

BHARTI VISHWAVIDYALAYA

DURG (C.G.)

Website - www.bhartiuniversity.org, Email - bhartiuniversity.in@gmail.com



SCHEME OF EXAMINATION & SYLLABUS OF BACHELOR OF SCIENCE (HONORS) BIOTECHNOLOGY UNDER FACULTY OF SCIENCE

Session: 2021-2022

(Approved by Board of Studies)

EXAMINATIONSCHEME

B. Sc. (Honors) BIOTECHNOLOGY

B. Sc. (Honors) examination will be conducted in six SEMESTER

SEMESTER– I

THEORY

PAPER CODE	SUBJECT	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-101	General Biochemistry	4	70	30	100
BSHBT-102	Inorganic Chemistry-I	4	70	30	100
GE-I	Botany-I Zoology-I	4	35	15	50
AECC	English Communication / MIL	2	35	15	50
ECA	Tour/Industrial Training/Field Visit, NSS/Swachhta/Vocational Training/Sports/Others	2	35	15	50

PRACTICAL

PAPER CODE	SUBJECT	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L101	General Biochemistry Lab	2	35	15	50
BSHBT-L102	Inorganic Chemistry-I Lab	2	35	15	50
GEL-I	Botany/Zoology-I Lab	2	35	15	50

B. Sc. (Honors) Biotechnology

SEMESTER-II

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-201	Industrial Fermentations	4	70	30	100
BSHBT-202	Organic Chemistry-I	4	70	30	100
GE-II	Botany-II Zoology-II	4	35	15	50
AECC	Environmental Science	2	35	15	50
ECA	ECA-Extracurricular activity/ Tour, Industrial training/ Field visit, NSS/ Swachhta/ vocational Training/ Sports/ others	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L201	Industrial Fermentations Lab	2	35	15	50
BSHBT-L202	Organic Chemistry-I Lab	2	35	15	50
GEL-II	Botany/Zoology-II Lab	2	35	15	50

B. Sc. (Honors) Biotechnology

SEMESTER–III

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-301	Cell and Molecular Biology	4	70	30	100
BSHBT-302	Structure, Development and Reproduction in Flowering Plants	4	70	30	100
BSHBT-303	Physical Chemistry-I	4	70	30	100
GE-III	Botany-III Zoology-III	4	35	15	50
SEC - 1	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L301	Cell and Molecular Biology Lab	2	35	15	50
BSHBT-L302	Structure, Development and Reproduction in Flowering Plants Lab	2	35	15	50
BSHBT-L301	Physical Chemistry-I Lab	2	35	15	50
GEL-III	Botany/Zoology-III Labs	2	35	15	50

B. Sc. (Honors) Biotechnology

SEMESTER–IV

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-401	Animal Biotechnology and Genetic Engineering	4	70	30	100
BSHBT-402	Medical Microbiology and Immunology	4	70	30	100
BSHBT-403	Physical Chemistry-V	4	70	30	100
GE-IV	Botany- IV Zoology- IV	2	35	15	50
SEC -2	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L401	Animal Biotechnology and Genetic Engineering	2	35	15	50
BSHBT-L402	Medical Microbiology and Immunology	2	35	15	50
BSHBT-L403	Physical Chemistry-V	2	35	15	50
GEL-IV	Botany/ Zoology-IV Lab	2	35	15	50

B. Sc. (Honors) Biotechnology

SEMESTER–V

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-501	Plant Physiology	4	70	30	100
BSHBT-502	Molecular diagnostics	4	70	30	100
DSE-1	DSE-1- Theory	4	70	30	100
DSE-2	DSE-2- Theory	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L501	Plant Physiology	2	35	15	50
BSHBT-L502	Molecular diagnostics	2	35	15	50
DSE-1	DSE-1- Lab	2	35	15	50
DSE-2	DSE-2- Lab	2	35	15	50

B. Sc. (Honors) Biotechnology

SEMESTER–VI

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-601	Industrial Biotechnology	4	70	30	100
BSHBT-602	Environment and Ecology	4	70	30	100
DSE-3	DSE-3-Theory	4	70	30	100
DSE-4	DSE-4-Theory	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHBT-L601	Industrial Biotechnology	2	35	15	50
BSHBT-L602	Environment and Ecology	2	35	15	50
DSE-3	Lab	2	35	15	50
DSE-4-Project	Dissertation/ Project work followed by seminar	2	35	15	50

* As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by one department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each Minimum One Skill Enhancement course shall be proposed by each department (4 credits) [4 L or 2 L+ 2 P or 1 L+3 P or 3L+ 1 T] 1P = 2 hours.

***Credit= L+T+P/2**

Where, **L**-Lecture, **T**-Tutorial and **P**- Practical

Total Credits=144

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment	25
Viva-voce	10
Teacher Assessment	15
TOTALMARKS	50

DSE 1-4 (ELECTIVES)

DSE-1:	MOLECULAR BIOLOGY & BIOPHYSICS
DSE-2:	BIO ANALYTICAL TOOLS
DSE-3:	HUMAN WELFARE AND BIOTECHNOLOGY
DSE-4:	GENOMICS AND PROTEOMICS

SKILL ENHANCEMENT COURSE (ANY TWO)

SEC-I:	BIOINFORMATICS
SEC-2:	BIostatISTICS
SEC-3:	BIOETHICS AND BIOSAFETY
SEC-4:	ENTERPRENEURSHIP

NAME OF THE GENERIC ELECTIVE SUBJECTS OFFERED BY YOUR DEPARTMENT

GE I:	BOTANY-I/ZOOLOGY-I
GE II:	BOTANY-II/ZOOLOGY-II
GE III:	BOTANY-III/ZOOLOGY-III
GE IV:	BOTANY-IV/ZOOLOGY-IV

CORE SUBJECTS (HONOURS IN BIOTECHNOLOGY)

SEMESTER I

GENERAL BIOCHEMISTRY (BSHBT-101)

CREDITS-4

UNIT –I

Carbohydrates: General Properties, Types (Monosaccharide, Oligosaccharide and Polysaccharide) and Biological Importance.

Monosaccharide: Structure, Occurrence, Reactions and Biological importance of Monosaccharide.

Isomerism: Stereoisomerism and Optical isomerism, Ring Structure and Anomeric forms, Mutarotation.

Derivatives: Derivatives of Monosaccharide, Di and Tri-saccharide.

Important Polysaccharide: Glycogen, Starch and Cellulose.

UNIT –II

Lipids: General Properties and Classification.

Fatty acids: Nomenclature, Classification, Structure and Properties of Saturated and Unsaturated fattyacids. Essential Fatty Acids.

Triacylglycerols: Properties and Characterization of Fats, Hydrolysis, Saponification value, Acid value, Rancidity of fats and Functions. Biological Significance of Glycerophospholipids, Sphingomyelins and Glycolipids.

UNIT –III

Amino acids: Definition, Classification and Properties of Amino acids.

Peptide bond: Definition, Structure, Solid phase Protein Synthesis in brief, C – terminal and N – terminalAmino acid determination.

Protein: Structure, Types (Primary, Secondary, Tertiary and Quaternary) and Functions.

UNIT –IV

Nucleic Acids: Definition, Structure, Phosphodiester bond and Properties.

Purine and Pyrimidine Bases: Structure and Types, Composition of DNA and RNA, Nucleosides andNucleotides.

