1. The B.Sc. Biotechnology will be of three years duration semester-based Choice Based Credit System [CBCS] course.

2. There will be broadly four types of courses for B.Sc. Biotechnology Programme.
   The one credit of practical/laboratory shall be of 2 hours duration and one credit of lecture/tutorial will be of one hour duration per week.
   A. The Compulsory courses will be of 3 credits each and a candidate has to choose a minimum of 3 Compulsory courses being offered by the concerned college/ institute. Thus a minimum of 9 [3 X 3 credits] will be opted by a candidate. Each of 3-credit courses will carry 75 marks.
   B. The core courses will comprise Hard core [Compulsory subject courses where no choice will be available] and Soft core courses [Choice for opting a course will be available] of 4 credits each, and a candidate will opt a total of 14 courses of 4-credits each [4 X 14 = 56 credits]. Each credit will carry 30 marks and each course of 4-credits will carry 100 marks. There will be 70 marks for theory and 30 marks for practical in each of the major/core courses. In theory 40 marks will be for semester end examination and 30 marks will be for continuous internal assessment. The component of internal assessment and marks will be as following:
      Internal assessment test I =10 marks (20 MCQs of ½ marks each)
      Internal assessment test II =10 marks (20 MCQs of ½ marks each)
      Assignment and presentation = 5 marks
      Attendance = 5 marks
      The criteria for attendance to be followed shall be: i) upto 75% lectures including condonation of lectures zero mark, ii) without condonation of lectures upto 75% : 1 mark; iii) 76-80% lectures : 2 marks, iv) 81-85% lectures : 3 marks; v) 86-90% lectures : 4 marks; vi) 91% and above lectures : 5 marks.
   C. Elective courses will comprise related to Minor subjects. Each Elective course will be of 4-credits each and a candidate opts for 5 courses of a Minor subject [say Chemistry, Botany, Zoology etc.] or at least 5 courses of two different minor subjects. A minimum of 10 Elective courses [4 X 12 = 48 credits] will be chosen by a candidate to get specialization in one or two minor subjects.
   D. General Interest and/ or Hobby courses will comprise such courses as the name suggests and each candidate will opt for at least one course of 1 credit.

3. (a) The admission to B.Sc. Biotechnology Programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.
   (b) The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/University with any of the three subjects out of Physics, Chemistry and Biology or any other science subject with 50% or equivalent grade (for SC/ST candidates marks of eligibility will be 45% or equivalent grade).
   (c) In case of candidates who are studying in University/Board/College/Schools in any of the foreign countries the eligibility/Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ST candidates, eligibility will be 45% marks or equivalent grade).
   (d) The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely
provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

(e) The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.

4. