SCHEME OF B.Sc. (HONS.) BIOTECHNOLOGY

UNDER CHOICE BASED CREDIT SYSREM

FROM SESSION 2020-2021, 2021-22 & 2022-23

SEMESTER V		**SEMESTER VI**	
C11-BHB23	Bioprocess Technology	C13-BHB28	Bio Analytical Tools
C12-BHB24	Recombinant DNA Technology	C14-BHB29	Genomics and Proteomics
DSE 1-BHB25	Animal Biotechnology/Animal Diversity I	DSE 3-BHB30	Medical Microbiology/Animal Diversity II/
DSE 2-BHB26	Plant Biotechnology/Plant Diversity I	DSE 4-BHB31	Bioinformatics /Plant diversity II
GE-6-BHB27	Basics of Forensic Science/Chemistry-5	GE-7-BHB 32	Food Biotechnology/Chemistry-6

C: Core Courses ; **GE:** Generic Elective; **AECC;** Ability Enhancement compulsory course

SEC; Skill Enhancement Course; **DSE**: Discipline specific Elective;

BHB: B.Sc.(Hons.) Biotechnology subject number code

	Semester I	**Semester II**	**Semester III**	**Semester IV**	**Semester V**	**Semester VI**	**GRAND TOTAL**
Total Marks	550	550	750	750	750	750	**4100**
Total Credits	20	20	30	30	30	30	**160**

SUMMARY OF COURSES, MARKS AND CREDITS FOR COMPLETION

B.SC.(HONS.) BIOTECHNOLOGY DEGREE

Total papers: 32; Core courses=14; Ability Enhancement Compulsory courses=5; Skill Enhancement Courses: 2; Discipline Specific Elective: 4; Generic Elective: 7; One month Industrial training/ hands on training for skill enhancement is compulsory for completion of this professional degree

B.Sc. (Hons.) Biotechnology PART III

CHOICE BASED CREDIT SYSTEM
(Academic Session 2020-2021, 2021-22 & 2022-23
Subject and Distribution of Marks
B.SC. (Hons.) Biotechnology Part III (5th Semester)

SEMESTER V					
Paper No and code	**Name of paper**	**Credit per Week**	**Internal Marks***	**External Marks**	**Total Marks**
C11-BHB23	Bioprocess Technology	4	26	74	100
C12-BHB24	Recombinant DNA Technology	4	26	74	100
DSE-1-BHB 25	Animal Biotechnology /Animal Diversity-I	4	26	74	100
DSE-2-BHB26	Plant Biotechnology /Plant Diversity-I	4	26	74	100
GE-6-BHB27	Basics of Forensic Science/Chemistry-5	4	26	74	100
LC-17 (C11-BHB23)	Practical Pertaining to Theory Paper-C11-BHB23	2	---	50	50
LC-18 (C12-BHB24)	Practical Pertaining to Theory C12-BHB24	2	---	50	50
LC-19 (DSE-1-BHB25)	Practical Pertaining to Theory Paper-DSE-1-BHB25	2	---	50	50
LC-20 (DSE-2-BHB26)	Practical Pertaining to Theory Paper-DSE-2-BHB26	2	---	50	50
LC-21 (GE-6-BHB27)	Practical pertaining to Theory Paper (GE-6-BHB27)	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%

B.Sc. (Hons.) Biotechnology PART III

CHOICE BASED CREDIT SYSTEM
(Academic Session 2020-2021, 2021-22 & 2022-23
Subject and Distribution of Marks
B.SC. (Hons.) Biotechnology PART III (6th Semester)

SEMESTER VI					
Paper No and code	**Name of paper**	**Credit per Week**	**Internal Marks***	**External Marks**	**Total Marks**
C13-BHB28	Bio Analytical Tools	4	26	74	100
C14-BHB29	Genomics and Proteomics	4	26	74	100
DSE-3-BHB-30	Medical Microbiology/Animal Diversity-II	4	26	74	100
DSE-4-BHB31	Bioinformatics/Plant Diversity II/	4	26	74	100
GE-7-BHB32	Food Biotechnology/ Chemistry-6	4	26	74	100
LC-22 (C13-BHB28)	Practical Pertaining to Theory C13-BHB28	2	---	50	50
LC-23 (C14-BHB29)	Practical Pertaining to Theory C14-BHB29	2	---	50	50
LC-24 (DSE-3-BHB-30)	Practical Pertaining to Theory Paper DSE-3-BHB-30	2	---	50	50
LC-25 (DSE-4-BHB 31)	Practical Pertaining to Theory Paper DSE-4-BHB-31	2	-	50	50
LC-26 (GE-7-BHB32)	Practical pertaining to (GE-7-BHB32)	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%