DNA double helix: Watson - Crick Model, Complementary base- pairings, Base staking, Chargaff's rule. Different forms of DNA structure (A, B & Z DNA), Major and Minor groove, Denaturation and Annealing of DNA

RNA: Types of RNA, Secondary and Tertiary structure of t-RNA.

UNIT- V

Porphyrin: General Properties, Structure of Nucleus and Classification.

Metalloporphyrins: Structure of Haemoglobin, Myoglobin, Chlorophyll, Cyanocobalamin and their Biological Importance.

Reference Books:

1. Biochemistry: J M Berg, J L Tymoczko and L Stryer.
2. Lehninger Principles of Biochemistry: David L Nelson and Michael M Cox.
3. Biochemistry: D Voet, J Voet and C W Pratt.
4. Biochemistry: U Satyanarayana and U Chakrapani.
5. Textbook of Biochemistry: Edward S West.
6. Fundamentals of Biochemistry: J L Jain, Sunjay Jain and Nitin Jain
7. Harpers Illustrated Biochemistry: Robert K Murray, Daryl K Garner and Peter A Mayes

GENERAL BIOCHEMISTRY PRACTICAL
(BSHBT-L101)

CREDITS-2

1. Molisch's test for Carbohydrate.
2. Benedict's test- distinguishes between reducing and non-reducing sugars.
3. Barfoed's test- distinguishes between monosaccharides and disaccharides.
4. Iodine test for starch.
5. Ninhydrin test for amino acids.
6. Thiol group test using sodium nitroprusside.
7. Test for indole group using Ehrlich's reagent.
8. Test for hydroxyphenylaniline using Million's test.
9. Iodine value of oil and wax.
10. Acid value of oil and wax.
11. Saponification value of oil and wax.

Reference Book:

1. Practical Biotechnology – Methods and Protocols - By S. Janarthanan and S. Vincent (Universities Press).
2. Essentials of Biotechnology for Students - By Satya N. Das.

INORGANIC CHEMISTRY-I (BSHBT-102)

CREDITS-4

UNIT –I: Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2 . Quantum numbers and their significance. Normalized and orthogonal wave functions. Shapes of *s*, *p*, *d* and *f* orbitals.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT –II: Periodicity of Elements

s, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* & *p*-block'

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT –III: Chemical Bonding

Ionic bond- General characteristics, types of *ions*, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond- Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions; HCl , BeF_2 , CO_2 , (idea of $s-p$ mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons.

UNIT –IV: Chemical Bonding-II

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electro-negativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Weak Chemical Forces. van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

UNIT- V: Oxidation-Reduction

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.

INORGANIC CHEMISTRY-1 LAB: (BSHBT-L102)

CREDITS-2

1. Titrimetric Analysis

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of different Polarity/Normality of titrants

2. Acid-Base Titrations

- (iii) Estimation of carbonate and hydroxide present together in a mixture.
- (iv) Estimation of carbonate and bicarbonate present together in a mixture.
- (v) Estimation of free alkali present in different soaps/detergents

3. Oxidation-Reduction Titrimetry

- (vi) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution.
- (vii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (viii) Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference Bookss:

- 1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

GE-I: B.Sc. (Hon's) Zoology(BSHZO101)

ANIMAL DIVERSITY– I (NON-CHORDATES) (BSHZO-101)

CREDITS: 4

UNIT -I

Taxonomy: definition, taxonomic procedure, classification, systemic, taxonomic levels, taxa, hierarchy, species concepts, Zoological nomenclature: kinds of taxonomic characters (morphological, embryological, cytogenetic, and numerical characters).

UNIT -II

Classification of multicellular animals: symmetry and early development (spiral and radial cleavage). Protostomes and Deuterostomes; body cavities: acoelomates, pseudocoelomates, coelomates.

UNIT- III

General characters and classification up to classes with examples showing distinctive and adaptive features:

1. Protozoans (locomotion)
2. Poriferans (canal system and skeleton),
3. Platyhelminthes and Nematodes (parasitic adaptations),
4. Annelids (metamerism),
5. Arthropods (mouthparts),
6. Molluscs (modification of foot),
7. Echinodermata (water vascular system and larval forms).

UNIT- IV

Overview of different patterns:

1. Digestion- intracellular, extracellular, feeding mechanisms (suspension, deposit, cropping, sucking, herbivorous and raptorial carnivorous)
2. Gas exchange and internal transport (structure and function of gills, trachea, book lungs)

UNIT- V

Overview of different patterns:

1. Excretory organs - open tubular (metanephridia) and closed saccular (protonephridia and Malpighian tubules)
2. Pattern of nervous system in non-chordates.

3. Types of asexual reproduction: fission, regeneration and parthenogenesis; sexual reproduction: primary and accessory sex organs in non- chordates.

Reference Books:

1. Kotpal Series on Non-chordates (Rastogi Publications).
2. Nigam: Biology of Non-Chordates (1997, S. Chand)
3. Barnes: The invertebrate (3rd ed. 2001, Wiley-Blackwell)
4. Moore: An introduction to the invertebrates (2006, Cambridge)
5. Kotpal, Agarwal and Khetrapal: Modern Text Book of Zoology; Invertebrates. Edition, Publisher, Rastogi Publications, 1990

GEL-I LAB: ZOOLOGY I-ANIMAL DIVERSITY – I (NON-CHORDATES)

PRACTICAL (BSHZO-L101)

CREDITS-2

1. Study of transverse sections/chart of the following: Sycon, Hydra, Fasciola, Ascaris,
 - a. Hirudinaria.
2. Study of salient features and classification up to classes of the following non-chordates: Amoeba, Euglena, Plasmodium, Paramecium, Euplectella, Physalia, Taenia, Ascaris (male and female), Nereis, Chiton, Mytilus, Octopus, Limulus, Sacculina, Asterias, Echinus, Holothuria.
3. External features of Earthworm.
4. Dissection of Earthworm showing alimentary canal, nervous system, reproductive system.
5. Dissection of snail showing radula, nervous system, Osphradium.
6. Culture of amoeba and paramecium.

Reference Books:

- 1.Kotpal Series on Non-chordates (Rastogi Publications)
- 2.Nigam: Biology of Non-Chordates (1997, S. Chand)

GE-I: PLANT DIVERSITY-I (BSHB-101)
(VIRUS, BACTERIA, ALGAE & FUNGI)

CREDITS: 4

UNIT-I

Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

UNIT-II

Viruses: General characteristics, general account of Retrovirus, TMV; General characteristics, general structure with special reference to viroids and prions; replication (general account),

UNIT-III

Cyanobacteria: General characteristics; heterocyst and akinetes; General account of *Nostoc*, *Oscillatoria* and *Scytonema*; Economic importance of cyanobacteria. General account of actinomycetes.

UNIT-IV

Algae: General characteristics; Chlorophyceae: *Volvox*, Xanthophyceae: *Vaucheria*; Phaeophyceae: *Sargassum*; Rhodophyceae: *Polysiphonia*; Single cell protein, Economic importance of algae.

UNIT-V

Fungi: General characteristics; Mastigomycotina: *Phytophthora*; Zygomycotina: *Rhizopus*; Ascomycotina: *Peziza*; Basidiomycotina: *Puccinia*; Deuteromycotina: *Alternaria*.

