Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

FIRST SEMESTER

CORE COURSE (4+2 credits)		ABILITY ENHANCEMENT COMPULSORY(2 credits) [Any One (T+P)]		GENERIC ELECTIVE (4+2 credits) [Any One (T+P)]	
Paper Name	**Paper Code**	**Paper Name**	**Paper Code**	**Paper Name**	**Paper Code**
Biochemistry and Metabolism	CBT-101	English Communication	AECBT-101	Bio-mathematics I (Theory+Tutorial)	GEBT-101
Lab on Biochemistry and Metabolism	CBT-191				
Cell Biology -	CBT-102	Computer Fundamentals	AECBT-102	Plant and animal tissue culture (T)	GEBT-102
Lab on Cell Biology -	CBT-192			Lab On Plant and animal tissue culture(P)	GEBT-192
		Environmental Science	AECBT-103	Biotechnology and Human welfare(T)	GEBT-103
				Lab on Biotechnology and Human welfare (P)	GEBT-193

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SECOND SEMESTER

CORE COURSE		ABILITY ENHANCEMENT COMPULSORY [Any One (T+P)]		GENERIC ELECTIVE [Any One (T+P)]	
Paper Name	**Paper Code**	**Paper Name**	**Paper Code**	**Paper Name**	**Paper Code**
General Microbiology	CBT-201	Computer Fundamentals	AECBT-201	C Programming Language	GEBT-201
Lab on General Microbiology	CBT-291			C Programming Lab	GEBT-291
Chemistry-1	CBT-202	Environmental Science	AECBT-202	Inheritance biology	GEBT-202
Lab on Chemistry-1	CBT-292			Lab on Inheritance biology	GEBT-292
Plant and Mammalian Physiology	CBT-203			Biomathemtics II (Theory +Tutorial)	GEBT-203
Lab on Plant and Mammalian Physiology	CBT-293				

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THIRD SEMESTER

CORE COURSE		SKILL ENHANCEMENT COURSE [Any One (T+P)]		GENERIC ELECTIVE [Any One (T+P)]	
Paper Name	**Paper Code**	**Paper Name**	**Paper Code**	**Paper Name**	**Paper Code**
Genetics	CBT-301	Enzymology	SECBT-301	Biostatistics	GEBT-301
				Lab on Biostatistics	GEBT-391
Chemistry-II	CBT-302	Industrial fermentation	SECBT-302	Biological Diversity and Taxonomy	GEBT-302
Lab on Chemistry-II	CBT-392			Lab on Biological Diversity and Taxonomy	GEBT-392
Molecular Biology	CBT-303	Plant and animal chromosome preparation and karyotyping	SECBT-303	Data Structure & Numerical Analysis	GEBT-303
Lab on Molecular Biology	CBT393			Data Structure Lab	GEBT-393

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FOURTH SEMESTER

CORE COURSE(4+2 credits)		SKILL ENHANCEMENT COURSE (2 credits) [Any One (T+P)]		GENERIC ELECTIVE(4+2 credits) [Any One (T+P)]	
Paper Name	Paper Code	Paper Name	Paper Code	Paper Name	Paper Code
Immunology	CBT-401	Molecular Diagnostics	SECBT-401	Entrepreneurship Development	GEBT-401
Lab on Immunology	CBT-401	Biofertilzers	SECBT-402	Lab on Entrepreneurship Development	GEBT-491
Bio-analytical Tools	CBT402	Research Methodology	SECBT-403	Ecology and Environmental Management	GEBT-402
Lab on Bio-analytical Tools	CBT492	Basics of Forensic Science	SECBT-404	Lab on Ecology and Environmental Management	GEBT-492
				Introduction to DBMS, Computer networking and Numerical analysis	GEBT-403
				Lab on DBMS, Computer networking and Numerical analysis	GEBT-493

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FIFTH SEMESTER

CORE COURSE (4+2 credits)		DISCIPLINE SPECIFIC ELECTIVE (4+2credits) [Any One (T+P)from A group and one from B group]	
Paper Name	**Paper Code**	**Paper Name**	**Paper Code**
Bioprocess Technology	**CBT-501**	**Animal Biotechnology**	**DSEBT-501A**
Lab on Bioprocess Technology	**CBT -591**	**Lab on Animal Biotechnology**	**DSEBT -591A**
Recombinant DNA Technology	**CBT -502**	**Model organism and human genome project**	**DSEBT -502A**
Lab on Recombinant DNA Technology	**CBT -592**	**Lab on Model organism and human genome project**	**DSEBT 592 A**
		Medical biotechnology	**DSEBT -503A**
		Lab on Medical biotechnolog	**DSEBT -593A (Any one)**
		Plant Biotechnology	**DSEBT501B**
		Lab on Plant Biotechnology	**DSEBT591B**
		Plant secondary metabolites and Bio-transformation	**DSEBT -502B(Any one)**
		Lab on Plant secondary metabolites and Bio-transformation	**DSEBT -592B**

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SIXTH SEMESTER

CORE COURSE(4+2 credits)		DISCIPLINE SPECIFIC ELECTIVE(4+2 credits) [Any One (T+P) from A group]	
Paper Name	**Paper Code**	**Paper Name**	**Paper Code**
Genomics, Proteomics and Bioinformatics	CBT-601	Genetic Modification In agriculture and Medicine	DSEBT-601A
Lab on Genomics, proteomics and Bioinformatics	CBT -691	Lab on Genetic Modification In agriculture and Medicine	DSEBT-691A
IPR, Biosafety and ethical issues	CBT -602	Environmental Biotechnology	DSEBT-602A
Lab on IPR, Biosafety and ethical issues	CBT -692	Lab on Environmental Biotechnology	DSEBT-692A (Any one)
		Project/ Dissertation	DSEBT-601B

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

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(Applicable from the academic session 2018-2019)

First semester

CBT101 BIOCHEMISTRY AND METABOLISM **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To aquaint students with Concepts of Biochemistry and metabolism

Learning Outcome: To impart basic knowledge about the structure, function and metabolism of carbohydrate, lipid, amino acid, protein and nucleic acid

UNIT I: Introduction to Biochemistry: **(14 Periods)**

A historical prospective.

Carbohydrates:- Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of monosaccharides.

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

UNIT II **(14 Periods)**

Lipids: Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membrane, membrane protein – structural aspects, Lipoproteins (elementary idea).

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

UNIT-III **(8 Periods)**

Chemical & Enzymatic Kinetics - An introduction to enzyme; How enzyme works; Reaction rate; Thermodynamic definitions; Principles of catalytic power and specificity of enzymes; Enzyme kinetics – Approach to mechanism.

UNIT IV **(24 Periods)**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Lipid Metabolism – Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, Ketone bodies.

Amino acid Metabolism – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, seretonin, GABA, histamin, glutathione); biosynthesis of essential & non-essential amino acids.

Nucleotide Metabolism – biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine.

CBT191 (Practical) [Lab on Biochemistry and Metabolism]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Estimation of protein by Folin Lowry method	**(6 Periods)**
2. TLC separation of Amino acids /sugars	**(6 Periods)**
3. Determination of Iodine number of a fat	**(6 Periods)**
4. Estimation of RNA by Orcinol method	**(6 Periods)**
5. Estimation of DNA by diphenyl amine method	**(8 Periods)**
6. Qualitative tests for Carbohydrates, lipids and proteins	**(8 Periods)**
7. Testing of Blood Sugar	**(4 Periods)**
8. Testing of Liver Function Test (Bilirubin, SGOT, SGPT, Alkaline Phosphatase, Albumin, Globulin, Total Protein)	**(8 Periods)**
9. Testing of Renal Function Test (Urea, Uric acid, Creatine, Creatinine)	**(8 Periods)**

Learning Resources

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.

3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.

4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.

5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

CBT102 CELL BIOLOGY **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with basic Concepts of cell structure and function

Learning Outcome: To impart basic knowledge about the basic components of prokaryotic and eukaryotic cells, cell cycle and cell death

UNIT I **(16 Periods)**

Basics of Cell Biology (structure & function) – Discovery of cell and Cell Theory;

Comparison between plant and animal cells; cytosol, compartmentalization of eukaryotic cells, cell fractionation.

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; Cytoskeleton;

Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex;

UNIT II **(12 Periods)**

Membrane Vacuolar system, cytoskeleton and cell motility : Structure and function of microtubules, Microfilaments, Intermediate filaments.

Endoplasmic reticulum: Structure, function including role in protein segregation.

Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III **(12 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis

Nucleus: Structure and function, chromosomes and their structure.

UNIT IV **(20 Periods)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cell cycle - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer,

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

CBT192 (Practical))[Lab on Cell Biology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Preparation of Mitotic Chromosome from onion root tip.

3. Preparation of Meiotic Chromosome from *Rhoeo* discolor or onion sp.
4. Preparation and study of polytene chromosome from *Drosophila* salivary gland.
5. Study of sex chromatin through preparation of Barr body from buccal epithelium .
6. Study of chromosomal aberration induced by pesticide in onion root tips.
7. Study of plasmolysis and de-plasmolysis.

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Second Semester

CBT201 GENERAL MICROBIOLOGY **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with basics of microbiology

Learning Outcome: To impart basic knowledge about the classification and growth and maintenance of microorganisms as well as the basic concept of sterilization.

UNIT I **(8 Periods)**

Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi,

Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner and Flemming [Penicillin], Scope of Microbiology.

Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters for classification, General properties and principles of classification of microorganisms Systematics of bacteria, General properties of Archae and Eubacteria

UNIT II **(4 Periods)**

Staining: Concept of auxochrome, chromophore, dyes, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella and endospore staining

UNIT III **(8 Periods)**

Methods of isolation: Cultivation and Maintenance of microorganisms, Concept of Sterilization - Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation,

ultrasonication, filtration. Physical and Chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient of disinfectant, Chemotherapeutic agents

UNIT III **(12 Periods)**

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways

Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and

sporulation in bacteria.

UNIT IV **(10 Periods)**

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage

composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria.Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods (Yoghurt, cheese, Idli, Kinema).

CBT291 (Practical)[Lab on General Microbiology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Sampling and quantification of microorganisms in air, soil and water. **(6 Periods)**

2. Isolation of bacteria [Streak plate, spread plate, pour plate,serial dilution] **(6 Periods)**

3. Identification of microorganisms from the habitats [simple staining,differential staining, acid fast staining, capsule staining, spore staining and motility] **(6 Periods)**

4. Observation of morphology - shape and arrangement of cells. **(6 Periods)**

5. Methods of inoculation of different microbes in selective media. **(6 Periods)**

6. Microscopic measurements, micrometer (ocular and stage), **(6 periods)**

7. Enumeration of microorganism - total & viable count **(4periods)**

Learning Resources:-

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition.ohn and Sons, Inc.

2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.

3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.

4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.

5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.

6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.

8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

CBT202Chemistry I **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with basics of chemistry

Learning Outcome: To impart basic knowledge about atomic structure, chemical bonding organic , inorganic and other related concepts.

