PUNJABI UNIVERSITY,

PATIALA, PUNJAB, INDIA

(Established under Punjab Act No. 35 of 1961)

Syllabi

for

B.Sc.(HONS.)- BIOTECHNOLOGY

PART 2 (Semester III & IV)

PROGRAMME CODE: BTHB3PUP

(Choice Based Credit System)

for

Sessions: 2022-23, 2023-24, 2024-25

Faculty of Life Sciences,

Punjabi University, Patiala

B.Sc. (Hons.) Biotechnology Part II
(Semester III)

PROGRAMME CODE: BTHB3PUP

CHOICE BASED CREDIT SYSTEM
(Academic Session 2022-2023, 2023-24 & 2024-25)

Subject and Distribution of Marks

SEMESTER III

Paper Code	Name of paper	Credit per Week	Internal Marks*	External Marks	Total Marks
BTHB2101T	Genetics	4	26	74	100
BTHB2102T	General Microbiology	4	26	74	100
BTHB2103T	Chemistry-3**	4	26	74	100
BTHB2104T	Spectroscopic Techniques]**	4	26	74	100
BTHB2105T	Enzymology	4	26	74	100
BTHB2106T	Environmental Biotechnology**	4	26	74	100
BTHB2107T	Ecology& Environment Management**	4	26	74	100
BTHB2101L	Practical Pertaining to Theory BTHB2101T	2	---	50	50
BTHB2102L	Practical Pertaining to Theory BTHB2102T	2	---	50	50
BTHB2103L	Practical pertaining to Theory Paper BTHB2103T/ BTHB2104T	2	---	50	50
BTHB2104L	Practical pertaining to theory BTHB2105T	2		50	50
BTHB2105L	Practical pertaining to Theory Paper BTHB2106T/ BTHB2107T	2		50	50
Total		30	130	620	750

Note: *Weightage of different components in internal assessment is as: Attendance: 20%, written assignment/project work/Seminar/Industrial visit: 40%; two- mid semester Tests/Internal Examination- 40%
** Candidate have to select one option from papers BTHB2103T & BTHB2104T and one option from papers BTHB2106T & BTHB2107T

B.Sc. (Hons.) Biotechnology Part II
(Semester IV)
PROGRAMME CODE: BTHB3PUP
CHOICE BASED CREDIT SYSTEM
(Academic Session 2022-2023, 2023-24 & 2024-25)

Subject and Distribution of Marks

SEMESTER IV

Paper Code	Name of paper	Credit per Week	Internal Marks*	External Marks	Total Marks
BTHB2201T	Molecular Biology	4	26	74	100
BTHB2202T	Immunology	4	26	74	100
BTHB2203T	Chemistry-4**	4	26	74	100
BTHB2204T	Spectroscopic Techniques-II**	4	26	74	100
BTHB2205T	Industrial Fermentations	4	26	74	100
BTHB2206T	IPR, Entrepreneurship Bioethics & Bio-safety**	4	26	74	100
BTHB2207T	Entrepreneurship Development**	4	26	74	100
BTHB2208T	Environmental & Road Safety Awareness (Qualifying/ as per university rules) (Shift into 3rd Semester)	2 lectures per week	30	70	100*** (Qualifying Paper)
BTHB2201L	Practical Pertaining to BTHB2201T	2	---	50	50
BTHB2202L	Practical Pertaining to Theory Paper BTHB2202T	2	---	50	50
BTHB2203L	Practical Pertaining to Theory Paper BTHB2203T/ BTHB2204T	2	-	50	50
BTHB2204L	Practical Pertaining to Theory BTHB2205T	2	---	50	50
BTHB2205L	Practical Pertaining to Theory BTHB2206T/ BTHB2207T	2	---	50	50
Total		30	130	620	750

Note: *Weight age of different components in internal assessment is as: Attendance: 20%; written assignment/project work/Seminar/Industrial visit: 40%; two- mid semester Tests/Internal Examination- 40%

** Candidate have to select one option from papers BTHB2203T&BTHB2204T and one option from paper BTHB2206T & BTBH2207T

*** Marks of the qualifying papers would not be included in total marks of the semester

Syllabus

B.Sc. (HONS.) BIOTECHNOLOGY

PROGRAMME CODE: BTHB3PUP

PART II
(3rd SEMESTER)

GENETICS: BTHB21011T

Time Allowed: 3hrs;   **MM: 74;**   **Pass Percentage: 40 %**

OBJECTIVES:

- The main objective of this subject is to understand the significance of mitosis and meiosis.