Reference Books:

1. Ananthanarayan and Paniker: 7th Edition. A text book of Microbiology, Orient Blackswan Publisher, Delhi
2. Kumar H D, 1990. Introductory Phycology. East-west Press, India
3. Lee R E. 2008. Introduction to Algae. Cambridge University Press, U K.
4. Pelczar Mi J., Chan, E.C.S., Krieg, NR, 1972. Microbiology, McGraw-Hill publisher, Columbus, OH
5. Prescott ML, 2000: Microbiology. McGraw-Hill Publisher, Columbus, OH

GEL-I: Plant Diversity-I (BSHB-L101)

CREDITS: 2

1. Micro preparation observations of bacteria and viruses.
2. Gram staining of bacteria
3. Identification of cyanobacterial specimens
4. Identification of algal specimens
5. Identification of fungal specimens
6. *Albugo*: Study of symptom of plants infected with *Albugo*
7. Specimen of different stage of mushroom(*Agaricus*)

Reference Books:

1. Ananthanarayan and Paniker: 7th Edition. A text book of Microbiology, Orient Blackswan Publisher, Delhi
2. Kumar H D, 1990. Introductory Phycology. East-west Press, India
3. Lee R E. 2008. Introduction to Algae .Cambridge University Press, U K.

AECC- ENGLISH LANGUAGE

CREDITS-4

UNIT-I COMMUNICATION, THEORY AND TYPES

Theory of Communication, Types and modes of Communication Verbal and Non-verbal(Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal,Inter-personal and Group communication

UNIT-II SPEAKING SKILLS

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication,Interview Public Speech.

UNIT- III READING AND UNDERSTANDING

Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts.

UNIT- IV WRITING SKILLS

Documenting Report Writing Making notes Letter writing .

UNIT-V FUNCTIONAL GRAMMAR

Parts of Speech, Word order / Types of Sentences, Questions (Affirmative and Negative),Present Perfect – Simple & Continuous, Present Perfect and Past Simple, Future Tense,Articles, Prepositions, Modals, Conjunctions, Quantifiers and Voice.

Reference Books:

1. English Language and Indian Culture - Published by M.P. Hindi Grant Academy Bhopal.

Extra Curricular Activity(ECA)

Tour/Industrial Training/Field Visit, NSS/Swachhta/Vocational Training/Sports/Others

Semester II

INDUSTRIAL FERMENTATIONS (BSHBT-201)

CREDITS-4

UNIT- I

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

Microbial products of pharmacological interest, steroidal fermentations and transformations. Overproduction of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.

UNIT- III

Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

UNIT- IV

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.

UNIT- V

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 coefficient (K_a) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

Reference Books:

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,

INDUSTRIAL FERMENTATIONS (BSHBT-L201)

CREDITS-2

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

Reference Book:

1. Principles and Practice of Animal Tissue Culture - By Sudha Gangal (Universities Press)

ORGANIC CHEMISTRY-I: (BSHCY-201)

CREDITS-4

UNIT- I Structure and Bonding

Classification, *nomenclature* and general structure of organic compounds. Hybridization. orbital representation of methane, ethane, ethylene, acetylene and benzene. Bond energy, bond length and bond angles. Polarity of covalent bonds-Inductive, resonance, hyper-conjugation and steric inhibition in resonance and its influence on acidity and basicity of organic compounds.

UNIT- II Mechanism of Organic reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double headed arrows. Homolysis and heterolysis of carbon-carbon bonds; Reactive species e.g. Carbocations, carbanions, free radicals and their stability. Nucleophiles and electrophiles.

UNIT- III Alkanes and cycloalkanes

Preparation and general reactions of alkanes and cycloalkanes, Bayer Strain theory of strain less ring; Conformation of ethane, *n*-butane and cyclohexane, chlorination of methane and side chain chlorination of toluene.

UNIT-IV Alkenes

General methods for preparation of alkenes, Reactions of alkenes: Addition reactions (Electrophilic and free radical), Halogenation, Hydrohalogenation, Hydration, Hydroxylation, Hydroboration-oxidation, Mercuration-demercuration, Epoxidation and Ozonolysis.

Dienes: Conjugated and isolated Dienes; 1,2- versus 1,4-addition. Diels-Alder reaction of dienes: Mechanism.

UNIT-V Alkynes

Preparation of alkynes, acidity and metal acetylides, Electrophilic addition reactions viz., Halogenation, Hydrohalogenation, Hydration. Hydroboration-oxidation, Mercuration-demercuration and Ozonolysis.

Reference Books:

1. "*Organic Chemistry*", R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P)Ltd., New Delhi.
2. "*Organic Chemistry*", S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
3. "*Organic Chemistry*", I. L. Finar, [Vol. 1, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.

4. *'Organic Chemistry - Structure and Reactivity', Seyhan N' Ege, 3rd Edition (1998), AITBS Publishers and Distributors, Delhi'*
5. *-Organic Chemistry", Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).*
6. "Organic Chemistry", ", G. Solomon, Wiley India, Paper Back, 9" Edition.
7. *"Modern Organic Chemistry", M. K. Jain and S. C. Sharma, Vishal Publishing CO. Jalandhar, India. 4th Edition (2012).*

ORGANIC CHEMISTRY-I LAB
(BSHCY-L202)

CREDITS-2

1. Calibration of the thermometer
2. Purification *of organic* compounds by crystallization using the following solvents: a. Water b. Alcohol, c. Alcohol-Water
3. Determination of the melting points of unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point-mixed melting point of two unknown organic compounds.
5. Detection of special elements (N, S, Cl, Br, I).

Reference Books:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012)

GE-II: ANIMAL DIVERSITY– II (CHORADATES): (BSHZO-201)

CREDITS-2

UNIT-I

Hemichordates: General characters and classification up to the order, Protochordates: Urochordates, Cephalochordates, Cyclostomes: General characters, Comparative account of Petromyzon and myxine.

UNIT- II

General characters and classification of Pisces and Amphibians up to orders, Fishes: migration, Parental care, Amphibian: Parental care, Neoteny.

UNIT- III

General characters and classification of Reptiles up to orders, Difference between poisonous and non-poisonous snakes with examples, Poison apparatus and biting mechanism of poisonous snakes. Snake venom, its uses and antivenin.

UNIT- IV

General characters and classification of Aves up to orders, Migration and flight adaptation, Beaks and claws in birds, Ratitae, Archaeopteryx.

UNIT- V

General characters and classification of Mammals up to orders, Receptors and Sense organs: Phonoreception and Photoreception, Oviparity, Ovoviviparity, Viviparity, Aquatic and Flying mammals.

Reference Books:

1. Cambell and Reece: Biology (7th ed. 2005, Pearson)
2. Nigam: Biology of Chordates (1997, Chand)
3. Kotpal Series of Chordates (Rastogi Publications)

GEL-II LAB: LABORATORY EXERCISES (BSHZO-L201)

ANIMAL DIVERSITY– II (CHORADATES)

- 1.Study of museum specimens relevant to theory paper.
- 2.Study of models relevant to theory paper.
- 3.Dissection of fish showing digestive system.
- 4.Mounting of scales.
- 5.Fish dissection showing afferent and efferent cranial nerves.
- 6.Fish internal ear.

