test during laboratory hours :	05 marks
Laboratory attendance :	10 marks
Laboratory note book on experiment :	05 marks

Course: BT-410 Course Name: Lab in Fermentation technology

Full Marks: 100 Unit: 1 Credit: 3.5

- Exp.1: Isolation of antibiotic resistant organisms from hospital effluents and study of their characteristics.
- Exp.2: Isolation of lactose fermenting bacteria.
- Exp.3: Isolation of plasmid DNA from *E.coli*.
- Exp.4: Agarose gel electrophoresis for DNA.
- Exp.5: Separation of amino acid mixture by paper chromatography.
- Exp.6: Thin layer chromatographic separation of amino acids.
- Exp.7: Thin layer chromatography of fruit juices.
- Exp.8: Gel filtration chromatography for separation of known proteins.

Course: BT-411 Course Name: Lab in Animal and Plant Biotechnology

Full Marks: 100 Unit: 1 Credit: 3.5

- Exp.1: Determination of quantitative viable cells by serial dilution technique (spread plate & pour plate) and making of growth curve
- Exp.2: Detection of HBs Ag from patients' serum by serological methods
- Exp.3: Study of gene expression in *E.coli*
- Exp.4: DNA digestion by restriction enzymes
- Exp.5: Tuberculin test
- Exp.6: Agrobacterium mediated gene transformation

Course: BT-412 Field Work/Industrial Tour/Industrial Training

Full Marks: 100 Unit: 1 Credit: 3.0

Students will be sent for a short duration study tour in some specified industries and research organization in Bangladesh. A report shall be written by each student and the field work will be evaluated by the internal members of the examination committee on the basis of report, written test, oral presentation and the viva-voce on the report submitted by the students.

Course: BT-413 Course Name: Project Dissertation

Full Marks: 100 Unit: 1 Credit: 4.0

A short project dissertation will be submitted by each student under the supervision of a teacher who will suggest the topic of the project. The project will be evaluated by the internal members of the examination committee on the basis of report, oral presentation and the viva-voce on the project submitted by the students.

Course: BT-414 Viva-voce

Full Marks: 50 Unit: 1 Credit: 1.0