- Students will learn Mendelian Genetics which tells how to solve genetic problems that involves monohybrid and dihybrid crosses.

- Students will understand the molecular genetics which describes the structure of DNA, DNA replication, transcription and translation processes.

- It will help students to understand the causes and effects of mutation on molecular level.

- This subject also describes the role of Genetic code, gene, mRNA, ribosomes etc.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I   (12 Periods)

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

Cell Cycle: Mitosis and Meiosis. Role of meiosis in life cycles of organisms. Mendelian genetics Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment, Verification of segregates by test and back crosses, Chromosomal theory of inheritance. Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele.

UNIT II

(18 Periods)

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition -unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin, packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns.

SECTION-B

UNIT III

(15 Periods)

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities- Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV

(15 Periods)

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over. Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity. Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systemsof mating, evolutionary genetics, natural selection.

SUGGESTED READINGS

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.

GENERAL MICROBIOLOGY: BTHB2102T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- This subject highlights the structure, metabolism, genetics and ecology of prokaryotic microorganism, eukaryotic microorganism and viruses.
- Students will understand the principles of physical and chemical methods in the control of microorganism.
- Students will understand the prevention and control of infectious diseases.
- This subjects gives the understanding of various laboratory techniques such as isolation, staining, identification for various microorganism.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I   (10 Periods)

Fundamentals, History and Evolution of Microbiology.
Classification of microorganisms: Microbial taxonomy, criteria used, including molecular approaches, Microbial phylogeny and current classification of bacteria.
Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms viz. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II   (10 Periods)

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

SECTION-B

UNIT III   (20 Periods)

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.
Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

5.

UNIT IV   (20 Periods)

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

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

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications.

SUGGESTED READINGS

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

CHEMISTRY-3: BTHB2103T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- Students will learn the laboratory skills.
- Students will acquire the knowledge of alcohols, aldehydes and ketones.
- Students will understand the basic concepts of thermodynamics and Chemical equilibrium

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I

Alcohols Nomenclature, Methods of formation by reduction of aldehydes, ketone, carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols. Phenols Nomenclature, structure and bonding. Preparation of Phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation   **(15 periods)**

UNIT II

Aldehydes and Ketones Nomenclature and structure of the carbonyl group, Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitriles and carboxylic acids. Physical properties and chemical reactions.

Carboxylic Acids Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of amides, Reactions of carboxylic acids.   **(15 periods)**

SECTION-B

UNIT III

Thermodynamics-I Definition of thermodynamics terms: system, surroundings. Types of systems, intensive and extensive properties. State and path functions and their differentials, Thermodynamic processes, Concept of heat and work, elementary idea of thermochemistry, First Law of Thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law. Joule Thomson coefficient and inversion temperature, Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.   **(12 periods)**

Thermodynamics-II- Second law of thermodynamics: need for the law, different statements of the law. Concept of entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, entropy as a criterion of spontaneity and equilibrium. Entropy change in ideal gases mixing of gases.

(15 periods)

UNIT IV

Thermodynamics-III Third law of thermodynamics, Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. Variation of G and A with P, V and T.

Chemical Equilibrium Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation and Clausius-Clapeyron equation.