B.Sc. (HONS.) BIOTECHNOLOGY PART III (5TH SEMESTER)

C11- BIOPROCESS TECHNOLOGY-CODE: BHB23

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

OBJECTIVES:

- The aim of this subject is to instruct students with an in-depth understanding of the key process design concepts relating to the production of biomolecules of industrial importance, produced using isolated microbial and mammalian cells.
- This will also provide students with an up-to-date knowledge of upstream and downstream processing technology.
- Throughout this module, the emphasis will be on relating how market requirements influence the development and cost-effective optimization of biotechnology processes, stressing the multidisciplinary nature of this sector.
- Students will be equipped with a knowledge and understanding of mainstream bioprocess design heuristics so that they may engage productively within multidisciplinary process development teams.

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)**

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

UNIT II **(20 Periods)**

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

SECTION-B

UNIT III **(15 Periods)**

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV **(15 Periods)**

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

SUGGESTED READINGS

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.

C12- RECOMBINANT DNA TECHNOLOGY-CODE: BHB24

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

OBJECTIVES:

- This subject covers both the principles and the applications of molecular biology methods with an emphasis on the application of recombinant DNA technology to animals, plants and microbial organisms.
- It describes the use of genetically engineered products to solve environmental problems and cure human diseases.
- It also covers the practical application of recombinant DNA technology in industry, food production, human and veterinary medicine, agriculture and bioengineering.
- It will also discuss the use of recombinant DNA technology to identify, map and sequence genes and to determine their function.

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 (15 Periods)

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

UNIT II (20 Periods)

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription, Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

SECTION-B

UNIT III **(10 Periods)**

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

UNIT IV **(15 Periods)**

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

SUGGESTED READINGS

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing,
2. Oxford, U.K. 2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

DSE-1- ANIMAL BIOTECHNOLOGY-CODE: BHB25

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

OBJECTIVES:

- This subject covers the topics for the identification and characterization of animal breeds.
- Students will study the methods of developing DNA based diagnostics and genetically engineered vaccines for animals.
- This subject also includes animal genomics studies and its varied applications.
- Students will learn embryo-transfer technology, cloning, and transgenic animals.
- This subject also covers DNA forensics, molecular diagnostics, wildlife conservation, stem cell research and bio-processing technologies**.**

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)**

Gene transfer methods in Animals - Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II **(10 Periods)**

Introduction to transgenesis. Transgenic Animals - Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology - Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

SECTION-B

UNIT III **(20 Periods)**

Animal propagation - Artificial insemination, Animal Clones. Conservation Biology - Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV **(20 Periods)**

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

SUGGESTED READINGS

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

DSE-1 ANIMAL DIVERSITY I-CODE: BHB25

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

OBJECTIVES

- Students will be able to identify the Phylum or subphylum.
- Students will be able to define and discuss the means of locomotion used by each phylum or subphylum.
- Students will be able to define characters of each phylum and class.
- Students will be able to understand the type of symmetry and level of organization of each group.
- Students will be able to define and/or locate on a specimen all of the underlined terms in the text.
- Students will learn to explain and compare the life cycles of the Hydrozoa, Scyphozoa and Anthozoa.