Reference Books:

1. Nigam: Biology of Chordates (1997, Chand).
2. Kotpal Series of Chordates (Rastogi Publications)

GE-II: Botany –II: (BSHB-201)

TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS (BSHB-201)

CREDITS: 4

UNIT-I

Structure and Development of Plant Body Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development. Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspect

UNIT-II

General feature and classification of Angiosperms, merits and demerits (Bentham and Hooker, Takhtajan); Modern trends in plants taxonomy.

UNIT-III

General features of the following families: Ranunculaceae, Malvaceae, Brassicaceae, Asclepiadaceae, Solanaceae, Asteraceae, Euphorbiaceae, Poaceae.

UNIT-IV

Embryology: structure of angiosperms flower, Androecium (stamens), pollen morphology only, Gynoecium (Ovary, style and Stigma). Types of ovary, ovules and placentation, structure and main types.

UNIT-V

Pollination types, Double fertilization and triple fusion, Monocot and dicot embryo. Types of embryo sacs, organization and ultrastructure of mature embryo sac. Embryo endosperm relationship

Reference Books:

1. Bhojwani S and Bhatnagar S P, 2009. Embryology of Angiosperm, Vikas Publication House, New Delhi.
2. Eames, A.J, 1961: Morphology of Angiosperms, McGraw Hill Publication, New Delhi.
3. Pandey B P, 2001: Plant Anatomy, S Chand and Company, New Delhi.
4. Sharma O P, 2005. Plant Taxonomy, Tata Mc Graw Hill, New Delhi.

GEL-II LAB: Taxonomy and Embryology of Angiosperms (BSHB-L201)

CREDITS: 2

1. Study of Floral characters and Floral diagram of representative member of some families:
Malvaceae, Brassicaceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Poaceae
2. Study of type of ovary,
3. Study of type ovules, placentation types,
4. Study of type types of pollen grains and stages of dicotembryo.

Field trips: for habitat study & collection of samples.

Reference Books:

1. Lawrence, G. H. M 1951. Taxonomy of Vascular Plants. N. Y.
2. Pande B. P 1997. Taxonomy of Angiosperms. S. Chand Publication.
3. Takhtajan A. 1969. Flowering Plants; Origin and Dispersion.

AECC- ENVIRONMENTAL SCIENCE

CREDITS-4

UNIT – I

General: Environmental segments, environmental degradation, environmental impact assessment. Concept of Ecosystem: Fundamental of Ecology and Ecosystem, components of ecosystem, food-chain, foodweb, trophic levels, energy flow, cycling of nutrients, major ecosystem types (forest, grass land and aquatic ecosystem).

UNIT – II

Air Pollution: Atmospheric composition, energy balance, classification of air pollutants, source and effect of pollutants – Primary (CO, SO_x, NO_x, particulates, hydrocarbons), Secondary [photochemical smog, acid rain, ozone, PAN (Peroxy Acetyl Nitrate)], green house effect, ozone depletion, atmospheric stability and temperature inversion, Techniques used to control gaseous and particulate pollution, ambient air quality standards.

UNIT – III

Water Pollution: Hydrosphere, natural water, classification of water pollutants, trace element contamination of water, sources and effect of water pollution, types of pollutants, determination and significance of D.O., B.O.D., C.O.D. in waste water, Eutrophication, methods and equipment used in waste water treatment preliminary, secondary and tertiary.

UNIT – IV

Land Pollution & Noise Pollution: Lithosphere, pollutants (agricultural, industrial, urban waste, hazardous waste), their origin and effect, collection of solid waste, solid waste management, recycling and reuse of solid waste and their disposal techniques (open dumping, sanitary land filling, thermal, composting). Noise Pollution: Sources, effect, standards and control.

UNIT – V

Environmental Biotechnology: Definition, current status of biotechnology in environmental protection, bio-fuels, bio-fertilize, bio-surfactants, bio-sensor, bio-chips, bio-reactors. Pollution Prevention through Biotechnology: Tannery industry, paper and pulp industry, pesticide industry, food and allied industry.

Reference Books:

1. Environment and Ecology by Piyush Kant Pandey and Dipti Gupta (Sum India Publication).

2. A Textbook of Environmental Chemistry and Pollution Control by S.S. Dara (S. Chand and Company).
3. Masters, G.M. Introduction to Environment Engineering and Science (Prentice Hall of India).
4. Environmental Chemistry by A.K. Dey (Eastern Ltd.).
5. Environmental Chemistry by B.K. Sharma (Krishna Prakashan).
6. Nebel B.J. Environmental Science (Prentice Hall of India-1987).
7. Environmental Biotechnology by S.N. Jogdand (Himalaya Publishing House).
8. Introduction to Environmental Biotechnology by A.K. Chatterji (Prentice Hall of India).

Semester- III
CELL AND MOLECULAR BIOLOGY (BSHBT-301)

CREDITS: 4

UNIT-I CELL

Discovery of cell, The Cell theory. Prokaryotic and Eukaryotic cell – Plant and Animal cell. Cell Membrane, Cellular Reproduction. Techniques in Cell Biology.

UNIT- II CELL ORGANELLES

Cell Organelles: Structure and Functions of Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus and chromosomes.

UNIT- III CELL DIVISION

Cell Division - Cell cycle, Amitosis, Mitosis and Meiosis. Regulation of cell cycle. Central Dogma: Brief introduction of Structure and Functions of DNA, RNA and proteins.

UNIT- IV MECHANISM OF REPLICATION

DNA Replication: Prokaryotic and Eukaryotic – Mechanism, Enzymes and accessory proteins involved. DNA Repair.

UNIT- V INHERITENCE

Prokaryotic and Eukaryotic Transcription and Translation, Genetic code, Recombination in prokaryotes.

Reference Books:

1. Cell & Molecular Biology : Gerald Karp
2. Cell Biology : C.B. Powar
3. Essential Cell Biology : An introduction: Bruce, Alberts, Dennis
4. The Cell: A Molecular Approach: Geoffrey M. Cooper
5. Cell & Molecular Biology: SC Rastogi
6. Cell & Molecular Biology: Robertis & Robertis
7. Cell Biology & Genetics: Starr & Taggart
8. Molecular Cell Biology: Lodish

CELL AND MOLECULAR BIOLOGY LAB: (BSHBT-L301)

CREDITS: 2

1. Study of Parts of Microscope
2. To measure the length and breadth of the given cell sample by using micrometer.
3. To prepare permanent slides using the given sections like Stem, Root and Leaf.
4. Study of Mitosis.
5. Study of Meiosis.
6. Preparation of Blood Smear and study of blood cells.
7. Differential counting of white blood cells using Micrometer.
8. Identification of Barr Body in Buccal smear.
9. Identify the different types cells present in the leaf cross section.
10. Extraction of DNA from plants.
11. Extraction of DNA from animal tissues.
12. Extraction of DNA from fungus.
- 13.** Estimation of DNA using Diphenyl amine.

Reference Book:

1. Principles and Practice of Animal Tissue Culture - By Sudha Gangal (Universities Press).
2. Essentials of Biotechnology for Students - By Satya N. Das.

STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS (BSHBT-302)

CREDITS: 4

UNIT- I

The basic body plan of a flowering plant: modular type of growth.

The root system: root apical meristem; differentiation of tissues; modification of roots.