Atomic Structure, radioactivity and Nuclear Structure of Atoms: [15 lectures]
Bohr,s atomic model & limitation. Idea of de Broglie matter weaves. Hisenberg's uncertaintyprinciple. Schrodinger's wave equation. Significance of wave function. Quantum numbers. Multielectron system-Pauli's exclusion principal, Hunds rules of maximum multiplicity. Stability of half filled and full field orbitals, Afbau principal & its limitation. Electronic configuration of atoms.

Radioactive disintegration series, group displacement law, law of radioactive decay, half-life and average life of radio elements, radioactive equilibrium, measurement of radioactivity. Stability of atomic nucleus, n/p ratio. Radioisotopes and their application: Determination of age of earth, radio carbon dating, Medicinal and agriculture use of isotopes, hazards of radio activity.

Chemical Bonding and Structure: [6 lectures]

(a) Ionic Bonding:

General characteristics of ionic compounds: ionization energy, electron affinity etc. Sizes of ions, radius ratio rule and its limitation. Lattice energy, Born-Haber cycle.

(b) Covalent Bonding:

General characteristics of covalent compounds, valence bond approach, directional character of covalent bond, hybridization involving s-, p- and d- orbitals. Valence State Electron Pair Repulsion (VSEPR) concept, shapes of simple molecules and ions. Fajan's Rules. Hydrogen bonding and its effect on physical and chemical properties. Others types of molecular interaction.

Acids-Bases and Solvents: [5 lectures]

Modern concepts of acids and bases: Arrhenius theory, theory of solvent syst em, Bronsted and Lowry's concept, Lewis concept with typical examples, applications and limitations. Strengths of acids and bases (elementary idea). Ionization of weak acids and bases in aqueous solution, ionization constants, ionic product of water, pH scale

Nomenclature and Bonding in organic compounds : [5 lectures]

Classification, trivial names and IUPAC system of nomenclature of organic compounds. Nature of covalent bond and its orbital representation. Hybridization, bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance.

Haemolytic & heterolytic fission of bonds electrophiles & nucleophiles, carbocation, carbanions and radicals- there stability, geometry & generation.

Alkanes, Alkenes, Alkynes: [5 lectures]

Isomerism, synthesis , chemical reactivity of alkanes, Mechanism of free radical halogenation of alkanes, sulphonation of alkanes. Chemical reactivity, hydrogenation, heat of hydrogenation and stability of alkanes, electrophilic addition reaction & mechanism, halogenation, hydrohalogenation, hydration, hydroboration, Markownikoffs rule, peroxide effect, 1-3 dipolar addition (only formation no details mechanism is required). Alkyne synthesis hydration, substitution reactions, polymerization.

Mechanism of SN1 & SN2 reaction, E1&E2 reaction (elementary treatment) of aliphatic hydrocarbon. Saytzeff& Hofmann elimination.

Aromatics Hydrocarbons and Aromatic substitution reactions : **[5 lectures]**

Isomerism of aromatic compounds, their nomenclature, structure of benzene ring. General mechanism of aromatic electrophilic substitution (elementary treatment)

Methods of synthesis, nitration, Sulphonation, halogenation.

Friedel-crafts alkylation and acylation, reaction, nuclear and side chain halogination.

Mechanism of Nucleophilic and electrophilic aromatic substitution.

Stereochemistry: **[5 lectures]**

Dissymmetric Molecules: Different types of Isomerism,Structural Isomers, Geometrical, Stereoisomerism, Configurational Isomers, Conformational Isomers, Concept of asymmetric carbon atom, Enantiomers, Diastereiosmers, Stereogenic atom / center, Chirotopic / Achirotopic Centre, Protereoisomerism, Concept of Topicity of Ligands and Faces (Homotopic, Enantiotopic, Diastereotopic atoms and groups; Prochiral, Homotopic, Enantiotopic, Diastereotopic Faces), Projection Structures of Streoisomers (Fischer, Sawhorse, Newman, Flying-Wedge projection and Interconversion of these projections formulas) of simple molecules containing one or two asymmetric carbon atom, Optical isomerism, Optical activity, Element of symmetry and chirality,Meso compounds, Chiral centers and the number of stereoisomers, Racemic modifications,Racemic mixture or (+/-)-Conglomerate, Racemic Compounds or racenate, Stereochemical nomenclature of Stereoisomers containing chiral centers(R/S and E/Z or cis-trans or sec cis- sec trans of C=C system);D,L system of designation; Pro-R, Pro-S, Re, Si, Erythro, threo, Pref and Praf designation of enantiotopic groups and atoms; Chirality of Organic molecules without chiral center and concept of chiral axis.

Alcohols, Ethers and phenols: **:** **[5 lectures]**

Methods of synthesis, physical properties, distinction of primary, secondary and tertiary alcohols. Chemical reactivity. Ethers, methods of synthesis, Chemical reactivity. physical

properties acidic character of phenols, chemical reaction –Reimer-Tiemann reaction, Fries rearrangement, Kolbe's reaction, phenol formaldehyde resins (Lederer-Manasse reaction) Cresols, nitro and amino phenols.(Synthesis only).

Aldehydes and ketones: : **[5 lectures]**

Methods of synthesis of aldehydes and ketones, chemical reactivity of carbonyl group, cannizzaro reaction and aldol condensation, relative reactivities of aldehyde and ketones. Perking reaction, benzoine condensation, Claisen condensation.

Carboxylic acid and their derivatives: **[4 lectures]**

Methodes of synthesis, acidity of aliphatic and aromatic acid, effects of substitutents on acidity (simple cases). Chemicalreactivity. Mechanism of esterification. Methods of synthesis and reaction of acid halides, amides, esters and anhydrides.

CBT292: (Practical)[Lab on Chemistry]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Qualitative organic analysis: **[20 lectures]**
Detection of elements (N,S,Cl,Br,I), unsaturation & all the functional groups (alcoholic & phenolic hydroxyl/ aldehydic & ketonic carbonyl / carboxylic acid & aromatic amino, anilide and nitro) present in a supplied mono- or bi- functional organic compounds.

2. Gravimetric Analysis : **[20 lectures]**

Techniques of Precipitations, filtration, washing, drying, igniting and weighing precipitates.Gravimatric estimation of any ion. Determination of hardness water. Estimation of glucose & phenol. sulphaides, sulphites, sulphates, nitrites, nitrates, nitrites, & phosphates, (Acid insoluble compounds & phosphate separation omitted).

Learning Resources:-

1. Inorganic Chemistry by R. L. Dutta

2. Organic Chemistry by I. L. Finer (Vol. I)

3. Advanced practical chemistry, 3rd edition by Subhas C Das

4. An advanced course in practical chemistry by Ghoshal, Mahapatra and Nad.

CBT203 PLANT AND MAMMALIAN PHYSIOLOGY **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with Concepts of basic physiology of plant and mammalian systems.

Learning Outcome: To impart knowledge about the basic physiological mechanisms of both plants and mammalian systems as well as overview of growth and development.

UNIT IA: Digestion and Respiration **(6 Periods)**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.

UNIT IB: **(6 Periods)**

Simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

UNIT IIA:) Circulation (6Periods)

Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of

coagulation of blood.Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT IIB:-Plant water relations and micro & macro nutrients (6Periods)

Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles anddeficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

UNIT IIIA: Muscle physiology and osmoregulation (5 Periods)

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical

events of mechanism of muscle contraction.

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation

UNIT IIIB:- Carbon and nitrogen metabolism (5Periods)

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT IVA: Nervous and endocrine coordination (5 Periods)

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitter Mechanism of action of hormones (insulin and steroids)Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

UNIT IVB: Growth and development (5 Periods)

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization

CBT293 (Practical)[Lab on Plant and mammalian Physiology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Finding the coagulation time of blood

2. Determination of blood groups

3. Counting of mammalian RBCs

4. Determination of Haemoglobin

5. Preparation of stained mounts of anatomy of monocot and dicot root and stem.

6. Separation of photosynthetic pigments by paper chromatography.

7. Demonstration of aerobic respiration and photosynthesis

LEARNING RESOURCES

1.Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

3. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.

4. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.

5. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.

6. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.

7. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.

8. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.

9. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.

10. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4thedition, Sinauer Associates Inc .MA, USA

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

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(Applicable from the academic session 2018-2019)

Third Semester

CBT301 Genetics **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with Basic Concepts of Pro- and Eukaryotic Genetics.

Learning Outcome: To impart basic knowledge about Prokaryotic Genomes, Mechanism of genetic exchange, Transcriptional regulation in prokaryotes, Genome organization and Fine structure of the Gene, Unique genetic features of plants, Genes controlling flower development in Plants, Genome Organization and Function, Cis-acting elements and Trans-acting factors, Chromosomal variation in Number & Structure, Human Cyto-Genetics

UNIT I

Prokaryotic Genomes - Physical organization of bacterial genomes (Structure of the bacterial nucleoid, Replication and partitioning of the bacterial genome and Genome of Archaea). **(3 periods)**

Mechanism of genetic exchange: Plasmid and bacterial sex, Types of plasmids (F Plasmid : a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes.. **(5 periods)**

Transcriptional regulation in prokaryotes (inducible and repressible system, positive regulation and negative regulation); Operon concept – lac, trp, Ara operons.

Transduction (Generalized transduction, Specialized Transduction)- gene mapping.

(5 periods)

UNIT II

Genome organisation and Fine structure of the Gene :

Genes and Gene numbers, C value paradox, Denaturation and Renaturation of DNA- Tm values and Cot curves, Repetitive and non-repetitive DNA, Inverted and Tandem repeats, Satellite DNA, Gene clusters-Histone, rRNA **(6 periods)**

Eukaryotic Chromosome- Macro-molecular organization. Primary and Secondary constriction, Sat-bodies, telomeres. Heterochromatin and Euchromatin and its significance. Ultra structure of chromosome- Nucleosome model and Nucleosome Structure. **(7 periods)**

UNIT III

Unique genetic features of plants - Ability to photosynthesize, Totipotency of plant cells, Hermaphroditism and ability to reproduce both sexually and asexually, Double fertilization, Alternation of generations, Mitosis in haploid state. **(5 Periods)**

Genes controlling flower development in Plants – genes responsible for steps of flower development, genes for floral organ identity, MADS-Box genes, molecular expression of floral organ genes and floral commitment genes. **(5 Periods)**

Genome Organization and Function - Analysis of Genomes by Re-association Experiments, , Organization of Single-copy Sequences, Chloroplast Genome Organization, Mitochondrial Genome Organization, RNA editing. **(6 Periods)**

Cis-acting elements and Trans-acting factors – Regulatory sequences that control gene expression, Enhancer and Silencer elements, role of 3' sequences, role of introns, conserved sequences in Eukaryotic promoters, Cis-acting elements, Trans-acting factors, Transposon tagging of Plant genes – Mc Clintock and the Ac-Ds transposable elements of Corn, **(6 periods)**

UNIT IV

Chromosomal variation in Number & Structure– Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants and animal, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, structural chromosomal variation, Chromosomal aberrations & evolution. **(6 periods)**

Human Cyto-Genetics– Human karyotype, Banding techniques, classification, use of Human Cyto-genetics in Medical science, , viable monosomies & trisomies, chromosomal deletions & duplications, genetics of chromosomal inversions & translocations, human traits, **(6 periods)**

Maulana Abul Kalam Azad University of Technology, West Bengal

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

CBT391: (Practical)[Lab on Genetics]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Permanent and temporary mount of mitosis.