SUGGESTED READINGS

1. Basic Inorganic Chemistry. F.A. Cotton. G. Wilkinson and P.L. Gaus. Wiley.
2. Concise Inorganic Chemistry. I.D. Lee. ELBS.
3. Concepts of Models of Inorganic Chemistry. B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
4. Inorganic Chemistry. D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. Inorganic Chemistry. W. W. Porterfield Addison. Wesley.
6. Inorganic Chemistry. A.G. Sharpe, ELBS.
7. Inorganic Chemistry. G.L. Miessler and O.A. Tarr, Prentice Hall.
8. Organic Chemistry. Morrison and Boyd, Prentice Hall.
9. Organic Chemistry. L.G. Wade Ir.Prentice Hall.
10. Fundamentals of Organic Chemistry. Solomons, John Wiley.
11. Organic Chemistry. Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry. F.A. Aarey, McGraw Hill India.
13. Introduction to Organic Chemistry. Stretwieser, Heathcock and Kosover, Machmilan.
14. Physical Chemistry. G.M. Barrow, International Student Edition. McGraw Hill.
15. Basic Programming with Application. V.K. Jain, I'ata McGraw Hill.
16. Computers and Common. Sense. B. Ryal and Shely, Prentice Hall.
17. University General Chemistry. C.N.B. Rao. Macmillan.
18. Physical Chemistry. R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.w. Aikins, Oxford.
20. Physical Chemistry Through Problems. S.K. Dogra and S. Dogra. Wiley Eastern Ltd.

SPECTROSCOPIC TECHNIQUES-I: BTHB2104T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- This subject will explain why atomic spectra consist of lines whereas molecular spectra at room temperature are broad and continuous.
- This subject will explain what it means to use spectroscopic methods for qualitative and quantitative analysis.
- This subject will describe the difference between a fluorescence excitation and emission spectrum.
- This subject will compare two molecules and determine which one will undergo more collisional deactivation
- This subject will determine the vibrations for atomic molecules and identify whether they are infrared active.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I   (10 Periods)

Absorption and emission Spectroscopy-The basis of absorption and emission of radiation by molecular species, the wave properties of the light, the quantum theory of light, quantum theory of matter, molecular energies and the Born Oppenheimer approximation, the types of molecular motion and spectroscopy associated with each

UNIT II   (15 Periods)

Rotational spectroscopy – classical description of molecular rotation, quantum mechanics of molecular motion, rotational spectra, determination of the bond length from rotational constants, vibrational stretching and vibrational satellites, no-rigid rotor, centrifugal distortion, degeneracies and intensities, Stark effect, selection rules, rotational spectra of polyatomic molecules.

SECTION-B

UNIT III

(15 Periods)

Vibrational spectroscopy – classical description of molecular vibrations, the classical harmonic oscillator, quantum mechanics of molecular vibration, vibrational selection rules, anharmonic vibrations and Morse oscillator, bond dissociation energies and Birge-Sponer plots, calculation of force constants from vibrational spectrum, isotopic shift, rotational structure in vibrational spectra of diatomic molecules, vibrational selection rules, vibration of polyatomic molecules, normal modes, characteristic group vibrational energies, hydrogen bonds in IR spectra.

UNIT IV

(10 Periods)

Raman Spectroscopy – description of Raman scattering, Rayleigh scattering, Stokes and anti-Stokes scattering, polarizability of the molecules, Placzek theory, selection rules for rotational Raman spectra of diatomic molecules, rotational Raman spectra, vibrational Raman spectra, Raman spectra of polyatomic molecules.

SUGGESTED READINGS

1. Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.

2. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition

3. Infrared spectra of Complex molecules: J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.

4. Spectroscopic Method in Organic Chemistry: Dudley Williams, Ian Fleming McGrawHill Education; 6th Edition.

5. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.

6. Elementary Organic Spectroscopy; Principles And Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.

7. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.

8. Modern Raman Spectroscopy: A Practical Approach; Ewen Smith, Geoffrey Dent, Wiley; 1st Edition

ENZYMOLOGY: BTHB2105T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- Students will learn various theoretical and practical aspects of enzymology.
- This subject will stimulates students's interest in learning the structure, function and kinetics of enzyme and their role as catalyst and regulator of cell metabolism.
- This subject will serve as foundation for more advanced enzymology courses.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I
(20 Periods)

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin).