UNIT- II

The shoot system: shoot apical meristem; Anatomy of primary shoot in monocotyledons (*Zea mays*) and dicotyledons (*Helianthus annuus*); Secondary Growth, characteristics of growth rings, sapwood and heartwood; secondary phloem; periderm.

UNIT- III

Leaf: origin, development, Structure, arrangement and diversity in size and shape, senescence and abscission.

Flower: Structure and function of anther and pistil. Development of male and female gametophytes.

UNIT IV

Pollination, self incompatibility, double fertilization, formation of seed, endosperm and embryo; fruit, development and maturation, Seed dormancy, vegetative propagation.

UNIT- V

Diversity of flowering plants: General account of the families Brassicaceae, Fabaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, and Poaceae.

Reference Books:

1. The Embryology of Angiosperms: Bhojwani and Bhatnagar.
2. Anatomy of Seed Plants: Esau, K. John Wiley and Son, USA.
3. Embryology of Angiosperms: Johri, B.M. Springer-Verlag, Berlin.
4. Pollination biology: Kapil, R.P. Inter India Publishers, New Delhi.
5. An Introduction to Embryology of Angiosperms: Maheswari.P.

STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS LAB: (BSHBT-L302)

CREDITS: 2

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach.
4. Study of different Angiosperms.
5. Study of commonly occurring dicotyledonous plants to understand the body plan and modular type of growth.
6. Anatomy of primary and secondary growth in monocots and dicots using hand sections or prepared permanent slides.
7. Study of diversity in leaf shape, size, thickness and surface properties and internal structure.
8. Structure of anther, microsprogenesis and pollen grains.
9. Study of *In vitro* pollen germination
10. Simple experiments to study vegetative propagation in plants.
11. Germination of non-dormant and dormant seeds.

Reference Book

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

PHYSICAL CHEMISTRY-I (BSHBT-303)

CREDITS-4

UNIT –I : Gaseous state

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z , Causes of deviation from ideal behaviour. Vander Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

UNIT –II: Liquid state

Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of matter.

UNIT –III: Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry. Symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl etc.

UNIT –IV: Ionic equilibria-I

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect.

UNIT –V: Ionic equilibria-II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry, Solubility and solubility product of sparingly soluble salts-applications of solubility product principle. Theory of acid-base indicators; selection of indicators and their limitations.

Reference Books:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemist 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

PHYSICAL CHEMISTRY-I LAB: (BSHBT-L303)

CREDITS: 2

1. To Calibration of thermometer
2. To Determine the Melting point of Organic Compound
3. To Determine the Boiling Point of Water
4. Preparation of solutions of various concentrations, NaOH, HCl and H₂SO₄
5. To Determine the percentage composition of given Organic mixture (glycerol & water) using stalgmometer by surface tension method.
6. To Determine the percentage composition of Acetone and Methyl Ethyl Ketone given mixture by surface tension method.
7. To Determine the viscosity/ percentage composition of given Amyl alcohol with respect to water by viscometer method.
8. To Determine the viscosity/ percentage composition of given binary mixture(Glycerol & Water) by viscometer method
9. To determine the velocity constant(specific reaction rate) of the hydrolysis of methyl acetate catalyzed by hydrogen ions at room temperature.
10. To determine the specific rate of hydrolysis of ethyl acetate catalyzed by hydrogen ions at room temperature.

any other experiment carried out in the class.

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senion Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry* 8th Ed. McGraw-Hill: New York (2003).
3. Halpem, A. M. & McBane, G. C. *Experimental Physical Chemistry* Ed.; W.H. Freeman & Co.: New Work (2003).

GE-III: GENETICS AND EVOLUTION (BSHZO-301)

CREDIT-4

UNIT -I

Elements of heredity and variation: Mendel's laws of inheritance; Chromosomal basis of inheritance.

Extension of Mendelism: dominance relationships, Multiple allelism, Lethal alleles', Pleiotropy, Epistasis, Complementary, Supplementary inheritance; Cytoplasmic inheritance.

UNIT -II

Linkage and crossing-over, Sex-linkage; Sex chromosome systems, Sex determination; Structural and numerical alterations of chromosomes, Pedigree analysis: symbols of pedigree, Pedigrees of sex linked and autosomal inheritance.

UNIT -III

Human genetics: Karyotype, banding, nomenclature of chromosome subdivisions and genetic map. Genetic disorders: Chromosomal aneuploidy (Down, Turner and Klinefelter syndromes), Chromosome translocation (chronic myeloid leukemia) and deletion ("cry of cat" syndrome), Gene mutation (cystic fibrosis); Genetic counselling.

UNIT- IV

Concept of organic evolution, Evidences of organic evolution from comparative anatomy, embryology, palaeontology, Theories of organic evolution: Lamarckism, Darwinism, Modern synthetic theory, natural selection in action.

UNIT -V

Gene frequency in Mendelian population, Hardy-Weinberg equilibrium; major evolutionary forces; isolating mechanisms, modes of speciation (allopatric and sympatric).

Reference Books:

1. Gardner et al: Principles of Genetics (2006, John Wiley)
2. Griffith et al: An Introduction to Genetic Analysis (2008, Freeman)
3. Hartl & Jones: Essential Genetics - A Genomic Perspective (2009, Jones & Bartlett)
4. Pierce: Genetics – A Conceptual Approach (W. H. Freeman, 12-Apr-2011)
5. Russell: iGenetics (2009, Benjamin Cummings)

6. Snustad& Simmons: Principles of Genetics (2012, John Wiley).
7. P A Moody: Introduction to Evolution
- 8 . Rastogi: Organic Evolution (2007, Kedarnath& Ramnath)
9. Strickberger: Evolution

ZOOLOGY I-GENETICS AND EVOLUTION LAB: (BSHZO-L301)

CREDITS: 2

1. Application of probability in the law of segregation with the coin tossing.
2. Frequency of following genetic trait in human attached ear lobe, widow's peak, dimple in chin mid-digital Hair, Thumb, hypertrichosis, color blindness, PTC (phenyl thiocarbamide).
3. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak
4. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.
5. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in
6. polytene chromosomes) from prepared slides/photographs.
7. Study of human karyotypes and numerical alterations (Down, Klinefelter and Turner syndrome).
8. Preparation of temporary slide of Barr body by own cheek epithelium or hair root.

Reference Books:

1. Gardner et al: Principles of Genetics (2006, John Wiley)
2. Griffith et al: An Introduction to Genetic Analysis (2008, Freeman)

GE-III: PLANT PHYSIOLOGY (BSHB-301)

CREDITS: 4

UNIT-I

Water Potential and its components, water absorption by roots, aquaporins, pathway of water

movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.

UNIT-II

Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, Electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

UNIT-III

Photosynthesis: role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO₂ reduction photophosphorylation, C₃, C₄ and CAM pathways of carbon fixation, photorespiration.

UNIT-IV

Respiration: Glycolysis, TCA cycle, electron transport, oxidative phosphorylation, alpha and betaoxidation of fatty acid.

UNIT-V

Plant growth hormones: Physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene, Phytochrome: Structure and function; Photoperiodism; Vernalization; Seed dormancy

Reference Books:

1. Devlin Robert M. 1983. Plant Physiology, Prindle Weber and Schmidt Publisher; 4th edition. UK
2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., New York, USA.
3. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones.