2. Permanent and temporary mount of meiosis.

3. Problems based on Reassociation Kinetics

4. Karyotyping with the help of photographs

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Learning Resources

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.

2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition.

Benjamin Cummings.

4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.4. Theory and problems in Genetics by Stansfield

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

CBT302: Chemistry II

Full marks 75

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with basics knoeledges of chemistryy

Learning Outcome: To impart basic knowledge about the chemical analysis, interhalogen and Organometallic Compounds and thermodynamics.

Chemical analysis : **[6 lectures]**

i) Comparative study of the following groups of elements:
(a) B, Al (b) C, Si, Ge, Sn, Pb (c) N, P, As, Sb, Bi, (d) O, S, Se, Te (e) F,Cl, Br,I
In respect of electronic configuration, elemental states, oxidation states, hydrides, halides, oxides, and oxyacides.

Double & complex salt: **[4 lectures]**

Werner's theory of co-ordination compounds. Chelates. Polydentate ligands including naturally occurring ones. Electronic interpretation of compounds formation. Stepwise and overall stability constants. (elementary idea only) Geometrical & optical isomerism. Nomenclature of coordination compounds.

Interhalogen compounds: **[3 lectures]**

Basic properties of iodine, pseudo halogens.

Organometallic Compounds: **[4 lectures]**

Organomagnesium Compounds, Organozinc Compounds, Organolead Compounds, Organocadmium Compounds.

Bio-inorganic chemistry **[6 lectures]**

Role of metal complexes in biological system : Role of Iron and Magnesium

Ideal and real Gases : **[6 lectures]**

Distribution of molecular velocities, root-mean-square velocity, kinetic molecular theory of ideal gases, deduction of kinetic gas equation. $P=\frac{1}{3}mnc^2$, deduction of gases laws. Deviations of real gas from ideal behavior, vander waal's equation. Andrews exprement, critical phenomena in light of vander waal's equation of state, law of corresponding state.

Thermodynamics and Homogeneous chemical equilibrium: **[15 lectures]**

Cyclic process, Reversible & irreversible process , internal energy, enthalpy, work

Done, an isothermal & adiabatic process, heat capacities, Cp-Cv =R for an ideal gas. Thermochemistry, Carnot cycle, Elementary treatment of entropy, free entry, work function & criterion of equilibrium. Gibbs Helmohltz equation, Clasious Clapeyron equation and its application. Law of mass action and equilibrium constant Kp,Kc,Kx and their relationship.

Le-chatelier's principal- effect of temperature, pressure and addition of products and inert gases. vant's hoff equation (derivation not required) and its application.

Solubility and Ionic Equilibrium: **[5 lectures]**

Solubility product, common ion effect and factors of solubility. Strong and weak electrolytes degree of dissociation. Ostwald's dilution law. Hydrolysis, buffer, calculation of pH, salt effect, elementary idea of activity & activity co-efficient of electrolytes, ionic strength, buffer reaction of blood.

EMF : **[6 lectures]**

Electrochemical cells, half-cell, electrode potential, standard electrode potential, Nernst equation, redox potential, reference electrode,standered cell, measurement of emf, determination of pH, potentiometric titration, storage battery, corrosion.

Dilute solution: **[5 lectures]**

Rault's law, ideal solution, non- ideal solution, and qualitative treatment of colligative properties relative lowering of vapour pressure, elevation of boiling point, and osmotic pressure-their application in finding molecular weight. Van't Hoff 'i' factor, plasmolysis, haemolysis, isotonic solution, normal saline, role of osmosis in living organism.

Reference books:

1. Inorganic Chemistry by R. L. Dutta

2. Organic Chemistry by I. L. Finer (vol. I)

3. Physical chemistry by P. C. Rakshit

CBT 392: (Practical)[lab On Chemistry]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Quantitative inorganic analysis
2. Preparation and standardization Mohr's solution by KMnO4 solution.

3. Preparation of standard K2Cr2O7 solution and standardization
4. Mohr's Salt solution.
5. Sodium thiosulphate solution.
6. Estimation of Fe(II) +Fe (III) mixture using standard solution of K2Cr2O7
7. Determination of Cu (II) using standard sodium thiosulphate solution

CBT303: Molecular Biology **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with the concepts of molecular biology

Learning Outcome: To impart basic knowledge about DNA structure, replication, Transcription and DNA damage and repair as well as regulation and gene expression

UNIT I:

DNA structure and replication (10 periods)

DNA as genetic material, structure of DNA, Types of DNA, Replication of DNA in prokaryotes and Eukaryotes**,** Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II:

DNA damage, repair, nonhomologous and homologous recombination (12 periods)

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair:

Photo-reactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination:models and mechanism.

UNIT III:

Transcription and RNA processing (10 Periods)

RNA structure and types of RNA, Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters,enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV:

Regulation of gene expression and translation (12 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and system), Genetic code and its characteristics, Prokaryotic and eukaryotic eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins.

UNIT V:

How to clone a gene- (16 Periods)

What is clone, overview of the procedure, Gene library, hybridization

Cutting and Joining DNA- Restriction Endonucleases, Ligation, Alkaline phosphate, Modification of Restriction fragment ends, Other ways of joining DNA molecules.

Plasmid vectors, Vectors based on the lambda bacteriophage, cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors- YACs and BACs

CBT 393(Practical)[lab On Molecular Biology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Preparation of buffers and solutions for molecular biology experiments
2. DNA isolation from Cabbage leaves/ goat liver/Human blood and Microbes
3. Plasmid DNA isolation
4. Agarose gel Electrophoresis of genomic DNA and plasmid DNA
5. Preparation of restriction digestion of DNA samples
6. Gel Documentation and photography

Learning Resources

1. Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition,Pearson Benjamin Cummings Publishing, San Francisco

3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia

4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning

7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Fourth Semester

CBT401: IMMUNOLOGY **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

Course Objective: To acquaint students with basic concepts of immunology

Learning Outcome: To impart basic knowledge and history of the concepts of immunity, immunological techniques and different aspects.

Unit I

Introduction **(5 Periods)**

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa

Unit II

Immune Cells and Organs **(6 Periods)**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell,

Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

Unit III

Antigens **(5 Periods)**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit IV

Antibodies **(6 Periods)**

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies

Unit V

Major Histocompatibility Complex **(6 Periods)**

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit VI

Complement System **(8 Periods)**

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation

Unit VII

Generation of Immune Response **(6 Periods)**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance

Unit VIII

Immunological Disorders and Tumor Immunity **(6 Periods)**

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens and cancer.

Unit IX

Immunological Techniques **(6 Periods)**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA,

ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

Unit X

Vaccines & Vaccination **(6 Periods)**

adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles of vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs.

CBT491(Practical)[Lab on Immunology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Identification of human blood groups.

2. Perform Total Leukocyte Count of the given blood sample.

3. Perform Differential Leukocyte Count of the given blood sample.

4. Separate serum from the blood sample (demonstration).

5. Perform immunodiffusion by Ouchterlony method.

6. Immunoelectrophoresis

7. Antigen- antibody reaction (Coomb's test)

8. ELISA.

9.antibody and antigen(Ouchterlony method)

10. ELISA.

Learning Resources

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.

2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

CBT402: BIO-ANALYTICAL TOOLS **Full marks 75**

Credit 4 (3+1)

Lecture Period 60 L

Course Objective: To acquaint students with different essential bio-analytical tools

Learning Outcome: To impart basic knowledge about the bio-analytical tools and principles of centrifugation , microscopy, spectroscopy , chromatography and other different tools.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

UNIT I **(8 Periods)**

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter

UNIT II **(10 Periods)**

Absorption Spectroscopy – Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a Chromophore. Principle of absorption fluorimetry,

Unit III **(8 Periods)**

Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation, Standard Sedimentation Coefficient, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation. Cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT IV **(10 Periods)**

Introduction to the principle of chromatography. Paper chromatography, thin layer

chromatography, column chromatography: silica and gel filtration, affinity and ion exchange

chromatography, gas chromatography, HPLC. Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting.

Unit V **(8 periods)**

Mass spectrometry(MALDI, ESI) and Introduction to Biosensors and Nanotechnology and their applications. Radioactive labeling & counting, Autoradiography.

Unit VI **(8 periods)**

X-Ray Crystallography – X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure [concept of rotating crystal method, powder method].

Unit VII **(8 periods)**

NMR Spectroscopy – Basic principle of NMR spectroscopy, Experimental technique & instrumentation, Chemical shift, hyperfine splitting, Relaxation process.

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CBT 492 (Practical)[lab on Bio-Analytical Tools]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Microscopy-light microscopy: principles, , parts and function, operation
2. Principles and operations of incubators, centrifuge
3. Principles and operations of pH meter and colorimeter
4. . Determination pH of unknown solution
5. Native gel electrophoresis of proteins
1. Separation of sample mixture by column chromatography
2. Principles and operations of spectrophotometer
3. To identify lipids in a given sample by TLC.
4. Separation of amino acids by paper chromatography
5. Preparation of the sub-cellular fractions of liver cells.

Learning Resources:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM, Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009

5. The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Fifth Semester

CBT501: Bioprocess Technology **Full marks 75**

Credit 4 (3+1)

Lecture Period 60 L

Course Objective: To acquaint students with basics of Bioprocess Technology

Learning Outcome: To impart the knowledge about the range and basic principle components of fermentation and bio-processing technology, designs of bioprocess vessels and different essential factors.

UNIT I **(10 Periods)**

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II **(20 Periods)**

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

UNIT III **(15 Periods)**

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting

KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV **(15 Periods)**

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

CBT 591Lab on Bioprocess technology

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40 L

1. Bacterial growth curve.

2. Calculation of thermal death point (TDP) of a microbial sample.

3. Production and analysis of ethanol.

4. Production and analysis of amylase.

5. Production and analysis of lactic acid.

Suggested Reading

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

CBT 502 Recombinant DNA Technology **Full marks 75**

Credit 4 (3+1)

Lecture Period 60 L

Course Objective: To acquaint students with basics of Recombinant DNA Technology

Learning Outcome: To impart the knowledge about different molecular tools and application ,mutagenesis, genetic engineering in animals and plants

UNIT I **(15 Periods)**

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline

phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection ,Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR),primer-design, and RT- (Reverse transcription) PCR.