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 **(15 Periods)**

a) Outline of classification of Non- Chordates upto subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes.
b) Protozoa: Locomotion, Reproduction, evolution of Sex, General features of *Paramoecium* and *Plasmodium*. Pathogenic protozoans
c) Porifera: General characters, outline of Classification; skeleton, Canal System

UNIT II **(15 Periods)**

a) Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.
b) Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations.
c) Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

SECTION-B

UNIT III **(15 Periods)**

a) Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features of Earthworm, Vermicomposting.

b) Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

UNIT IV **(15 Periods)**

a) Mollusca : general features, Outline of classification, Shell Diversity; Torsion in gastropoda,

b) Echinodermata: General features, Outline of Classification Larval forms

c) Hemichordata: Phylogeny: Affinities of *Balanoglossus*

SUGGESTED READINGS

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
2. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
3. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
4. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Pres

DSE-2 PLANT BIOTECHNOLOGY–CODE: BHB26

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

OBJECTIVES

- The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.
- Students will develop molecular strategies to support plant breeding programs, including molecular biodiversity analysis, quantitative genetics and molecular marker-trait associations.
- Students will be able develop a model to introduce and to study the expression of genes related to plant adaptations.
- Students will learn to apply biotechnology to the development of agriculture.
- Students will learn to apply and develop strategies to produce bio-products (metabolites, enzymes, recombinant proteins)
- Students will understand biotechnological processes that have also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

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 **(15 Periods)**

Introduction, Cryo and organogenic differentiation, Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II **(20 Periods)**

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

SECTION-B

UNIT - III **(20 Periods)**

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation Nomenclautre, methods, applications basis and disadvantages.

UNIT - IV **(10 Periods)**

Plant Growth Promoting bacteria.

Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

SUGGESTED READINGS

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics - A Molecular Approach. 3rdedition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

DSE-2 PLANT DIVERSITY I-CODE: BHB26

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

OBJECTIVES

- Students will learn taxa of lower and higher plant giving: characteristics, structures, forms, life cycle and economic importance.
- Students will be able to identify characteristics that distinguish the various plants adaptations

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.
2. The use of scientific calculators is allowed.

SECTION-A

UNIT I

Algae: **(20 Periods)**

General character, classification and economic importance. Life histories of algae belonging to various classes:

Chlorophyceae - *Volvox, Oedogonium*
Xantho phyceae -*Vaucheria*
Phaeophyceae - *Ectocarpus*
Rhodophyceae-*Polysiphonia*

UNIT II

Fungi: **(20 Periods)**

General characters, classification & economic importance.
Life histories of Fungi:
Mastigomycontina- *Phytophthora*
Zygomycotina-*Mucor*
Ascomycotina- *Saccharomyces*
Basidomycotina-*Agaricus*
Deutromycotina-*Colletotrichum*

SECTION-B

UNIT III

Lichens: **(10 Periods)**

Classification, general structure, reproduction and economic importance. Plant diseases:
4 of 36

Casual organism, symptoms and control of following plant diseases.
Rust & Smut of Wheat.
White rust of Crucifers.
Late blight of Potato.
Red rot of Sugarcane.
Citrus Canker.

UNIT IV

Bryophytes: **(10 Periods)**

General characters, classification & economic impotance.
Life histories of following:
Marchantia.
Funaria.

SUGGESTED READINGS

1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4 th edition, John Wiley and Sons (Asia) Singapore.
3. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.
5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.
8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
9. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
10. Webster, J. and Weber, R. 2007 Introduction to Fungi. 3 rd edition, Cambridge University Press, Cambridge.
11. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

GE-6-CHEMISTRY-5-CODE: BHB27

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

OBJECTIVES:

- Students will acquire an ability to observe accurately and objectively.
- Students will acquire an ability to solve problem.
- Students will acquire an ability to think scientifically, independently and to make rational discussion.
- Students will be able to understand what it means to use spectroscopic methods for qualitative and quantitative analysis.
- This subject will be able to describe the difference between a fluorescence excitation and emission spectrum.
- 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

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 **(15 Periods)**

Spectroscopy Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol

Electromagnetic radiation, regions of spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degrees of freedom.

UNIT II **(18 Periods)**

Electromagnetic spectrum: Absorption Spectra Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert's law, Molar absorptivity, presentation and analysis ofUV Spectra, types of electronic transitions, effect of conjugation.Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

SECTION-B

UNIT III **(15 Periods)**

Infrared (IR) Infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, Selection rules, intensity and position of IR bands, measurement of lR spectrum, fingerprint region, characteristic absorption of various functional groups and Interpretation of IR spectra of simple organic compounds.