Springer Verlag, New York, USA.

4. Pandey S N and Sinha B K. 2009. Plant physiology: Vikas Publishing, New Delhi
5. Singh G S. Renger G, Sopory, S K, Irrganag K D, Govindjee; 1999. Concepts in Photobiology, Photosynthesis and Phytomorphogenesis, Narosa Pub. House, New Delhi.
6. Taiz L and Zeiger E. 2010. Plant physiology. Sinauer Associates, UK.

GEL-III: PLANT PHYSIOLOGY LAB (BSHBL-301)

CREDITS: 2

1. Determination of diffusion pressure deficit (DPD)
2. Study of transpiration rate
3. Transpiration rate by Ganong's potometer
4. Study of effect of different light on photosynthetic rate
5. Separation of plant pigments by paper chromatography
6. Demonstration of osmosis phenomenon
7. Role of plant growth hormones

Reference Books:

1. Salisbury F. B and Ross C.W 1992. Plant physiology (Fourth Edition)
Wadsworth Publishing Company, California, USA.
2. Singhal G. S., Renger G., Sopory, S. K. Irrgang K. D and
Govindjee 1999. Concept in Photobiology; Photosynthesis and
Photomorphogenesis. Narosa Publishing House, New Delhi.
3. Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer
Associates, Inc. Publishes, Massachusetts, USA.

Semester-IV
ANIMAL BIOTECHNOLOGY AND GENETIC
ENGINEERING: (BSHBT-401)

CREDITS: 4

UNIT -I

Animal Biotechnology: Animal Biotechnology- Introduction, History, Scope, Advantages & Disadvantages. Tissue Culture Media, Applications of Animal Biotechnology

UNIT- II

Cell Culture & Cell Lines, Culture Procedure, Large Scale Cell Culture in Biotechnology, Cell Banking & Scaling up of Cell Culture, Organ Culture- Types & Techniques, Applications in the field of Biotechnology

UNIT- III

Genetic Engineering- Concepts, Tools, Enzymes responsible for Genetic Engineering, Cloning Vectors and their Applications

UNIT -IV

Gene Libraries- Creating & Screening Methods & Its different Techniques. Methods of DNA Technology, Molecular Research Procedures of DNA

UNIT -V

DNA & its Sequencing, Applications of Genetic Engineering in the Field of Agriculture, Industry, Medicine & Diagnostics.

Reference Books:

1. Elements of Biotechnology (2nd Edition): P K Gupta
2. Animal Cell Culture: A Practical Approach: R. I. Freshney
3. Methods in Cell Biology (Vol-57): Animal Cell Culture Methods Mather & David Barnes
4. Principles of Genetic Manipulation: Old & Primrose
5. Animal Cell Culture Techniques- Martin Clynes
6. Recombination DNA Technology: Glick
7. Applied Molecular Genetics: Roger L Meisfeld
8. DNA Cloning:- A Practical Approach; A.M. Glover and B.D. Hames, IRL Press, Oxford

ANIMAL BIOTECHNOLOGY AND GENETIC ENGINEERING LAB- (BSHBT-L401)

CREDITS: 2

1. To Isolate the Genomic DNA from spleen
2. To Estimate the DNA by DPA method.
3. To Estimate the RNA by Orcinol method.
4. To Isolate and Elute the DNA from Given sample by Agarose Gel Electrophoresis
5. To Isolate the Genomic DNA from Rice Plant by GFP Cloning mehtods
6. To Determine the Tm Value (GC) content in Denatured DNA.
7. To Determine the Competent Cell from the given sample.
8. To Transform the foreign DNA from given sample.
9. To Study the Bacterial conjugation by Genetic Engineering process.
10. To Isolate the Plasmid DNA from given sample.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

MEDICAL MICROBIOLOGY AND IMMUNOLOGY: (BSHBT-402)

CREDITS-4

UNIT- I

History and Major developments in Medical Microbiology. Normal Microbial flora of human body. Host parasite relationship, Process of infection.

Disease – Types of Disease. Disease Classification. General discussion of all types of Pathogens and development of symptoms. Some common bacterial disease – *Spirochetes*, *Trypanema*, *Streptococcal pneumonia*, *Clostridium tetani*, Tuberculosis, Salmonellosis, Cholera, *Yersinia*, *Staphylococcus*, *Cornebacteria*.

UNIT- II

Viral Diseases – Influenza, Hepatitis, HIV, Herpes, Pox, Polio, Adino, Reo. Fungal and Protozoal Diseases – **Fungal Diseases** – Cutaneous and Sub-Cutaneous Mycoses, Aspergillosis. Protozoal Diseases – Amoebiasis, Malaria, Kalaazar.

UNIT- III

Antimicrobial drugs - synthetic antimicrobial drugs, naturally occur antimicrobial drugs: antibiotics, β lactum antibiotics, antibiotics from prokaryotes, antiviral drugs, antifungal drugs, antimicrobial drug resistance.

UNIT- IV

History and Development of Immunology. Types of Immunity. Cells, Tissues and Organs of Immune system. Antigens- Essential features of antigens. Epitopes, Haptens, Adjuvants, Cross reactivity. **Antibody**- Structure, Types, Properties, Classification and their biological functions. Antigen-Antibody interaction. Clinical assays involving Antigen- Antibody interactions.

UNIT- V

Humoral mediated immune response – B cells; Response of B cells to antigens. Plasma cells, Memory cells. Cell- mediated immune response – T cell Receptors, Role of T helper cells and cytotoxic T cells; Function of MHC complex, Monoclonal antibodies – Production and Function.

Reference Books:

1. A text book of Medical parasitology Jayaram Panicker

2. A text book of Microbiology;Chakraborty
3. Medical Microbiology Vol I and II –Mackie and McCarthy
4. A text book of Microbiology;R.Ananthnarayanan

MEDICAL MICROBIOLOGY AND IMMUNOLOGY LAB: (BSHBT-L402)

CREDITS: 2

1. Precipitation reaction: antigen-antibody interaction.
2. Agglutination reactions
3. Radial Immuno diffusion.
4. Antibiotic sensitivity test of given sample.
5. To isolate bacterial flora of skin.
6. To isolate bacterial flora of saliva
7. To isolate normal flora of mouth teeth crevices
8. To determine dental caries susceptibility
9. To estimate the urine bacteria by pour plate (dilution) method
10. To perform VDRL test from the given sample of blood/ serum
11. To perform HBsAg antigen test from the given sample.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

PHYSICAL CHEMISTRY-V (BSHBT-502)

CREDITS-4

UNIT- I Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

Qualitative treatment of hydrogen atom and hydrogen-like ions:

UNIT- II Molecular Spectroscopy

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

UNIT- III Raman spectroscopy

Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra Stokes and anti-stokes lines; their intensity difference, rule of mutual exclusion.

UNIT- IV Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre-dissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

UNIT- V Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Reference Books:

1. Banwell, C. N. & Mccash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra A. K. Introductory Quantum Chemistry Tata Mccraw-Hill (2001).
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
5. Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

PHYSICAL CHEMISTRY-V LAB: (BSHBT-L502)

CREDITS: 2

UV/Visible spectroscopy

- I. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).
- II. Study the pH dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$.
- III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

- I. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration.
- II. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
- III. Study the kinetics of iodination of propanone in acidic medium.
- IV. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
- V. Determine the dissociation constant of an indicator (phenolphthalein).
- VI. Study the kinetics of interaction of crystal violet phenolphthalein with sodium hydroxide.
- VII. Analysis of the given vibration-rotation spectrum of HCl(g)

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A' Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed, ' McGraw-Hill: New York (2003).
3. Halpem, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W-H.
4. Freeman & Co.: New York (2003).