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 K_m and V_{max} and their physiological significance, factors affecting initial rate. E, S, temp. & pH. Significance of activation energy and free energy.

UNIT II
(15 Periods)

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition typesof inhibition, determination of K_i, suicide inhibitor.

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, lysozyme, RNase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

SECTION-B

UNIT III

(13 Periods)

Allosteric enzymes with special reference to aspartate, Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes- multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT IV

(12 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. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering- selected examples.
Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes.

SUGGESTED READINGS

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 andSons, 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

ENVIRONMENTAL BIOTECHNOLOGY: BTHB2106T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- Students will know the basic physiology of a microorganism and how their structure dictates their function in the environment.
- Students will understand the bases for microbial metabolism of environmental contaminants
- Students will know various techniques to modify and augment microorganisms in the laboratory and environment.
- Students will understand the principles of bioremediation, phytoremediation, bioleaching and waste water treatment.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I

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
(18 Periods)

UNIT II

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

SECTION-B

UNIT III

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).
(12 Periods)

UNIT IV   (10 Periods)

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

SUGGESTED READINGS

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

ECOLOGY AND ENVIRONMENT MANAGEMENT: BTHB2107T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- Students will learn advancement in the science and practice of ecology and environmental management for the public benefit
- Students will learn how to conserve and enhance biodiversity and maintenance of ecological processes and life support systems essential to a fully functional biosphere.
- Students will also learn environmentally sustainable management and development.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

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).

SECTION-B

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.

15

SUGGESTED READINGS

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. (5th edition) 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 Enforcement in India. TRAFFIC, India.

10. Thakur,IS,EnvironmentalBiotechnology,IKPublication.

PRACTICAL: BTHB2101L
PERTAINING TO THEORY BTHB2101T

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.

PRACTICAL: BTHB2102L
PERTAINING TO THEORY BTHB2102T

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

PRACTICAL: BTHB2103L
PERTAINING TO THEORY BTHB2103T

1. Determination of acetic acid in commercial vinegar using NaOH, Alkalinity of water sample.
2. Determination of alkaline content of antacid.
3. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
4. Estimation of hardness of water by EDTA.
5. Estimation of ferrous and ferric by dichromate method.
6. Estimation of copper using sodium thiosulphate.
7. Thin Layer Chromatography
   Determination of Rf values of different components.
   (a) Separation of green leaf pigments (spinach leaves may be used)
   (b) Preparation and separation of 2, 4-dinitrophenylhydrazones of acetone, benzophenone and cyclohexanone using toluene and light petroleum mixture (40:60).
   (c) Separation of a mixture of dyes.

PERTAINING TO THEORY BTHB2104T

1. To study the absorption spectrum of hemoglobin and NADH.
2. Determination of Tm of nucleic acid.
3. The validity of beers law for colorimetric estimation of creatinine.
4. The ultraviolet absorption of proteins and amino acids.
5. Estimation of proteins by Lowry's and Bradford method

PRACTICAL: BTHB2104L.
PERTAINING TO THEORY BTHB2105T

1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as K_m, V_{max}, K_{cat}

PRACTICAL: BTHB2105L.
PERTAINING TO THEORY BTHB2106T

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.

PERTAINING TO THEORY BTHB2107T

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

<u>Syllabus</u>

B.Sc. (HONS.) BIOTECHNOLOGY

PROGRAMME CODE: BTHB3PUP

PART II
(4$^{\text{TH}}$ SEMESTER)

MOLECULAR BIOLOGY: BTHB2201T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40%

OBJECTIVES:

1. This subject will demonstrate knowledge and understanding of the molecular machinery of living cells.
2. This subject will demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.
3. This subject will demonstrate knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signaling.
4. Students will learn the use of basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
5. Students will learn how to implement experimental protocols, and adapt them to plan and carry out simple investigations.
6. Students will be able to analyse, interpret, and participate in reporting to their peers on the results of their laboratory experiments;
7. Students will participate in report orally on team work investigations of problem-based assignments;
8. Students will build on their knowledge and understanding in tackling more advanced and specialised courses, and more widely to pursue independent, self-directed and critical learning.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I: DNA structure and replication   (15 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-priming proteins, primosome, replisome, Rolling circle replication.