UNIT II **(20 Periods)**

Restriction and modification system, restriction mapping. Southern and Northern hybridization.Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering,

Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III **(10 Periods)**

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT IV **(15 Periods)**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

CBT 592: (Practical)[Lab on Recombinant DNA Technology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

Learning resources:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.

2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution.

Elsevier Academic Press, USA.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington

4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.

5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Sixth Semester

CBT601: Genomics, Proteomics and Bioinformatics **Full marks 75**

Credit 4 (3+1)

Lecture Period60 L

Course Objective: To acquaint students with the concepts of Genomics, Proteomics and bioinformatics

Learning Outcome: To impart the knowledge about genomics, managing and distributing genome data, introduction to proteomics and Bioinformatics, Data Generation , Data Retrieval, Sequence Alignment and Pattern recognition

Unit I. Introduction to Genomics: **[7 Lectures]**

Information flow in biology, DNA sequencing methods– manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

Unit II. Managing and Distributing Genome Data: **[5 lectures]**

Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome, GenBank, EMBL. Concept of INSDC, Selected Model Organisms' Genomes and Databases.

Unit III: Single Nucleotide Polymorphisms: **[5 Lectures]**

Genome variation; Single nucleotide polymorphism idea of Missense,Synonymous, Frameshift SNPs, SNP profiling, Disease and SNPs. Basic idea of DNA microarray and SNP array.

Unit IV: Structure and properties of proteins **(5 Lectures)**

Introduction to protein structure, Chemical properties of proteins, Physical interactions that determine the property of proteins. Determination of sizes (Sedimentation analysis, gel filtration, Native PAGE, SDS-PAGE); Determination of covalent structures of proteins

Unit V: Introduction to Proteomics (5 lectures)

Fundamental goals of proteomics, Analysis of proteomes. 2D-PAGE (Sample preparation,solubilization, reduction, resolution. Reproducibility of 2D-PAGE). Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

Unit VI: Protein databases and networks: (10 lectures)

protein sequence and structural data, protein information resources and secondary data bases, protein data bank. Introduction to preliminary analysis of the transcriptome, Proteomics-Expression analysis & Characterization of proteins, Protein microarray, Metabolomics & global biochemical networks.

Unit VII: Introduction to Bioinformatics (5 Lectures)

History of Bioinformatics. Importance of Bioinformatics in the field of biology and healthcare,

Goal and Scope of bioinformatics. Central Dogma and bioinformatics.

Unit VIII: Data Generation and Data Retrieval (4 Lectures)

Sequence submission tools (BankIt, Sequin); Sequence filenformat (flat file, FASTA, Genbank, Genpept, EMBL, Swiss-Prot); D ata retrieval systems (NCBI Entrez).

Unit IX: Sequence Alignment and Pattern recognition (14 Lectures)

Sequence similarity searching; Methods of Alignment (Dot matrix,Dynamic Programming, BLAST and FASTA algorithm); Local and global alignment, pairwise and multiple sequence alignments (without algorithm); Concept of identity and homology of sequences. Scoring Matrices (PAM, BLOSUM).

Reference Books:

1.Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition.Wiley-Blackwell.

3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

4. David W Mount Bioinformatics: Sequence and Genome analysis Cold Spring Harbor Laboratory Press.

5. Fundamentals of Biochemistry by Voet, Voet and Pratt.

CBT691: (Practical)[Lab on Genomics, Proteomics and Bioinformatics]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. **Internet basics in hand (I**ntroduction to computer hardware and software, Concept of intranet and internet. LAN, MAN and WAN, IP address, MAC address. Internet Browsers and search engine.)
2. **Introduction to NCBI**
   Database Handling of NCBI; PubMed, Nucleotide, Protein, Gene, SNP, EST, OMIM.
   Tools of NCBI;Genome Browser, performing various kinds of blast.
3. **Multiple Sequence alignment tool;** Clustal W2
4. USING PIR,
5. **Handling Structural data;** PDB
6. **Visualization of structures;** using Rasmol.

CBT602 : IPR, Biosafety and ethical issues

Full marks 75

Credit 4 (3+1)

Lecture Period 60 L

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Course Objective: To acquaint students with the concepts of Intellectual property rights, Biosafety and ethical issues

Learning Outcome: To introduce basic concepts of ethics and safety that are essential for various branches of science involving technical procedures and protection of intellectual property and related rights.

Introduction to Intellectual property Rights- Concept of IPR, different forms of IPR **(10 periods)**

Classification of patents, Special patents, Patenting biological products, Patentale and non patentable inventions in India, grant of patents, Grant process and requirements,

(16 Periods)

Introduction and Overview of Biosafety, Categories and Cartagena protocol .Good laboratory biosafety practices **(8 periods)**

Genetic technologies – an overview of Genetic screening for any predisposition symptoms, Cancer screening, Cloning, Gene therapy, DNA fingerprinting,(Paternity and Forensics) in vitro fertilization, surrogate motherhood, PGD, transgenic organisms, xenotransplantation, GMOs. **(12 Periods)**

Ethical issues – ethical issues against the molecular technologies. **(6Periods)**

Bioethics – Necessity of Bioethics, Scope of bioethics, different paradigms of Bioethics – National & International. **(8 Periods)**

CBT692: (Practical)[Lab on IPR, Bio-safety and ethical issues]

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40L

1. Proxy filing of Indian Product/ Process patent
2. Seminar presentation on Bio-safety
3. Seminar presentation on Bio-ethics
4. Assignments

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

ABILITY ENHANCEMENT COURSE

AECBT101 English Communication

Total Marks-50

Credit-2

Lecture Hour-40L+Practicals 20L

1. Communication and communicative activities of the notions of encoder and decoder and the message and the medium **5Periods**
2. Concise grammatical structures and key vocabulary for general as well as specific purpose accuracy and appropriateness in the use of English. **6 Periods**
3. English speech sounds and sound combinations. **4 Periods**
4. Elements of Spoken English. **4 Periods**
5. Topic of discourse, mode of discourse and style of discourse with special reference to scientific discourse. **4 Periods**
6. Writing notes, reports, proceedings etc. **4 Periods**
7. Expanding and summarizing. **3 Periods**
8. Narrating and describing. **5 Periods**
9. Tutorial for each topic. **5 Periods**

Practical

Practical on all language activities and communicative tasks- group discussion, seminar

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Curriculum Structure

(Applicable from the academic session 2018-2019)

AECBT102 - COMPUTER FUNDAMENTALS **Total Marks-50**

Credit-2

Lecture Hour- 40L

UNIT 1: Basic concept of Computer System 4L

Introduction, Characteristics of Computer, Components of Computer, Basic organization of Computer System (I/P, O/P, Memory & CPU units).

Generation of Computer: 1st to 4th generations with characteristics.

UNIT 2: Operating System

Introduction 2L

What operation systems do? Operations of OS. Evolution of OS – Batch processing, Multiprogramming, Time sharing, Distributed.

Process Management 12L

Process concept, Process States, Process control block (PCB)

Process scheduling: Schedulers (long-term, short-term and medium-term), Context switching, scheduling criteria, scheduling algorithms (FCFS, SJF, Priority, RR), Multilevel Queue scheduling and Multilevel Feedback Queue scheduling.

Threads: Concept, Models, Multi-threading example (word processor).

Process Synchronization: Cooperating process, Critical-Section problem and solution, Semaphores (Binary & counting).

Deadlocks: Concept, Resource Allocation Graph, Necessary conditions for Deadlock, Handling deadlocks: Deadlock prevention and avoidance. Concept of Banker's algorithm with example, Deadlock recovery.

File Management 4L

File concepts: File attributes, File types, File operations and File structure. File accessing methods (sequential and direct). File directories type (single-level, two-level and tree-level).

File mounting and file sharing. Implementation of Directory (Linear list and Hash list). File Allocation methods (contagious, linked and index).

UNIT 3: Digital Logic 12L

Number System: Positional & Non-Positional, Representation of positional number system, Classification of positional number system (Decimal, Binary, Octal, Hexadecimal).

Inter-conversion: among known and unknown bases.

Digital Logic: addition, subtraction, multiplication, division, r's complement & (r-1)'s complement.

Boolean Algebra & Logic Gates

Basic laws and postulates, Huntington postulates, Duality.

Logic Gates: AND, OR, NOT, NAND, NOR, XOR & XNOR with truth table.

Boolean Functions: Representation (Boolean expression, Truth Table & Circuit Diagram), Canonical Form (SOP, POS), Conversion between canonical forms.

UNIT 4: Basic Computing Lab

Basic Operating System Commands 3L

- Listing directory contents, creating directory, changing directory.
- Creating file, copying & moving files, renaming & removing files.
- Date & time commands.
- Pipe & batch command concepts.

Familiar with OS interface 1L

- Customising desktop, arranging files & directories etc.

Office applications 2L

- Word Processor Application
- Spreadsheet Application
- Presentation Application

Reference Books:

- Computer Fundamentals – by Pradeep K Sinha, Priti Sinha
- Operating System Concepts – by Abraham Silberschatz, Peter B. Galvin, Gerg Gange
- Operating System – by P. Bala Krishna Prasad
- Digital Design - by M. Morris R. Mano (Author), Michael D. Ciletti (Author)
- Digital Logic and Computer Design – by M. Morris Mano

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

AECBT103: Environmental Science

Total Marks-50

Credit-2

Lecture Hour-
50L+Tutorials 10L

UNIT I **(15 Periods)**

Introduction to environmental studies & ecosystems: Multidisciplinary nature of environmental studies: Scope and importance; what is an ecosystem? The structure and function of ecosystem, Energy flow in an ecosystem, food chains, food webs and ecological succession, forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems; Levels of biological diversity such as genetic, species and ecosystem diversity; biogeography zones of India, biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation, endangered and endemic species of India, threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions, conservation of biodiversity, *in-situ* and *ex-situ* conservation of biodiversity, concept of sustainability and sustainable development.

UNIT II **(18 Periods)**

Natural resources & its management and conservation: Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: Renewable and non renewable energy sources, use of alternate energy sources and growing energy needs.

UNIT III **(11 Periods)**

Environmental pollution & management: Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Solid waste management: Control measures of

urban and industrial waste. Climate change, global warming, ozone layer depletion, acid rain and their impact on human communities and agriculture. Environment Laws: Environment Protection

Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and control of pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD); Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

UNIT IV **(6 Periods)**

Environment & social issues: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; environmental communication and public awareness.

Learning resources

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.

2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of

California Press.

3. Gleeson, B. and Low, N . (eds.) 1999. *Global Ethics and Environment*, London, Routledge.

4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev.,

Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of*

Conservation Biology. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,*339: 36-37.

7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.

8. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

9. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.

10. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.

11. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.

12. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.

13. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and*

14. *C*S*th*o*o*e*d*n *T*h*sre*i,*or vp*N*ai*.*ct*S*iso*.., *n* JG.o Shibn. s CWohnai,l neLdy. P&&u bSRloiasnvhsei. nn g, ,P N.Hew. (Dedesl)h.i .2 013. *Conservation Biology*: *Voices from*

15. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.

16. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Second semester

AECBT201 - COMPUTER FUNDAMENTALS **Total Marks-50**

Credit-2

Lecture Hour- 40L

UNIT 1: Basic concept of Computer System 4L

Introduction, Characteristics of Computer, Components of Computer, Basic organization of Computer System (I/P, O/P, Memory & CPU units).

Generation of Computer: 1st to 4th generations with characteristics.

UNIT 2: Operating System

Introduction 2L

What operation systems do? Operations of OS. Evolution of OS – Batch processing, Multiprogramming, Time sharing, Distributed.

Process Management 12L

Process concept, Process States, Process control block (PCB)

Process scheduling: Schedulers (long-term, short-term and medium-term), Context switching, scheduling criteria, scheduling algorithms (FCFS, SJF, Priority, RR), Multilevel Queue scheduling and Multilevel Feedback Queue scheduling.

Threads: Concept, Models, Multi-threading example (word processor).

Process Synchronization: Cooperating process, Critical-Section problem and solution, Semaphores (Binary & counting).

Deadlocks: Concept, Resource Allocation Graph, Necessary conditions for Deadlock, Handling deadlocks: Deadlock prevention and avoidance. Concept of Banker's algorithm with example, Deadlock recovery.

File Management 4L

File concepts: File attributes, File types, File operations and File structure. File accessing methods (sequential and direct). File directories type (single-level, two-level and tree-level).

File mounting and file sharing. Implementation of Directory (Linear list and Hash list). File Allocation methods (contagious, linked and index).

UNIT 3: Digital Logic 12L

Number System: Positional & Non-Positional, Representation of positional number system, Classification of positional number system (Decimal, Binary, Octal, Hexadecimal).

Inter-conversion: among known and unknown bases.

Digital Logic: addition, subtraction, multiplication, division, r's complement & (r-1)'s complement.

Boolean Algebra & Logic Gates

Basic laws and postulates, Huntington postulates, Duality.

Logic Gates: AND, OR, NOT, NAND, NOR, XOR & XNOR with truth table.

Boolean Functions: Representation (Boolean expression, Truth Table & Circuit Diagram), Canonical Form (SOP, POS), Conversion between canonical forms.

UNIT 4: Basic Computing Lab

Basic Operating System Commands 3L

- Listing directory contents, creating directory, changing directory.
- Creating file, copying & moving files, renaming & removing files.
- Date & time commands.
- Pipe & batch command concepts.

Familiar with OS interface
1L

- Customising desktop, arranging files & directories etc.

Office applications
2L

- Word Processor Application
- Spreadsheet Application
- Presentation Application

Reference Books:

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

AECBT202: Environmental Science

Total Marks-50

Credit-2

Lecture Hour-
50L+Tutorials 10L

UNIT I **(15 Periods)**

Introduction to environmental studies & ecosystems: Multidisciplinary nature of environmental studies: Scope and importance; what is an ecosystem? The structure and function of ecosystem, Energy flow in an ecosystem, food chains, food webs and ecological succession, forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems; Levels of biological diversity such as genetic, species and ecosystem diversity; biogeography zones of India, biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation, endangered and endemic species of India, threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions, conservation of biodiversity, *in-situ* and *ex-situ* conservation of biodiversity, concept of sustainability and sustainable development.

UNIT II **(18 Periods)**

Natural resources & its management and conservation: Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: Renewable and non renewable energy sources, use of alternate energy sources and growing energy needs.

UNIT III **(11 Periods)**

Environmental pollution & management: Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Solid waste management: Control measures of urban and industrial waste. Climate change, global warming, ozone layer depletion, acid rain and their impact on human communities and agriculture. Environment Laws: Environment Protection

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UNIT IV **(6 Periods)**

Environment & social issues: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; environmental communication and public awareness.

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1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.

2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of

California Press.

3. Gleeson, B. and Low, N . (eds.) 1999. *Global Ethics and Environment*, London, Routledge.

4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev.,

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7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.

8. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science.

Academic Press.

9. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.

10. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.

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12. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.

13. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and*

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15. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.

16. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

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(Applicable from the academic session 2018-2019)

GENERIC ELECTIVE COURSE

FIRST SEMESTER

GEBT101 Biomathematics

Total Marks-100

Credit: 6 (5+1)

Lecture period: 60L

Classical Algebra

Complex Number including D'Moivre's Theorem, Logarithm (only algebra, without Series expansion), Binomial Theorem (without infinite series). Determinant, Matrix, Rank of Matrices by Diagonalisation method. **(20 Periods)**

Calculus – I [For functions of single variable]

Limit, Continuity, Differentiation (including differentiability), Successive Differentiation, Expansion of Functions – Rolle's theorem, Mean Value theorem, Integration – Definite and Indefinite (ordinary, method of substitution, special trigonometric function, partial fraction) Application of integration to find area, Differential equations --homogeneous and Linear ODE's and its simple applications to biological problems. **(20 Periods)**

Calculus – II [For functions of two variables]

Partial Differentiation including Euler's theorem and its application.

Sequence: Its definition, Convergence, Types of sequences, Simple examples of finding limits of simple sequences **(20 Periods)**

TUTORIAL **(20 Periods)**

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(Applicable from the academic session 2018-2019)

GEBT102: Plant and animal tissue culture

Total Marks-75

Credit: 4 (3+1)

Lecture period: 60L

Introduction to Techniques - Introductory history, Laboratory organization, Media, Aseptic manipulation. **(3 Periods)**

Basic concepts in cell culture - cell culture, Cellular Totipotency, **(5 Periods)**

In vitro culture: approaches & methodologies - preparation steps for tissue culture, surface sterilization of plant tissue material, basic procedure for aseptic tissue transfer, incubation of culture. **(8 Periods)**

Tissue nutrition: Growth Hormones - Plant cells (Composition of culture media, Growth hormones, Vitamins, Unidentified supplements, selection of media); Animal cells (substrate on

which cells grow, Feeder layer on substrate, gas phase for tissue culture, media and supplements). **(10 Periods)**

Tissue culture methodologies - Plant cells (Types of cultures -Callus Culture, Cell Suspension Culture, Organ Micro-culture, plant micro-propagation, Somatic Embryogenesis); Animal cells (Source of tissue, primary culture, differentiation of cells, growth kinetics, animal cell lines and their origin and characterization). **(12 Periods)**

Cloning & Selection of specific cell types – cloning, somatic cell fusion and HAT selection, Medium suspension fusion, selection of Hybrid clone, production of monoclonal antibodies.

(10 Periods)

Organ Culture - Culture of embryonic organs, whole embryo culture, culture of adult organs.

(12 Periods)

GEBT-192 Plant and animal tissue culture (Practical)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)
Total Marks-25

Credit: 2

Laboratory period: 40L

1. **In vitro Culture** - Washing & Sterilization, Preparatory steps for tissue culture, surface sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture. **(8 Periods)**

2. **Preparation of Culture media & Reagents** - Media composition, Nutrition, Hormones. **(8 Periods)**

3. **Basics of Tissue Culture** – (Requirement for) Callus culture, Cell suspension. **(8 Periods)**

4. **Organ Micro-culture** – (Requirement and Overall procedure for) Shoot tip, excised root, Leaf culture. **(8 Periods)**

5. **Plant micro-propagation** – micro-culture of plants. **(8 Periods)**

GEBT103: Biotechnology and Human welfare

Total Marks-75

Credit: 4 (3+1)

Lecture period: 60L

Industrial production of Alcohol and antibiotic (Penicilin) **(15 Periods)**
Application of biotechnology in agriculture, N2 fixation, transfer of pest resistance genes to plants. **(10 Periods)**

Application of biotechnology in environments: e.g. chlorinated and non-chlorinated organic pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB. **(15 Periods)**
Application of biotechnology in forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing. **(10Periods)**
Application of biotechnology in health, Basic concept of therapy. **(10Periods)**

GEBT-193 Plant and Human Welfare (Practical)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)
Total Marks-25

Credit: 2

Laboratory period: 40L

1. Study of ethanolic fermentaion using Baker's yeast **(8 Periods)**
2. Study of a plant part infected with a microbe **(8 Periods)**
3. Isolation and analysis of DNA from minimal available biological samples. **(8 Periods)**
4. Preparation of root nodules from a leguminous plant. **(8 Periods)**
5. Dissertation based on applications of biotechnology (any one topic from theory syllabus) and viva-voce to be conducted on whole syllabus of the practical paper **(8 Periods)**

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SECOND SEMESTER

Paper Code: **GEBT-201** Full Marks: **75**

Lecture Period: **60L**

Paper Name: **C PROGRAMMING LANGUAGE**

UNIT 1: **8L**

Programming Language concepts & Introduction to C.

C character set, Constants, variables and keywords. Type of variables & constants. Rules of constructing variable identifier.

UNIT 2: **16L**

Types of C Instructions (Type declaration, Arithmetic & Control Instructions), Data Types, Operators, Hierarchy of operators, Associativity of operators, **Type conversion** (explicit and implicit), **Control Instructions**: if-else, switch case, conditional operator. Loops (for, while, do-while). ***break*** & ***continue*** statement.

UNIT 3: **12L**

Array: one-dimensional & multi-dimensional (2D) array. **Function and pointer**: Prototype, definition and calling of function, Recursive functions, Call-by-value & Call-by-reference, passing array to function. Pointer concept, pointer to pointer, pointer operations, pointer and array.

UNIT 4: **14L**

C Preprocessor: Concept, File inclusion & Macro expansion, Symbolic constants. **Type modifiers** (long, short & signed), **Storage class** (auto, extern, static & register). **String**: Pointer and String, Standard library functions (*strlen(), strcpy(), strcmp(), strcat()*). **Structure and Union**, Self-referential structure.

UNIT 5: **10L**

File handling: File opening modes, Reading from file, writing into file.

Reference Books:

- **Programming with C – by** Byron Gottfried
- ***Let Us C*** **-**by Yashavant P. Kanetkar

Paper Code: **GEBT-291** Full Marks: **25**

Paper Name: **C PROGRAMMING LAB**

1. Write a program, which will take marks of five subject of a student and will give the output as sum & percentage of marks.
2. Write a program to determine inputted integer is even or odd.
3. Write a program to calculate sum of digits of an inputted integer.
4. Write a program to find reverse of an inputted integer.
5. Write a program to find weather given integer is palindrome or not.
6. Write a program which will calculate the electricity bill on the basis of following condition:
    - Bill amount = 1000 if units < 500

- Bill amount = 1000 + 2*(units – 1000) if units in between 500 and 1000
- Bill amount = 1000 + 3*(units – 1000) if units is more than 1000.