Raman Spectrum Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

UNIT IV **(18 Periods)**

Elementary Quantum Mechanics

Black-body radiations, Planck's radiation law, photoelectric effect, heat capacity of solids. Sinusoidal wave equation Hamiltonian operator, Schrodingcr wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

SUGGESTED READINGS

1. Basic Inorganic Chemistry, F.A. Cotton, G Willdson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Leee, ELBS.
3. Concept of models of Inorganic Chemistry, B. Douglas, D. McDaniel, and J. Alexander, Jolin Wiley.
4. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W. W. Porterfield Addison-Welsey.
6. Inorganic Chemistry, A. G Sharpe, ELBS
7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall.
8. Inorganic Chemistry, Morrison and Boyd, Prentice-Hall.
9. Inorganic Chemistry, L.G Wade Jr. 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 Carey, McGraw-Hill, Inc.
13. Introduction to Organic Chemistry, Streitwieser, Healthcock and Kosover and Kosover, Macmillan.
14. Physical Chemistry, G.M. Barrow, International Student edition, McGraw Hill.
15. University General Chemistry, C.N.R. Rao. Macmillan.
16. Physical Chemistry, R.A Alberty, Wiley Eastern Ltd.

GE-6- BASICS OF FORENSIC SCIENCE-CODE: BHB27

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

OBJECTIVES:

- Students will understand the use of creativity in problem solving.
- Students will use primary scientific literature affectively in their own research.
- Students will be demonstrated practical experience of public speaking and presentation of their ideas and research.
- Students will be demonstrated competency in written forms of scientific communication.
- Students will learn principles and scientific knowledge in order to find facts about a criminal case.

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 **(15 Periods)**

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

UNIT II **(15 Periods)**

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

SECTION-B

UNIT III **(15Periods)**

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

UNIT IV **(15 Periods)**

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine,

Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

SUGGESTED READINGS

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

PRACTICALS

LC-17 (PRACTICAL PERTAINING TO THEORY C11-BHB23)

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

LC-18 (PRACTICAL PERTAINING TO THEORY C12-BHB24)

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

LC-19 (PRACTICAL PERTAINING TO THEORY DSE-1-BHB25) –ANIMAL BIOTECHNOLOGY

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.
8. Resolving DNA on Agarose Gel.

LC-19 (PRACTICAL PERTAINING TO THEORY DSE-1-BHB25) –ANIMAL DIVERSITY-I

1. Identification and Classification of Any these of the following -

Porifera*: Scypha, , Leucosolenia, Euspongia, Hylonema, Euplectella Cnidaria: Medrepora, Millepora, Physalia, Porpita, Valella, Aurelia, Metridium* Platyhelminthes: *Taenia, Fasciola*, Aschelminthes*: Ascaris, Ancylostoma, Enterobius* Annelida:

Pheretima, Hirudinaria, Chaetopterus, Nereis, Aphrodite Arthropoda: *Julus, Scolopendra, Peripatus, Carcinus, Limulus, Lepisma, Dragonfly, Musca, Acheta* Mollusca: *Pila, Unio, Mytilus, Loligo, Sepia, Octopus, Solen* Echinodermata: *Asterias, Ophiothrix, Echinus, Holothuria, Astrophyton* Hemichordata: *Balanoglossus*

2. Identification of slides with two points of identification.
Amoeba, Paramoecium, Ceratium, Plasmodium, Opalina, L.S. Sponge, Spicules of sponges, L.S. *Hydra, Obelia, Bougainvillia,* Larvae of *Fasciola,* Seta of Earthworm, Radula
3. Ecological Note - On any of the specimens in Exercise No 1
Models of dissection of Earthworm, Cockroach
Earthworm: Digestive, Nervous System,
Cockroach: Digestive Reproductive, Nervous System

LC-20 (PRACTICAL PERTAINING TO THEORY DSE-2-BHB26) PLANT BIOTECHNOLOGY

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.
5. To demonstrate various steps of Micropropagation.