UNIT II: DNA damage, repair and homologous recombination   (10   Periods)

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion, synthesis, recombinational repair, nonhomologous end joining. Homologous recombination:models and mechanism.

SECTION-B

UNIT III: Transcription and RNA processing
(17 Periods)

RNA structure and types of RNA. Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains 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
(18 Periods)

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

SUGGESTED READINGS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Roberts, E.D.P. and De Roberts, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.), Cold Spring Harbour Lab. Press, Pearson Pub.

IMMUNOLOGY: BTHB2202T

Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %

OBJECTIVES:

- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.
- The students will be able to demonstrate a capacity for problem-solving about immune responsiveness.
- The students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T- lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

(20 Periods)

UNIT II

Antibody diversity & brief overview, allotypes, idiotypes, immunologic memory, Complement system.

(15 Periods)

SECTION-B

UNIT III

Major Histocompatibility complexes - class I & class II MHC antigens, antigen processing. Immunity to infection - immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

(13 Periods)

UNIT IV

Vaccines & Vaccination - adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunology - immunity to infection. Autoimmune diseases, Immunology, RIA, ELISA, precipitation, agglutination.

(12 Periods)

SUGGESTED READINGS

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 Publicatio

CHEMISTRY-4: BTHB2203T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- The students will develop curiosity and interest in chemistry.
- The student will acquire knowledge of acid and bases, carboxylic acids and its derivatives.
- The student will learn concepts of phase equilibrium, fats & oils and electrochemistry.
- The students will learn applications of conductance measurement.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I

Acids and Bases - Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases. Use of redox potential.   (10 periods)

Non-aqueous Solvents- Physical properties of a solvent, types of solvents and their general characteristics

UNIT II

Carboxylic Acid Derivatives -Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Relative stability and reactivity of acyl derivatives.   (10 periods)

Ethers -Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-cleavage and autooxidation, Ziesel's Method.

Fats, Oils and Detergents- Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

SECTION-B

UNIT III

Phase Equilibrium- Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule; phase equilibria of one component system-water and S systems. Phase equilibria of two component systems-solid-liquid equilibria, Nernst distribution law   (10 periods)

Electrochemistry-I-Electrical transport-conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance with dilution. Migration of ions and Kohlrausch law. Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes.

UNIT IV

(10 periods)

Applications of conductance measurements-determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salts, conductometric titrations.

Electrochemistry-II-Definition of pH and pK, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods. Buffers--mechanism of buffer action, Henderson-Hazel equation.

SUGGESTED READINGS

1. Basic Inorganic Chemistry, F.A. Cotten, G. Wilkinson and P.L.. Gaus. Wiley.
2. Concise Inorganic Chemistry, 1.D. Lee. ELBS.
3. Concepts of Models of Inorganic Chemistry, B. Doaglas, D. McDaniel and 1. Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. Inorganic Chemistry, W. W. Porterfield Addison, Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L. Miessler and O.A. Tarr, Prentice Hall.
8. Organic Chemistry, Morrison and Boyd, Prentice Hall.
9. Organic Chemistry, L.G. Wade Ir.Prentice Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry, Vol. I, II & III. S.M.Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. Organic Chemistry, F.A. Aarey, McGraw Hill India.
13. Introduction to Organic Chemistry, Stretwieser, Heathcock and Kosover, Machmilan.
14. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain, 1'ata McGraw Hill.