7. Write programs to display following patterns based on height:

(a) *Height = 4*

```
*
* *
* * *
* * * *
```

(b) *Height = 4*

```
   *
  * *
 * * *
* * * *
```

(c) *Height = 5*

```
        1
      2 1
    3 2 1
  4 3 2 1
5 4 3 2 1
```

8. Write a program to find factorial of given positive integer.
9. Find the sum of following series up to n[th] term:

$$\frac{\mathbf{1}}{\mathbf{1}!}+\frac{\mathbf{2}}{\mathbf{2}!}+\frac{\mathbf{3}}{\mathbf{3}!}+\cdots+\frac{\boldsymbol{n}}{\boldsymbol{n}!}\ , \quad n \geq 1$$

10. Write a program to calculate $\boldsymbol{x^y}$, where x and y are positive integers.
11. Find the sum of following series up to n[th] term:

$$\frac{\mathbf{1}}{\mathbf{1^1}}+\frac{\mathbf{2}}{\mathbf{2^2}}+\frac{\mathbf{3}}{\mathbf{3^3}}+\cdots+\frac{\boldsymbol{n}}{\boldsymbol{n^n}}\ , \quad n \geq 1$$

12. Write a program to determine whether an inputted integer is prime or not.
13. Write a recursive function to calculate factorial of given positive integer.
14. Write a recursive function to obtain the first *N* numbers of a Fibonacci series.
15. Write a program to check whether given string is palindrome or not [use strcmp() function].
16. Write a menu driven program which has following options:
    a. Factorial of a number.
    b. Prime or not.
    c. Odd or even.
    d. Exit.
17. Write a program to obtain transpose of a matrix. [Hints: The transpose of a matrix is obtained by exchanging the elements of each row with the elements of the corresponding column].
18. Write a program, which will produce an output to show student details (roll, name, city, phone number, and department) from an institution.
19. Write a program to calculate the number of characters, words, blanks, tabs & lines in a given

text file.

20. Write a program to copy the content of a given text file into a newly created file.

GEBT202 Inheritance Biology

Full marks 75

Credit 4 (3+1)

Lecture Period 60L

Unit -I **(12 Periods)**

Science of Genetics – an overview of modern history of Genetics before 1860, 1860-1900, 1900-1944, 1944-Present.).

Mendelism & Chromosome Theory– Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked, Autosomal, Unifactorial, Multi-factorial).

Extension of Mendelism– Deviation from Mendel's Dihybrid phenotype, Bateson & Punnet's Coupling & Repulsion hypothesis.

Unit II **(12 Periods)**

Linkage & Crossing over- Chromosome theory of Linkage, kinds of linkage, linkage groups, Sutton's view on linkage, Morgan's view on linkage, types of Crossing over, mechanism of Meiotic Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

Allelic Variation & Gene function– Multiple allele, Epiststic and Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.

Unit III **(12 Periods)**

Non-Mendelian inheritance– Evidences for Cytoplasmic factors, cytoplasmic inheritance, extra-nuclear inheritance (mitochondrial, chloroplast), Kappa articles in *Paramoecium*, Sigma factor in *Drosophila*, Cytoplamic Male Sterility (CMS) in maize maternal inheritance, uniparental inheritance, non-chromosomal inheritance.

Unit-4 **(12 Periods)**

Chromosome Mapping- Haploid mapping (2 point & 3 point cross), Diploid mapping (Tetrad analysis), determination of linkage groups, determination of map distance, determination of gene order, cytological mapping.

Unit 5 **(12 Periods)**

Pedigree analysis– Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance.

GEBT 292(Practical)[Lab on Inheritance Biology]

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 25

Credit 2

Laboratory Period 40 L

1. Preparation of Mitotic Chromosome from human Leucocytes.
2. Study of salivary gland chromosomes in Drosophila
3. Problems on Linkage and Crossing over in Eukaryotes
4. Tetrad Analysis in Neurospora /and Aspergillus
5. Study of Polyploidy in plants 6. Barr body / drumstick identification

Gene mapping in prokaryotes- using transformation and conjugation data

Learning Resources:-

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th
Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett
Publishers
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

GEBT203

Biomathematics -II **Full marks 75**

Credit 6 (5+1)

Lecture Period 60L+ Tutorial 20 L

1. Algebra :

Linear Algebra: - Rank of Matrix by Diagonalization method, Eigen value & eigen

Vector (6 Periods)

Vector Algebra: - Vector addition, Vector multiplication (dot & cross product),

There geometrical meanings, Simple properties (without proof)

with simple examples, Vector triple product with simple examples.(6 Periods)

Abstract Algebra: - Relation-definition, example, binary relation, construction of

function from relation.

Mapping, Composite mapping, with simple examples.

Group- Definition with examples, Sub- group-- its definition &Examples, Necessary & Sufficient condition for a subgroup,characterization of a sub-group, order of a group, Cyclic group –its definition, simple properties & examples. (8 Periods)

Geometry: 3D Straight Line. (5 Periods)

Calculus :

Sequence: Its definition, Convergence, Types of sequences, Simple examples of finding limits of simple sequences. Series: - Logarithmic series, Exponential series, Convergence of series-

Absolute convergence, Test of convergence- Comparison test, D'Alembert Ratio test, Raabe's test, Cauchy's Root test, P-series Test, Leibinitz test for alternating series (Only simple examples

without proof).Power Series - Its definition, Convergence, radius convergence. (9 Periods)

Differentiation: Existence of differentiation, Expansion of function – Rolle's

Theorem (Statement only), Langrange's mean value theorem (with proof), Cauchy's mean value theorem (Statement only), Verification of each by simple examples.

Integration- Improper integration, Beta & Gamma function-statement and only

examples. Fourier series- Definition and simple problems assuming convergence condition, D statement of Dirichlet's condition. (16 Periods)

Deferential equation – Linear ODE of second Order. (10 Periods)

THIRD SEMESTER

GEBT 301 :BIOSTATISTICS **Full marks 75**

Credit 4 (3+1)

Lecture Period 60L

UNIT I **(12 Periods)**

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II **(18 Periods)**

Probability classical & axiomatic definition of probability, Theorems on total and compound

probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT III **(18 Periods)**

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

UNIT IV **(12 Periods)**

Correlation and Regression. Emphasis on examples from Biological Sciences.

GEBT 391 Lab on Biostatistics **Full marks 25**

Credit 2

Laboratory Period 40 L

Assignments

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and

Sons Inc.

GEBT302: Biological Diversity and Taxonomy

Full marks 75

Credit 4 (3+1)

Lecture Period 60L

Basic concept of Biodiversity – What is Biodiversity, Why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns of Species Diversity. **(5 Periods)**

Global patterns of Biodiversity – measuring biodiversity, Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis.

(7 Periods)

Biodiversity & Conservation – Overexploitation threatening living species, International Trade, Animals threatened by International trade, Problems in Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free Trade & the Environment, Free Trade & Conservation, Common patterns of Overexploitation. **(8 Periods)**

Exotic Species – Introduction, types Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental Effects of Exotic Species. **(3 Periods)**

Endangered Species Conservation – The US Endangered Species Act, State Endangered Species Acts Successes and Failures of the Endangered Species Act Role of ESA in Habitat Protection, Critical Habitat, Problems with the Endangered Species Act, Habitat Conservation Plans. **(6 Periods)**

Ethics of Conservation – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues. **(8 Periods)**

Taxonomy

Basic concept of Taxonomy – Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature. **(5 Periods)**

Taxonomy in relation to Chromosomal morphology & Evolution – Chromosomal evolution, why location of genes matter, evolutionary oddities about chromosomes, evolutionary effect of rearrangements of chromosomes, karyotypic orthoselection, chromosomal evolution & speciation. **(8 Periods)**

Molecular Taxonomy in relation to DNA characteristics & Protein sequences – modes of molecular evolution, Neutral theory of Molecular evolution, genetic markers for taxonomic purposes, comparing total genome by DNA-DNA hybridization,comparing DNA sequences, Cladistics, biological identification through DNA barcodes, chromosome painting, establishing molecular homology using protein sequences. **(10 periods)**

GEBT-392: Lab on Biological Diversity and Taxonomy (Practical)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)
Total Marks-25

Credit: 2

Laboratory period: 40L

1. Assignments
2. Seminars

Maulana Abul Kalam Azad University of Technology, West Bengal

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Paper Code: **GEBT-303** Full Marks: **75**

Lecture Period: **60L**

Paper Name: **DATA STRUCTURE & NUMERICAL ANALYSIS**

UNIT 1: Introduction to Data Structure **40L**

Introduction: Why we need data structure? Linear and non-linear data structure. **Algorithms**: Introduction, basics of time and space analysis of algorithms – order notations.

Array: Concepts, 2-dimentional array representation in memory.

Linked list: Representation, Operation: traversing, searching, Insertion, deletion. Doubly linked list. Linked list representation of polynomial. Advantage of Linked List over Array.

Stack: representation (array & list), Application of Stack: prefix, infix & postfix, postfix to infix conversion & vice versa.

Queue: representation, Operations: Enqueue & Deques, Applications of Queue.

Sorting Algorithms: Bubble, Selection, Insertion and Merge.

Searching Algorithms: Linear and Binary.

Graph theory: Concepts – Connected graph, regular graph, undirected graph, directed graph, complete graph, null graph, isomorphic graph, multi-graph and weighted graph. Hamiltonian cycle. Degree of vertex, in-degree & out-degree. Representation of graphs (adjacency matrix & list representation). Warshall's algorithm, shortest path algorithm. Application of graph theory in Biological Science.

UNIT 2: Numerical Analysis **20L**

Introduction

Bisection Method

Newton's forward and backward

1/3 Simpsons &

Trapizoidal

Reference Books

- ***Fundamentals of Data Structures of C*** –by Ellis Horowitz, Sartaj Sahni, Susan Andersonfreed.
- ***Data Structures in C*** –by Aaron M. Tenenbaum.
- ***Data Structures Using C*** –by Reema Thareja.
- ***Introduction to Numerical Analysis*** – by Sahajahan Ali Mollah
- ***Numerical Methods*** – by B.S. Grewal

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

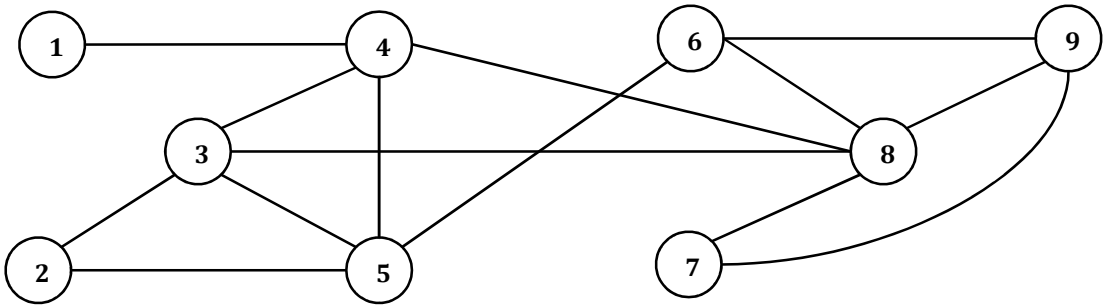
Curriculum Structure

(Applicable from the academic session 2018-2019)

Paper Code: **GEBT-393** Full Marks: **25**

Paper Name: **DATA STRUCTURE LAB**

1. Write a program to perform stack operations using array.
2. Write a program to perform queue operations using array.
3. Write a program to perform link list operations (insertion, deletion, modification and searching).
4. Implement *Bubble Sort* algorithm in C to sort a list of integers.
5. Implement *Selection Sort* algorithm in C to sort a list of integers.
6. Implement *Insertion Sort* algorithm in C to sort a list of integers.
7. Implement *Linear Search* algorithm to search an element in the list.
8. Implement *Binary Search* algorithm to search an element in the list.
9. Represent the following network in computer using C program and sort the vertices based on their degree.