LC-20 (PRACTICAL PERTAINING TO THEORY DSE-2-BHB26) PLANT DIVERSITY I

1. Comparative study of thallus and reproductive organs of various algae mentioned in theory
2. Comparative study of vegetative and reproductive parts of various fungi mentioned in theory.
3. Study and section cutting and lectophenol mount of plant disease materials studied in theory.
4. Study of various types of lichens.
5. Study of external features & anatomy of vegetative and reproductive parts of Marchantia and Funaria
6. Collection of algae, fungi, plant diseases materials and bryophytes available locally.

LC-21 (PRACTICAL PERTAINING TO THEORY GE-6-BHB27) CHEMISTRY-5

1. Synthesis and Analysis

(a) Preparation of sodium trioxalatoferrate(III), Na_3 $[Fe(C_2O_4)_3]$ and determination of its composition by permagnometry.

2. Synthesis or Organic Compounds

(a) Iodoform from ethanol and acetone

(b) Aromatic electrophlic substitution of benzene

1. p-nitroacetanilide
2. 2,4,6-tribromophenol

Diazotization/Coupling

3.Preparation of m-nitroaniline from m-dinitrobenzene

4. Interpretation of different spectra

LC-21(PRACTICAL PERTAINING TO THEORY GE-6-BHB27) BASICS OF FORENSIC SCIENCE

1. Documentation of crime scene by photography, sketching and field notes.
2. a. Simulation of a crime scene for training.

   b. To lift footprints from crime scene.
3. Case studies to depict different types of injuries and death.
4. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
5. Investigate method for developing fingerprints by Iodine crystals.
6. PCR amplification on target DNA and DNA profiling,
7. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking.

B. SC (HONS.) BIOTECHNOLOGY 3rd Year (6TH SEMESTER)

C13- BIO-ANALYTICAL TOOLS-CODE: BHB 28

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

OBJECTIVES:

- The primary objectives of this course are to develop the skills to understand the theory and practice of bio-analytical techniques.
- This subject will provide scientific understanding of analytical techniques and detail interpretation of results.

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)

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

UNIT II (15 Periods)

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

SECTION-B

UNIT III (15 Periods)

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV (20 Periods)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

SUGGESTED READINGS

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.

C14- GENOMICS & PROTEOMICS-CODE: BHB29

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

OBJECTIVES:

- The ultimate goal of this subject is to develop student's understanding towards the identification and characterization of proteins expressed in a genome.
- It includes study of the entire set of proteins in order to understand its structure and function.
- This subject will cover recent developments in genetics, epigenetics, small RNAs, proteomics, gene expression, mutagenesis and mapping genes.
- It aims to teach students advanced technologies, research methods with major emphasis on the applications of DNA sequencing and protein analysis techniques**.**

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 (15 Periods)

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 (10 Periods)

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.

SECTION-B

UNIT III (20 Periods)

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 filteration, SDS-PAGE); Native PAGE, Determination of covalent structures - Edman degradation.

UNIT IV **(15 Periods)**

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.

SUGGESTED READINGS

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.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. 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). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

DSE-3- MEDICAL MICROBIOLOGY-CODE: BHB-30

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

OBJECTIVES:

- Students will be able to identify common infectious agents and the diseases that they cause.
- Students will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
- Students will be able to recall microbial physiology including metabolism, regulation and replication.
- Students will be able to explain general and specific mechanisms by which an infectious agent causes disease.
- Students will be able to recognize and diagnose common infectious diseases from the clinical presentation and microbiological lab findings.
- Students will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.
- Students will be able to explain interventions employed to prevent infectious diseases including infection control measure and vaccines.

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 **(18 Periods)**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum, C.diphtheriae M.tuberculosis, M. leprae.*

UNIT II **(15 Periods)**

Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.*

SECTION-B

UNIT III **(12 Periods)**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

UNIT IV **(15 Periods)**

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton, Microsporun and Epidermophyton*) Subcutaneous infection (*Sporothrix, Cryptococcus*), systemic infection (*Histoplasma, Coccidoides)* and opportunistic fungal infections (*Candidiasis, Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

SUGGESTED READINGSS

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

DSE-3 ANIMAL DIVERSITY II-CODE: BHB-30

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

OBJECTIVES:

- Students will be able to identify organisms of given phylum.
- Students will be able to learn defining characters of each Phylum and Class and identify them
- Students will be able to learn general characteristics of each phylum, e.g. type of coelom, digestive system, circulatory system, fate of blastopore, type of symmetry, number of germ layers.