SPECTROSCOPIC TECHNIQUES-II: BTHB2204T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- Students will understand how light interacts with matter and how it can be used to quantitatively understand chemical samples.
- Students will understand spectroscopy the way other common tools of measurement like the watch or the ruler are understood.
- Students will learn that spectroscopy is a set of tools that can put be together in different ways to understand systems and solve chemical problems.
- Students will understand basic concepts of instrumentation, data acquisition and data processing.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I

(12 Periods)

Electronic Spectroscopy – electronic transition, energy of electronic transition, selection rules, the Franck–Condon principle, term symbols for describing atomic and molecular states, Russel Saunders spin–orbit coupling, selection rules of electronic transition, absorption intensity, probability of light absorption, an electronic spectrum, classification of electronic transition, d-dand CT transitions.

UNIT II

(15 Periods)

Emission Spectroscopy – fluorescence and phosphorescence, deactivation processes – internal conversion, de-excitation process, non-radiative and radiative transitions, characteristic of fluorescence emission, Stokes shift, fluorophores, quantum yield of a fluorescent process, phosphorescence, intersystem crossing, Jablonski diagram, Kasha's rule of the quantum yield of Luminescence.

SECTION-B

UNIT III

(12 Periods)

Photoelectron spectroscopy – the photoelectric effect, UV photoelectron spectroscopy UPES, X-ray photoelectron spectroscopy XPES, electron binding energy, ESCA, Auger electron spectroscopy. 15. EPR Spectroscopy – paramagnetic species, electron spin, magnetic properties of the electron and selected particles, magnetogyric ratio, electron spin–orbit couplings, energy levels

UNIT IV

(15 Periods)

Spectra in magnetic field-NMR – the Stern-Gerlach's experiment, nuclear spin angular momentum, the magnetic moment of a nucleus, the nuclei in a magnetic field, the Larmor frequency, the chemical shift, electronic shielding of nuclei, the chemical scale, the spin-spin coupling, the spin-spin coupling constant, spin-spin splitting, molecular structure from NMR spectra..

SUGGESTED READINGS

1. Introduction to Spectroscopy: Donald L. Pavia, Gary M. Lampman, George S. Kriz Cengage Learning; 4th Edition.

2. Spectrometric Identification of Organic Compounds: Robert M. Silverstein, Francis X. Webster, David Kiemle Wiley; 7th Edition

3. Infrared spectra of Complex molecules: J. Bellamy, John Wiley & Sons, Inc., 3rd Edition.

4. Spectroscopic Method in Organic Chemistry: Dudley Williams, Ian Fleming McGrawHill Education; 6th Edition.

5. Applications of spectroscopic techniques in Organic Chemistry: P.S. Kalsi, New Age International; 6th Edition.

6. Elementary Organic Spectroscopy; Principles and Chemical Applications: Y. R. Sharma, S. Chand & Co Pvt Ltd.

7. Fundamentals of Molecular Spectroscopy: C. M. Banwell and E. McCash, Tata McGraw Hill, 4th Edition.

8. Modern Raman Spectroscopy: A Practical Approach; Ewen Smith, Geoffrey Dent., Wiley; 1st Edition.

INDUSTRIAL FERMENTATIONS: BTHB2205T

Time Allowed: 3hrs; MM: 74; Pass Percentage: 40 %

OBJECTIVES:

- Industrial fermentation is an interdisciplinary science that applies principles associated with biology and engineering.
- Students will learn microbiology and biochemistry from biological aspect.
- Students will understand the commercial exploitation of microorganisms on a large scale.
- This subject provides the knowledge of basic principle of fermentation process, which help students to design, develop and operate industrial level fermentation process.
- This fundamental knowledge is essential for Students to make their career in industry based on bioprocess.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

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.

(12 Periods)

UNIT II
Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite. Secondary metabolism - its significance and products. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

(15 Periods)

SECTION-B

UNIT III
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.

(13 Periods)

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.

SUGGESTED READINGS

1. Casida I.E. (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.

IPR, ENTREPRENEURSHIP BIOETHICS & BIOSAFETY: BTHB2206T

Time Allowed: 3hrs;   MM:74;   Pass Percentage: 40 %

OBJECTIVES:

- This subject will introduce basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.