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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

FOURTH SEMESTER

GEBT 401 Entrepreneurship Developments

Full marks 75

Credit 4 (3+1)

Lecture Period 60L

UNIT I

INTRODUCTION (10 Periods)

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II

ESTABLISHING AN ENTERPRISE (12 Periods)

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III

FINANCING THE ENTERPRISE (15 Periods)

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw materials and its management.

UNIT IV

MARKETING MANAGEMENT (13 Periods)

Meaning and Importance, Marketing-mix, product management – Product line, Product mix,

stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V

ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS (10 Periods)

Meaning of International business, Selection of a product, Selection of a market for international Business, Export financing, Institutional support for exports.

Learning Resources

1. Holt DH. Entrepreneurship: New Venture Creation.

2. Kaplan JM Patterns of Entrepreneurship.

3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand &Sons.

GEBT-491: Lab on Entrepreneurship Development (Practical)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)
Total Marks-25

Credit: 2

Laboratory period: 40L

1. Assignments- project report on selected products should be prepared and submitted.
2. One day Industry visit

GEBT402:Ecology and Environment management Full marks 75

Credit 4 (3+1)

Lecture Period 60L

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

UNIT-I (12 Periods)

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.

UNIT II (20 Periods)

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N,C,P cycles).

UNIT-III (18 Periods)

Pollution & environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations ,Carcinogen, Poisons. Detection of Environmental pollutant. Indicators & detection systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup : Case studies

UNIT-IV (10 Periods)

Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

GEBT 492 Lab on Ecology and Environment management **Full marks 25**

Credit 2

Laboratory Period 40 L

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.

2. Determination of population density in a terrestrial community or hypothetical community by quad rate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.

3. Principle of GPS (Global Positioning System).

4. Study of the types of soil, their texture by sieve method and rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon

6. Study any five endangered/ threatened species- one from each class.

Learning resources

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge

University Press.

2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.

3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House

4. Joseph, B., Environmental studies, Tata Mc Graw Hill.

5. Michael Allabay, Basics of environmental science, Routledge Press.

6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5thedition) Books/Cole, Thompson Learning, Inc.

7. Mohapatra Textbook of environmental biotechnology IK publication.

8. Rana SVS, Environmenta lpollution – health and toxicology, Narosa Publication

9. Sinha, S. 2010. Handbook on Wildlife Law Enforsement in India. TRAFFIC, India.

10. Thakur, I S, Environmental Biotechnology, I K Publication.

Paper Code: **GEBT-403** Full Marks: **75**

Lecture Period: **60L**

Paper Name: **DBMS & COMPUTER NETWORK CONCEPTS**

UNIT 1: DBMS **34L**

Introduction: DBMS vs. File-system, Data models, architecture (2-Tier & 3-Tier), Database users and DBA.

Database Design: Design issue, E R Model: entity, entity set, attribute (single valued, multivalued, simple, composite & derived), Constraints – Mapping cardinalities, Keys, ER Diagram: Basic structure, Mapping, Specialization, Generalization, Weak entity.

Relational Model: Database schema & instance, Relation: schema & instance, attribute, domain, tuple, domain constrains, arity & cardinality of relation, integrity constraint, key constrains (super key, candidate key, primary key), Foreign Key Constraints.

SQL: DDL (Create, Alter, Drop), DML (Insert, Update, Delete) & Concept of DCL. Aggregation Functions (max, min, avg and sum). Nested query.

Normalization: Different anomalies in designing a Database. Normalization concept. 1NF, 2NF & 3NF.

Transaction & Recovery: Concepts, States, ACID properties. Concurrency Anomalies (Dirty read, lost update & incorrect summary problem), Types of failures, Log-based recovery.

UNIT 2: Computer Network **26L**

Introduction: Components of Networking, Data representation, Data flow (simplex, half-duplex & Full duplex), Topologies (star, bus, mesh, ring & hybrid), Network categories (LAN, MAN, WAN).

Network Models: Internet & OSI (Function of all layers). Process-to-process, node-to-node & source-to-destination delivery.

Signals: Analog signal, digital signal, bandwidth, Transmission impairment (attenuation, distortion, noise).

Transmission media: Guided(twisted-pair, coaxial, fibre optic), un-guided media(radio waves, micro waves, infrared)

Connecting devices: Repeaters, Hub, and Bridge, two-layer & three-layer switch, routers.

IP Addressing: Address space, notation, classful addressing (classes, blocks, netid, host id, mask), classless addressing (CIDER notation, subnetting & supernetting).

Domain Name System: Name Space, Domain Name Space (FQDN, PQDN), Domain, DNS in the Internet (Generic, country & Inverse Domain), Name-Address resolution.

Reference Books

- ***Database System Concepts*** –by Avi Silberschatz, Henry F. Korth, and S. Sudarshan.
- ***Database Management Systems*** –by Johannes Gehrke and Raghu Ramakrishnan.
- ***Data Communications and Networking*** –by Behrouz A. Forouzan.

Paper Code: **GEBT-493** Full Marks: **25**

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

Paper Name: **DBMS & WEB TECHNOLOGY LAB**

DBMS

1. Write down SQL query to create table in database using following Student schema: ***Student:{rollno, first_name, last_name, department, city, dob, marks_bio, marks_math, marks_comp}***
2. Insert ten records to Student table.
3. Display all records from Student table.
4. Display rollno, first_name, department & total_marks for each students.
5. Display rollno, first_name, department & marks_math for students who have more than 50 marks in marks_bio.
6. Select those students who have more than 50 marks in each subject.
7. Select student(s) who have heighest marks in marks_comp.
8. Insert another row in student table with *NULL* value in each subject.
9. Update all *NULL* values with some marks other than *NULL.*
10. Find the average marks for each subject from student table.
11. Delete a row from student table.
12. Add a Total_marks field to student table.
13. Update Total_marks field by sum of each subject.
14. Execute the following sql statement:
    Create table backup_student as select * from Student;
15. Remove the Student table from database;
16. **Demonstration of a Biological Database** (e.g. RegulonDB)

WEB TECHNOLOGY

1. Creation of web-page using HTML tags (b ,u, i, br ,p ,marquee , img, a ,font ,pre, sub, sup ,list tags).
2. Creation of table, merge cells row wise and column wise in html.
3. Use of HTML input tags (textbox, password, checkbox, radio button).
4. Hyper link between different web-pages.
5. Create a web-page that will contains basic information about yourself.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

SKILL ENHANCEMENT COURSE

SECBT301 :Enzymology **Full Marks-50**
Credit-2
Lecture hour: 40 L

UNIT - I **(10 Periods)**

Isolation, and purification of enzymes, Enzyme classification (rationale, overview and specific examples) Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH.

(Lab-. Purification of an enzyme from any natural resource)

UNIT II **(10 Periods)**

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, Iysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feed backcontrol, covalent modification**.**

(LAB- Quantitative estimation of proteins by Bradford/Lowry's method)

UNIT – III **(10 Periods)**

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative co-operativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes

(LAB- Calculation of kinetic parameters such as Km, Vmax, Kcat)

UNIT IV **(10 Periods)**

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry

Learning Resources

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

SECBT302 Industrial Fermentations **Full Marks-50**
Credit-2
Lecture hour: 40 L

UNIT I **(12 Periods)**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

UNIT II **(15 Periods)**

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

(Lab on .Solvent Extraction & Analysis of a Metabolite from a Bacterial Culture)

UNIT III **(13 Periods)**

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

(Lab on Comparative Analysis of Design of a Batch and Continuous Fermenter)

UNIT IV **(20 Periods)**

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass

transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.
(Lab on enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

Learning Resource

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

SECBT 303 Plant and Animal Chromosome Preparation and Karyotyping

Full Marks-50
Credit-2
Lecture hour: 40 L

1. **Basic Principle of Cytogenetics Procedure**- Specimen procurement , culture procedure ,harvesting, slide making (plant and animal) 5 L
2. **Chromosome Preparation from Different Plant Parts**- basic procedures 6L
3. **Peripheral Blood and Bone Marrow Culture**- sample collection , setting up of culture, media preparation and culture procedure, significance of different types of culture 6L
4. **Chromosome Staining (Plant and Animal)**- Aceto orcein and feulgen staining for plants – principle and methods, conventional giemsa staining, differential staining techniques 6L
5. **Photomicrograph and Image Processing** –basic concepts 5L
6. **Chromosome Analysis and Karyotype** - Karyotyping of normal male and female individuals and interpretentions, plant chromosomes grouping 6L
7. **Chromosome Identification**- individual band position and characteristics 6L

Learning resources-

Barch MJ et al. The AGT cytogenetics Laboratory Manual; 3rd ed,1007, Lippincott-Raven; New York
Purandare Hema & Chakravarty Amit: Human cytogenetics Techniques& clinical applications,2000, Bhalani Publishing House, Mumbai

Culture of Animal cells-a manual of basic Techniques:R IAN Freshney (Wiley Publication)

Arun Kumar Sharma and Archana Sharma :2014 Chromosome Techniques Theory and Practice, Butterworth-Heinemann, Oxford,

SECBT401 : Molecular diagnostics **Full Marks-50**
Credit-2
Lecture hour: 40 L

UNIT I **(12Periods)**
Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immunohistochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

UNIT II **(10 Periods)**
Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests (.Lab – Demonstration of RAPD, Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture)

UNIT III **(10 Periods)**
Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

UNIT IV **(8 Periods)**
GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.