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: Proto-chordates, Pisces and Ambhibia (15 Periods)

Proto-chordates: Outline of classification, General features and important characters of *Herdmania, Branchiostoma*
Origin of Chordates
Pisces: Migration in Pisces, Outline of classification
Amphibia: Classification, Origin, Parental care, Paedogenesis

UNIT II: Reptilia, Aves and Mammalia (15 Periods)

Reptelia: Classification, Origin
Aves: Classification, Origin, flight- adaptations, migration
Mammalia: Classification, Origin, dentition

SECTION-B

UNIT III: Comparative anatomy of vertebrates I (15 Periods)

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory systems.

UNIT IV: Comparative anatomy of vertebrates II (15 Periods)

Comparative Anatomy of vertebrates - Heart, Aortic arches, Kidney & urinogenital system, Brain, Eye, Ear.
Autonomic Nervous system in Mammals

SUGGESTED READINGS

1. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
2. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-HillCompanies.
4. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.
5. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

DSE-4 BIOINFORMATICS-CODE: BHB31

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

OBJECTIVES:

- The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.
- Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
- The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.
- The aim of practical subject is to provide practical training in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages.

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)

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 (20 Periods)

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

SECTION-B

UNIT III (20 Periods)

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 IV **(10 Periods)**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.

Genome Annotation: Pattern and repeat finding, Gene identification tools.

SUGGESTED READINGS

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

DSE-4 PLANT DIVERSITY II-CODE: BHB31

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

OBJECTIVES:

- Students will learn about seeds and pollen grains which are the key adaptations for life on land
- Students will learn about general characters of pteridophytes and gymnosperms

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: Pteridophytes (10 Periods)

General characters of pteridophytes, affinities with bryophytes & gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes - *Rhynia*

UNIT II: Pteridophytes Type studies **(20 Periods)**

Life histories of *Selaginella*- (Heterospory and seed habit), *Equisetum, Pteris*, *Lycopodium*

SECTION-B

UNIT III: Gymnosperms (20 Periods)

General characters, classification, geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms- *Williamsonia* & *Glossopteris,* telome and stele concept.

UNIT IV: Gymnosperms: Type studies (10 Periods)

Life histories of *Cycas & Pinus,* economic importance of gymnosperms.

SUGGESTED READINGS

1. Bhatnager, S.P. and Moitra, A. 1996 Gymnosperms. New Age International (P) Ltd. Publishers, New Delhi.
2. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
3. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
4. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

GE-7 FOOD BIOTECHNOLOGY-CODE: BHB32

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

OBJECTIVES:

- This subject discusses the technological principles and industrial applications of microorganisms and enzymes in food production and processing systems to provide useful products and services.
- This subject will cover basic properties, characteristics of microorganisms and enzymes, their metabolic pathways and how these are harnessed, manipulated and applied to increase productivity in food sector.
- Major fermented food product technologies will also be discussed with specific references to alcoholic beverages, dairy products, organic acid, traditional fermented products.
- The practical component of this subject will include food fermentation and processing concepts to help student's understanding in food technology and related processes.

INSTRUCTIONS FOR THE PAPER-SETTER

1. 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)**

Food and Microorganisms: Composition of food, food as substrates for microbes (intrinsic and extrinsic factors), factors affecting growth of microorganisms, SCP mushroom, food yeast's, algal proteins, applications of enzymes in food processing.

UNIT II **(12Periods)**

Principles of food preservation: Physical, chemical, and biological methods of preservations. Contamination, preservation and spoilage of different kind of foods. Fermented foods: Bread, cocoa, coffee, tea, cheese, yoghurt, meat and alcoholic beverages.

SECTION-B

UNIT III **(10 Periods)**

Food adulterants and food additives: Major food adulterants, types and their methods of assay, food additives their function and uses, flavoring agents, coloring agents and vitamins as food additives. Probiotics, biofortified foods, fortified foods, functional foods, nutraceuticals, organic foods. Biotechnology and future foods (Golden rice, potato).

UNIT IV **(15 Periods)**

Food and water borne diseases: Shigellosis, salmonellosis, cholera. Food borne intoxications: Stapgylococcal, Bacillus and Clostridium. Detection of microorganisms in food: Qualitative methods to isolate pathogenic microorganisms, test for bacterial toxins in foods; Quantitative methods for microbial enumeration: Direct enumeration, indirect estimations and standard and recommended methods; Rapid methods and automation: Immunoassays, nucleic acid probe for detection of pathogens.

SUGGESTED READINGSS

1.Frazier W.C., Westhoff, D.C. (Ed). (1988). Food microbiology (McGraw Hill).
2.Admas, M.R., Moss, M.O (2005). Food microbiology (Edition 3, Illustrated Publisher Royal Society of Chemistry).
3.SriLakshmi B. (2003) Food science (New Age International Publishers, India).
4. Jay J.M., M.J. Loessner, D.A. Golden. (2005). Modern food microbiology (Edition 7, Illustrated Publisher Springer).
5.B. Sivasankar (2004). Food processing and preservation (PHI Private Ltd, New Delhi).
6. Michael P. Doyle (1989). Food borne bacterial pathogens (Edition illustrated, Publisher Marcel Dekker).
7. Cappuccino J.G., Sherman N. (2007). Microbiology: A laboratory manual (Pearson Benjamin Cummings).

GE-7 -CHEMISTRY-6-CODE: BHB32

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

OBJECTIVES:

- Students will acquire an ability to communicate using the language of chemistry.
- Students will develop an appreciation of chemistry and its application in daily life.
- Students will develop an awareness of the social, economic, environmental and technological implication of chemistry.

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 **(15 Periods)**

Bioinorganic Chemistry-Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{+2}, Nitrogen fixation.

Carbohydrates Classification and nomenclature, Monosaccharides, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers, and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharide starch and cellulose.

UNIT II. **(15 Periods)**

Amino Acids, Pcptidcs, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids. Acid base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical levels of protein structure. Protein denaturation/renaturation.

Nucleic acids: Introduction, Constituents of nucleic acids Ribonucleosides and ribonucleotides. The double helical structure of DNA.

SECTION-B

UNIT III **(18 Periods)**

Solid State Definition of space lattice and unit cell.

Laws of crystallography, X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure ofNaCI, KCI and CsCI.

Heterocyclic Compounds Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Introduction to condensed five and six membered heterocycles.Preparation of indole, quinoline and isoquinoline .

UNIT IV **(15 Periods)**

Photochemistry Interaction of radiation with matter, difference between thermal and photochemical process. Laws of photochemistry: Grothus-Drapperlaw, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions- energy transfer processes (simple examples). Photochemistry of vision and colour.

SUGGESTED READINGSS

1. Basic Inorganic Chemistry, F.A. Cotton, G Willdson and P.L. Gaus, Wiley.
2.Concise Inorganic Chemistry, J.D. Leee, ELBS.
3. Concept of models of Inorganic Chemistry, B. Douglas, D. McDaniel, and J. Alexander, Jolin Wiley.
4.Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C.H. Langford, Oxford.
5.Inorganic Chemistry, W. W. Porterfield Addison-Welsey.
6.Inorganic Chemistry, A. G Sharpe, ELB
7. Inorganic Chemistry, G. L. Miessler and D. A. Tarr, Prentice Hall.
8.Inorganic Chemistry, Morrison and Boyd, Prentice-Hall.
9.Inorganic Chemistry, L.G Wade Jr. Prentice-Hall.
11.Fundamentals of Organic Chemistry, Solomons, John Wiley.
12.Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
13.Organic Chemistry, F.A Carey, McGraw-Hill, Inc.
14.Introduction to Organic Chemistry, Streitwieser, Healthcock and Kosover and Kosover, Macmillan.
15. Physical Chemistry, G.M. Barrow, International Student edition, McGraw Hill.
16.University General Chemistry, C.N.R. Rao. Macmillan.
17.Physical Chemistry, R.A Alberty, Wiley Eastern Ltd.
18.The Elements of Physical Chemistry, P. W. Atkins, Oxford.