COMPARATIVE ANATOMY OF VERTEBRATES (BSHZO-401)

CREDITS: 4

UNIT- I

Origin of vertebrates, Integument and its derivatives, Structure of integument, scales, feathers, hair, beak, claw, nail, hoof, horn, antler, gland, Endoskeleton: Pectoral, Pelvic, Hindlimb, Forelimb.

UNIT- II

Digestive system: Modifications in relation to feeding habits, digestive glands, Oesophagus, Stomach; Dentition, dental formula in mammals.

UNIT- III

Respiratory System: Aquatic respiration, Aerial respiration, Circulatory system: Heart, Aortic arches,

UNIT -IV

Nervous system: Brain, Chemoreceptors, Photoreceptors, Photoreceptors of vertebrates, Cranial and spinal nerve.

UNIT- V

Urinogenital system: Excretory system- Types and evolution of kidney tubules, Urinary duct and bladder.

Reproductive system- General plan of gonads, Accessory reproductive organs.

Reference Books:

1. Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)
2. Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi)
3. Nigam: Biology of Chordates (1983, S Chand)

**GEL-IV: ZOOLOGY I-COMPARATIVE ANATOMY OF
VERTEBRATES PRACTICAL (BSHZO-L401)**

CREDITS-2

1. Study of histological slides of Pisces.
2. Study of histological slides of Amphibians.
3. Study of histological slides of Reptiles.
4. Study of histological slides of Aves.
5. Study of histological slides of Mammals.
6. Dissection of Afferent and efferent arteries of available fish/ amphibia
7. Dissection of Cranial nerve of fish

Reference Book:

1. Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi).
2. Nigam: Biology of Chordates (1983, S Chand)

GE-IV: Botany- IV

PLANT PATHOLOGY (BSHB-401)

CREDITS: 4

UNIT-I

History of plant pathology, classification of plant diseases, general symptoms of plant diseases.

UNIT-II

Mode of infection and role of enzymes and toxins in plant disease, defense mechanisms of plants against infection: Pre-existing structural and chemical defense, Host pathogen interactions and PR proteins.

UNIT-III

Control of plant diseases: biological, chemical, physical; bio-pesticides, plant quarantine, integrated pest management.

UNIT-IV

General account of some plant diseases: Late blight of Potato, Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane, leaf spot of rice, Citrus canker; Yellow vein mosaic of bhindi.

UNIT-V

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology;

Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco

Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Reference Books:

1. Agrios G N, 200. Plant Pathology, Academic press, London
2. Bilgrami K.H. & Dube H.C..1976. A textbook of Modern Plant Pathology. International Book Distributing Co. Lucknow.
3. Dubey H.C. 2009. An introduction to Fungi, Vikas Publisher New Delhi

4. R.S. Mehrotra and A. Agrawal, 2005. Plant Pathology, Tata McGraw New Delhi
5. Sharma P.D. 2004. Plant Pathology, Rastogi Publishers, Meerut.

PLANT PATHOLOGY LAB: (BSHB-L401)

CREDITS: 2

1. To demonstrate control of plant diseases.
2. Symptomology of some viral disease specimens: Yellow vein mosaic of bhindi
3. Symptomology of some bacterial disease specimens: Bacterial blight of rice, Citrus canker
4. Symptomology of some fungal disease specimens: Late blight of Potato,
5. Study of Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane.

Reference Books:

1. Crop plant Disease Colender- IARI-India.
2. K. S. Bilgrami and H. S. Dubey 2000 A text book of Modern Plant Pathology
3. R.S. Mehrotra and A. Agrawal, 2005. Plant Pathology, Tata McGraw New Delhi
4. R. S. Singh Plant Pathology
5. Sharma P.D. 2004. Plant Pathology, Rastogi Publishers, Meerut.

Semester-V
PLANT PHYSIOLOGY (BSHBT-501)

CREDITS-4

UNIT – I

Plant water relation- Importance of water to plants, imbibition, diffusion, osmosis, water potential; Absorption of water; Ascent of sap; Transpiration - Stomatal physiology , Water stress and its significance ; Translocation in Phloem.

UNIT – II

Mineral nutrition: Essential macro and micro elements and their role, Mineral uptake, Deficiency symptoms.

UNIT – III

Photosynthesis: Photosynthetic pigment systems, radiant energy, cyclic and noncyclic electron transport, C3 and C4 pathways, factors affecting photosynthesis, photorespiration,

UNIT – IV

Respiration: Aerobic and anaerobic, Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway Factors affecting respiration.

UNIT –V

Growth - measurement of growth, growth curve, Plant growth regulators-Auxins, Gibberellins, Cytokinins, Ethylene Growth regulation, application of hormones in agriculture - Nitrogen fixation in plants. Photomorphogenesis - Photoperiodism, Vernalisation, Phytochrome, Biological clock.

Reference Books:

1. Plant Physiology: Salisbury and Ross
2. Plant Physiology: Pandey and Sinha Plant Physiology, Ting I.P Addison
3. Plant Physiology: Devlin and Withem
4. Text of Plant Physiology and Biochemistry: S. K. Verma
5. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.

PLANT PHYSIOLOGY (BSHBT-L501)

CREDITS-2

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O₂ evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

MOLECULAR DIAGNOSTICS (BSHBT-501)

CREDITS: 4

UNIT- I

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 immunoassays. Applications of enzyme immunoassays in diagnostic microbiology.

UNIT- II

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.

UNIT- III

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.

UNIT IV

Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

UNIT- V

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. Transgenic animals.

Reference Books:

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

MOLECULAR DIAGNOSTICS LAB (BSHBT-L501)

CREDITS: 2

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture.
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue)

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

DSE-I: MOLECULAR BIOLOGY & BIOPHYSICS

CREDITS: 4

UNIT-I

- a. DNA, Structure, types and replication.
- b. RNA: Structure, types and function.
- c. Structure of gene and function.

UNIT -II

- a. Genetic code: Types & Structure, Properties, codon assignment, secondary genetic code.
- b. Protein synthesis, Transcription & translation.
- c. Cancer and its mechanisms

UNIT -III

- a. Gene Therapy
- b. Transposable elements
- c. DNA damage and repair
- d. Tissue engineering: General concept

UNIT-IV

- a. Law of Thermodynamics
- b. Beer Lambert's law
- c. Hybridization Techniques
- d. DNA finger printing and its application

UNIT -V

- a. Biophysics Introduction, scope and application
- b. Principle, structure and function of the following:
 - I. Spectroscopy
 - II. Electrophoresis
 - III. Centrifugation
 - IV. Colorimeter
 - V. Chromatography
 - VI. Elisa

Reference Books:

1. Statistical Physics of Biomolecules, An Introduction, Daniel M. Zuckerman, 2010, CRC PRESS
2. Fractals in Chemistry, Geochemistry, and Biophysics, An Introduction, K.S. Birdi, 1993, Springer.