SECBT402 : Biofertilizers
Full Marks-50
Credit-2
Lecture hour: 40 L

Unit 1: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.
(6 Lectures)

Unit 2: *Azospirillum:* isolation and mass multiplication – carrier based inoculant, associative

effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication. **(10 Lectures)**

Unit 3: Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

(6 Lectures)

Unit 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

(10 Lectures)

Unit 5: Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. **(8 Lectures)**

Learning Resources

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

SECBT403:-Research methodology **Full Marks-50**
Credit-2
Lecture hour: 40 L

Unit 1: Foundations of Research **10L**

Meaning, Objectives, Motivation: Research Methods *vs* Methodology, Types of Research: Analytical *vs* Descriptive, Quantitative *vs* Qualitative, Basic *vs* Applied

Unit 2: Research Design **12L**

Need for research design: Features of good design, Important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs

Unit 3: Data Collection, Analysis and Report Writing **12L**

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology

Unit 4: Ethical Issues **6L**

Concepts of Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

SECBT404 : BASICS OF FORENSIC SCIENCE **Full Marks-50**
Credit-2
Lecture hour: 40 L

Unit I **(10 Periods)**

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II **(10 Periods)**

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink (various samples).

Unit III **(10 Periods)**

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,

Unit IV **(10 Periods)**

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, e-Discovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.(Lab- Demo on PCR amplification on target DNA and DNA profiling)

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

DECIPLINE SPECIFIC ELECTIVE

DSEBT 501A Animal Biotechnology **Full Marks: 50**

Credit: 3 (2+1)

Lecture period: 40L

1. Gene transfer methods in Animals – Microinjection, Embryonic Stem cell gene transfer, Retrovirus & Gene transfer. **(8 Periods)**

2. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. **(10 Periods)**

3. Animal diseases need help of Biotechnology – Foot-and-mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. **(6 Periods)**

4. Animal propagation – Artificial insemination, Animal Clones. **(6 Periods)**

5. Cryopreservation technology Basic techniques,–Animal cell culture and cryopreservation, Embryo conservation techniques Role of cryopreservation in assisted reproductive technology. **(10 Periods)**

DSEBT591A Lab on Animal Biotechnology

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full Marks: 50

Credit: 3

Lab period: 40L

1. Sterilization techniques: (Theory and Practical) Glass ware and media sterilization, Laboratory sterilization

2. Sources of contamination and decontamination measures.

3. Preparation of Hanks Balanced salt solution

4. Preparation of Minimal Essential Growth medium

5. Isolation of lymphocytes for culturing

6. Assignments and seminars

SUGGESTED READING

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.

2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.

3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.

5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

Maulana Abul Kalam Azad University of Technology, West Bengal

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

(Applicable from the academic session 2018-2019)

DSEBT 502 A: Model Organism and Human Genome Project Full Marks : 50

Credit: 3 (2+1)

Lecture period: 40L

Unit I

Genome – about genomes of model organisms (E. coli, Yeast, Arabidopsis thaliana, C. elegans, Drosophila melanogaster, laboratory mouse, Zebra fish, Human), types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution.

(8 Periods)

Genomics – about the genomics, history, comparative genomics, comparative genomic hybridization, functional genomics. **(6 Periods)**

Unit II

Genome projects – an overview of genome projects of human and other model organisms of Human Genome Project. **(8 Periods)**

Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, expected scientific & medical benefits of this project, about the organizations behind this project. **(10 Periods)**

Unit III

How Human genome was mapped – physical mapping, genetic mapping, gene ontology, gene annotation. **(8 Periods)**

Unit IV

Technologies used in HGP – RFLP, microsatellite markers, STS, EST, DNA sequencing, DNA microarray. **(10 Periods)**

DSEBT 592A : practical Lab on Life Cycle Studies

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full marks 50

Credits 3

Laboratory Hours. 40 h

1. **E. coli-** life cycle study, isolation and identification of mutants.
2. **Yeast**- life cycle study, isolation and identification of mutants
3. **Drosophila-** life cycle study, isolation and identification of mutants
4. **Arabidopsis**- life cycle study, isolation and identification of mutants
5. **Zebra Fish-** life cycle study, isolation and identification of mutants
6. **Laboratory Mouse-** life cycle study, isolation and identification of mutants
7. **Assignments and seminar**

DSEBT503A Medical Biotechnology **Full Marks: 50**

Credit: 3 (2+1)

Lecture period: 40L

UNIT I Gene therapy – background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. **(6 Periods)**

Gene Delivery methods – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering. **(6 Periods)**

Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **(5 Periods)**

UNIT II: Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.

(4 Periods)

Synthetic therapy – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **(4 Periods)**

UNIT III Tissue Engineering – Skin, Liver, Pancreas. **(3 Periods)**

Xenotransplantation – terminology, technology behind it, organ donors, social &

ethical issues. **(4 Periods)**

Cell Adhesion-based therapy – integrins, inflammation, cancer & metastasis. **(4 Periods)**

UNIT IV. Drug delivery – conventional & new approaches to drug delivery. **(4 Periods)**

DSEBT593A Medical Biotechnology **Full Marks: 50**

Credit: 3

Laboratory Hour: 40L

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Demonstration of Different gene delivery methods
2. Demonstration of Conventional and New approaches to drug deliver
3. GFP Cloning
4. Bacterial Gene Expression
5. Southern Hybridization.
6. PCR Application: Single Nucleotide Polymorphism (SNP)
7. DNA Fingerprinting:
8. DNA Fingerprinting (Using RAPD techniques)
9. Rice variety identification by RAPD analysis
10. Genotyping Analysis in Human
11. Assignments and seminar

DSEBT 501B : Plant Biotechnology **Full Marks : 50**

Credit: 3 (2+1)

Lecture period: 40L

UNIT- I: Plant Tissue Culture applications – Introduction, organogenic differentiation, Types of culture: Seed, Embryo, Callus, Organs, Cells. Micropopagation of Axillary bud proliferation, Meristem and shoot tip culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation. **(8 Periods)**

UNIT- II

In vitro haploid production Androgenic methods: Anther culture, Microspore culture Andogenesis, Double haploid production Significance and use of double haploids, Gynogenic haploids, factors effecting gynogenesis **(8 periods)**

UNIT III; Protoplast Isolation and fusion, Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation **(10 periods)**

UNIT IV. Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. **(8 Periods)**

Genetic modification in Agriculture – transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants. **(6 Periods)**

DSEBT 591B : Lab on Plant Biotechnology

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full Marks: 50

Credit: 3

Laboratory Hour: 40L

1. In vitro Culture - Washing & Sterilization, Preparatory steps for tissue culture, surface sterilization of plant material, basic procedures for Aseptic tissue transfer, incubation of culture. **(6 Periods)**

2. Preparation of Culture media & Reagents - Media composition, Nutrition, Hormones. **(8 Periods)**

3. Basics of Tissue Culture –(Requirement for)Callus culture, Cell suspension. **(8 Periods)**

4. Organ Micro-culture – (Requirement and Overall procedure for) Shoot tip, excised root, Leaf culture. **(8 Periods)**

5. Plant micro-propagation – micro-culture of plants and transformation experiments

(6 Periods)

6. Assignments and seminars **(4 Periods)**

DSEBT 502B : Plant Secondary Metabolites and Bio-transformation

Full Marks: 50

Credit: 3 (2+1)

Lecture period: 40L

Unit I-Introduction to primary & secondary metabolites: structure

Types of secondary metabolites -Glycosides, isoprenoids, cardenolides, alkaloids, and phenylpropanoids 12 periods

Unit-II-Biotechnological Method for the Production of Secondary

biosynthesis of important secondary products-Alkaloids, Flavonoids- 12 Periods

Unit-III-Important groups of secondary metabolites-Sources and uses

Importance of secondary metabolites 12 Periods

Unit-IV-Production of secondary metabolites by bioconversion genetic transformation for production of secondary metabolite

Basic concepts of Biotransformation. –Introduction, Applications and limitations.

14 periods

DSEBT 592B : Lab on Plant secondary metabolites and biotransformation

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full Marks: 50

Credit: 3

Laboratory hour: 40L

1. Extraction of secondary metabolites from plants
2. Quantitative and qualitative tests for secondary metabolites
3. Assignments and seminars

DSEBT601A Genetic Modification In agriculture Food and medical Industry

Full Marks: 50

Credit: 3 (2+1)

Lecture period: 40L

1. **Genetic Modification** – terminology, methods of genetic modification, Basics of genetic modification of bacteria, plant & animal, controversies over genetic modification, policy around the world (USA, European Union, EU regulation, Japan, China & other developing countries). **(12 Periods)**

2**. Genetic Modification in Agriculture** – types of transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants. **(15 Periods)**

3. **Genetically Modified Foods** – organic foods, types of organic foods, identifying

organic foods, organic food & preservatives. **(6Periods)**

4. **Genetic Modification in Food Industry** – background, history, controversies over

Risks Examples of modification and future application. **(10Periods)**

5. **Genetic Modification in Medicine** - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

(9 Periods)

DSE BT 691A Lab on Genetic Modification in agriculture Food and medical Industry

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full Marks: 50

Credit: 3

Laboratory hour: 40L

1. Analysis of organic VS. inorganic fruits and vegetables
2. Identification of metal or pesticide residues in foods
3. GFP cloning in bacteria
4. Assignments and seminars

DSEBT 602A Environmental Biotechnology

Full Marks: 50

Credit: 3 (2+1)

Lecture period: 40L

UNIT I **(12 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II **(14 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT III **(7 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers, Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT IV **(7 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

DSEBT 692A Laboratory on Environmental Biotechnology

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

Full Marks: 50

Credit: 3

Laboratory hour: 40L

1. Calculation of Total Dissolved Solids (TDS) of water sample.

2. Calculation of BOD of water sample.

3. Calculation of COD of water sample.

4. Bacterial Examination of Water by MPN Method.

5. Assignments and seminar

Learning Resources:-

1. Environmental Science, S.C. Santra

2. Environmental Biotechnology, Pradipta Kumar Mohapatra

3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter

4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

5. Agricultural Biotechnology, S.S. Purohit

6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T.Spencer

7. Introduction to Environmental Biotechnology, Milton Wainwright

8. Principles of Environmental Engineering, Gilbert Masters

9. Wastewater Engineering – Metcalf & Eddy

DSEBT 691B : Dissertation on Biotechnology

Full marks -100

Credit 6

Laboratory Work: 60 hrs

A project work should be done individually under the guidance of one faculty member on any topic related to the subject & can be recorded as dissertation & also be presented by the candidate in front of externals in a seminar.

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BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Curriculum Structure

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MOOCS BUSKET

Sl. No.	Course	Course Provider	Course Duration	Credits
1	Speaking Effectively	NPTEL	8 wks	3
2.	Intellectual Property	NPTEL	12 wks	4
3.	Ethics	NPTEL	12 wks	4
4	Biostatistics and Design of experiments	NPTEL	8wks	3
5	Human molecular Genetics	NPTEL	4Wks	1
6.	Functional genomics	NPTEL	4wks	1
7.	Research writing	NPTEL	4wks	1
8.	Introductory mathematical methods in biologists	NPTL	8wks	3
9.	Wild life conservation	NPTL	4wks	1
10.	Biomedical nanotechnology	NPTL	4 wks	1
11.	Industrial biotechnology	NPTL	12wks	4
12.	Bioreactors	NPTEL	4 wks	1