PRACTICALS

LC-22 (PRACTICAL PERTAINING TO THEORY C13-BHB28)

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.

LC-23 (PRACTICAL PERTAINING TO THEORY C14-BHB29)

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

LC-24 (PRACTICAL PERTAINING TO THEORY DSE-3-BHB30) MEDICAL MICROBIOLOGY

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of Aspergillus and Candida by apprpriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.

LC-24 (PRACTICAL PERTAINING TO THEORY DSE-3-BHB30) ANIMAL DIVERSITY II

1. Identification & Classification upto order of the following: Proto-chordata: *Salpa, Doliolum, Herdmania, Branchiostoma*
Cyclostomata*: Myxine, Petromyzon*
Chondrichthyes: *Scoliodon, Zygnea, Pristis, Trygon, Raja, Chimaera*
Ostiechthyes: *Labeo, Mystus, Catla, Hippocampus, Anabas, Echeneis, Lophius, Polypeterus* Amphibia: *Rana, Hyla, Amblystoma, Necturus, Proteus*.
Reptiles: *Hemidactylus, Calotes, Draco, Phrynosoma, Naja Vipera,*

Bungarus Aves*: Columba, Alcedo, Passer*
Mammalia: *Ornithorhynchus, Macropus, Didelphes, Dasypus*

2. An Ecological Note on any one of the specimens in Experiment 1
3. Identification of the following slides
Mammalian Histology: Liver, Lung, Intestine, Kidney, Ovary, Testes
Slides of *Salpa, Doliolum,* Spicules of *Herdmania,* Tadpole of Frog
4. Preparation of a permanent mount of *Salpa,* Placoid scales, spicules of *Herdmania*, Pharynax of *Amphioxus*, Tadpole Larva of frog
5. Identification of endoskeletons of frog and rabbit.

LC-25 (PRACTICAL PERTAINING TO THEORY DSE-4-BHB31) BIOINFORMATICS

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

LC-25 (PRACTICAL PERTAINING TO THEORY DSE-4-BHB31) PLANT DIVERSITY-II

1. Examination of morphology and anatomy of vegetative and reproductive parts of
Selaginella, Equisetum & Pteris.
2. Examination of morphology and anatomy of vegetative & reproductive parts of - *Cycas*
& Pinus
3. Plant collection (pteridophytes & gymnosperms)

LC-26 (PRACTICAL PERTAINING TO THEORY GE-7-BHB32) FOOD BIOTECHNOLOGY

1. Isolation and identification of microorganisms of spoiled (fungi and bacteria).
2.Inhibitory effect of low temperature on microbial growth.
3.Production and estimation of ethanol.
4.Production of vinegar.
5.Estimation of lactose in milk.
6.Methylene blue reductase test (MBRT) for determination of quality of milk.
7.Plating the milk samples for microbial contamination.
8.Demonstration for the identification of mushrooms by spore prints.
9.Checking the effect of pasteurization of milk by alkaline phosphatase.

LC-26 (PRACTICAL PERTAINING TO THEORY GE-7-BHB32)
CHEMISTRY-6

1.Column Chromatography
2. Separation of leaf pigments from spinach leaves.
3. Physical Experiments
(a) To determine the strength of the given acid conductometrically using standard alkali solution.
(b) To determine the solubility and solubility product of a given sparingly soluble electrolyte conductometrically.
(c) To study the saponification of ethyl acetate conductometrically.
(d) To determine the ionisation constant of a weak acid conductometrically.
(e) To determine the strength of the given acid solution pH- metrically by using standard alkali solution.
(f) To determine the molar refraction of methanol, ethanol and propanol.
(g) To study the distribution of benzoic acid between benzene and water, and ether and water.
(h) Knowledge of Stereochemical Study of Organic Compounds.
R and S configuration of optical isomers.
E and Z configuration of geometrical isomers.
Conformational analysis of cyclohexanes and substituted cyclohexanes.