DSE-I LAB: MOLECULAR BIOLOGY & BIOPHYSICS

CREDITS: 2

1. Isolation of DNA from given sample.
2. Isolation of RNA from given sample.
3. Estimation of DNA from plant cells
4. Demonstration of Lab equipments:
 - (a) Laminar Air flow
 - (b) Autoclave
 - (c) Hot air oven
 - (d) Incubator
 - (e) Water bath
 - (f) Quebec colony counter
 - (g) Centrifuge
 - (h) Spectrophotometer
 - (i) Electrophoresis
 - (j) Camera lucida

Reference Books:

1. Statistical Physics of Biomolecules, An Introduction, Daniel M. Zuckerman, 2010, CRC PRESS
2. Fractals in Chemistry, Geochemistry, and Biophysics, An Introduction, K.S. Birdi, 1993, Springer.

DSE-II: BIO-ANALYTICAL TOOLS

CREDITS: 4

UNIT- I

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

UNIT- II

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT- III

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.

UNIT- IV

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

Introduction to Biosensors and Nanotechnology and their applications.

Reference Books:

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

DSE-II LAB: BIO-ANALYTICAL TOOLS

CREDITS: 2

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
- 7.** To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

SEMESTER-VI

INDUSTRIAL BIOTECHNOLOGY: (BSHBT-601)

CREDITS-4

UNIT- I

Introduction to fermentation, Screening – Primary and Secondary, Strain development, Substrate for industrial fermentation, Fermentation scale up.

UNIT- II

Methods of fermentation, Fermenter systems, Types of Fermenters; Stirring and mixing, Gas exchange and mass transfer, Sterilization of gas and nutrient solutions, Instrumentation.

UNIT- III

Downstream processing; Filtration, Centrifugation; Extraction by salt and solvent precipitation; Chromatographic techniques; Packaging and Storage.

UNIT IV

Industrial production of Chemicals and Food products; Production Alcohol, Acids, Solvents, Antibiotics, Amino acids; Technology of typical food products.

UNIT- V

Biotransformation, Types of bioconversion reactions; Procedure for biotransformation; Application for Bioconversion.

Reference Books:

1. Industrial Microbiology: A H Patel
2. Bioprocess Engineering: Shuler and Kargi
3. Principles of Fermentation Technology: Stanbury et al.
4. Biotechnology: A Text book of Industrial Biotechnology: T D Brock
5. Industrial Microbiology: L E Casida
6. Industrial Microbiology: Prescott and Dunn
7. Microbial Biotechnology: A N Glazer and H Nikaido

INDUSTRIAL BIOTEHCNOLOGY LAB: (BSHBT-L601)

CREDITS: 2

1. Penicillin production and testing of antimicrobial activity.
2. Ethanol production by yeast.
3. Citric acid production by *Asperigillusniger*.
4. Free amino acid production from microorganisms.
5. Alpha-amylase synthesis from microorganisms.
6. Screening for enzyme production from microorganisms.
7. Role of yeast in bread in bread making.
8. Cellulose production from microorganisms.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

ENVIRONMENT AND ECOLOGY: (BSHBT-602)

CREDITS-4

UNIT- I

The Environment; Physical environment; Biotic environment; Biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies; concept of metapopulation, demes and dispersal, interdemographic extinctions, age structured populations, Diversity Index: Simpson's index, Shannon's index Species interactions.

UNIT- II

Community ecology; Nature of communities; community structure and attributes; Levels of species diversity and its measurements; Edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem: Structure and function; energy flow and mineral cycling (CNP); Primary production and decomposition; Structure and function of some Indian ecosystems; Terrestrial (forest, grassland). Aquatic (fresh water, marine, estuarine).

UNIT- III

Environmental Pollution- Sources, effects and bioremediation, Biotechnological methods for Management of pollution; Global climate change; Global warming, Global dimming; Biodiversity statuses; Monitoring and documentation; Major drivers of biodiversity change; Biodiversity management approaches, Economics of Biodiversity.

UNIT- IV

Principles of conservation; major approaches to management, Indian case studies on conservation/management strategy: Sanctuaries and National Parks, Project Tiger, Biosphere reserves. Metabolism & effects of Organochlorine, organophosphate and carbamate pesticides; Metabolism & effects of alkaloids, barbiturates, alcohol & cyanides; Metabolism & effects of heavy metal salts; Formation & effects of free radicals; Biochemistry of Detoxification.

UNIT -V

Environmental Monitoring: IGPPC (Inter Government Policy/ Protocol for Climate change);EPA (Environmental Protection Agency); Laws, legislation pertaining to environment; Control,monitoring & surveillance of environment.

Reference Books:

1. Environmental management of toxic and hazardous chemical - Madhuraj
2. Environmental Biology - J. L. Blish
3. Fundamental Ecology - Odum
4. Environmental Physiology - Philips G.

ENVIRONMENT AND ECOLOGY LAB: (BSHBT-L602)

CREDITS: 2

1. Determination of B.O.D. of water.
2. Analysis of water for pH, turbidity, colour, total dissolved solids.
3. Identification and estimation of nitrate, arsenic, iron and alkalinity in water.
4. Effect of cleaning and sweeping of floor on microbial population of laboratory.
5. Bacterial Examination of water by Coliform and MPN.
6. Isolation of cellulose degrading organism.
7. Microscopic studies of fresh water algae and protozoans.
8. To check the pollution levels by collection of particulate settled on leaves at various places in the city.
9. Diversity indices from soil and aquatic fauna.
10. Effects of toxicants on blood parameters of fish.

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

DSE- III: HUMAN WELFARE AND BIOTECHNOLOGY

CREDITS-4

UNIT- I

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT- II

Agriculture: N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT- III

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB..

UNIT- IV

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.

UNIT- V

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

Reference Books:

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

DSE- III LAB: HUMAN WELFARE AND BIOTECHNOLOGY

CREDITS: 2

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)

Reference Books:

1. Essentials of Biotechnology for Students - By Satya N. Das.
2. Bioprocess Engineering - By Shuler (Pearson Education).

DSE-IV: GENOMICS AND PROTEOMICS

CREDITS: 4

UNIT- I

Introduction to Genomics, 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: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT- III

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures –Edman degradation.

UNIT- IV

Introduction to 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.

Reference Books:

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
5. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.

DSE-IV

Dissertation/ Project work followed by seminar

SKILL ENHANCEMENT COURSE (ANY 2)

SEC-1 TO SEC-4

SEC-I: BIOINFORMATICS

CREDITS-4

UNIT- I

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT- II

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.

UNIT- III

Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT- IV

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT- V

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.

Reference Books:

1. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
2. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

SEC-2: BIOSTATISTICS

CREDITS-4

UNIT- I

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

Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT- III

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

Correlation and Regression. Emphasis on examples from Biological Sciences.

Reference Books:

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield™ 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.

SEC-3: BIOETHICS AND BIOSAFETY

CREDITS: 4

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel. Creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Reference Books:

1. E. Stocchi: Industrial Chemistry. Vol 1, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

SEC-4: ENTERPRENUERSHIP

CREDITS: 4

UNIT- I INTRODUCTION

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

UNIT -II ESTABLISHING AN ENTERPRISE

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

UNIT- III FINANCING THE ENTERPRISE

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

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product life cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT- V ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS

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

Reference Books:

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.