- Students will understand balanced integration of scientific and social knowledge in sustainable development.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT-I

Introduction to Indian Patent Law, Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, ethical and depository considerations. World Trade Organization, TRIPs.   **(15 Periods)**

UNIT II

Entrepreneurship: Selection of a product, line, design and development processes, economics of material and energy requirement. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations, export potential.   **(20 Periods)**

SECTION-B

UNIT III

Bioethics - Necessity of Bioethics, different paradigms of Bioethics - National & International. Ethical issues against the molecular technologies. Intuitional Ethical Committees   **(10 Periods)**

UNIT IV

Biosafety- Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).   **(15 Periods)**

SUGGESTED READINGS

1. Entrepreneurship: New Venture Creation: David H. Holt
2. Patterns of Entrepreneurship: Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

ENTREPRENEURSHIP DEVELOPMENT: BTHB2207T

Time Allowed: 3hrs;   MM: 74;   Pass Percentage: 40 %

OBJECTIVES:

- The course aims to allow students to formulate an awareness of strategic areas, to critically appraise the related theory and practice of entrepreneurial strategy.
- At the same time the course will provide students with the opportunity to apply theory to practice, thereby enabling them to learn by doing.
- Students will develop necessary knowledge and skills among the participants in EDPSs.
- This subject imparts basis managerial knowledge and understanding.
- Students will develop and strengthen entrepreneurial quality and motivation.
- Students will be able to analyze the environmental issues related to the proposed project.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections A, B and C. Section A and B will have four questions from the respective sections of the syllabus and carry 11 marks each. Section C will consist of 15 short answer type questions which will cover the entire syllabus uniformly and will carry 30 marks in all.

INSTRUCTIONS FOR THE CANDIDATES

1. Candidates are required to attempt two questions each from sections A and B of the question paper and the entire section C.

SECTION-A

UNIT I INTRODUCTION

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.   **(10 Periods)**

UNIT II ESTABLISHING AN ENTERPRISE

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.   **(12 Periods)**

SECTION-B

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.   **(15 Periods)**

UNIT IV MARKETING MANAGEMENT

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.   **(13 Periods)**

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.

SUGGESTED READINGS

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.

ENVIRONMENTAL & ROAD SAFETY AWARENESS: BTHB2208T

COMMON FOR ALL UNDERGRADUATE DEGREE COURSES
PART-II (SEMESTER-III) QUALIFYING SUBJECT- ENVIRONMENTAL & ROAD SAFETY AWARENESS

PRACTICAL: BTHB2201L
PERTAINING TO THEORY BTHB2201T

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA

PRACTICAL: BTHB2202L
PERTAINING TO THEORY BTHB2202T

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

PRACTICAL: BTHB2203L
PERTAINING TO THEORY BTHB2203T

1. Detection of elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
22. To determine the solubility of benzoic acid at different temperatures and
3. to determine ΔH of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and
5. To determine the enthalpy of ionization of the weak acid/weak base.

PERTAINING TO THEORY BTHB2204T

1. Interpret NMR spectra of five compounds.
2. Identify chemical compound using emission spectroscopy.
3. To study the absorption spectrum of any 5 compounds.

PRACTICAL: BTHB2204L
PERTAINING TO THEORY BTHB2205T

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.)

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PRACTICAL: BTHB2205L
PERTAINING TO THEORY BTHB2206T

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India.
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste.
8. Project Report on a selected product should be prepared and submitted.

PERTAINING TO THEORY: BTHB2207T

1. Test to assess the Entrepreneurial spirit of learner through questionnaire (Entrepreneurial Self Assessment Tool)
2. Demonstrate and practice five core life skills
   (a) Managing self and others
   (b) Positive Attitude.
   (c) Creativity
   (d) Team building
   (e) Motivation
3. A SWOT analysis of entrepreneurial opportunity in your locality with reference to the vocational course.
4. Prepare ppt. of successful entrepreneurs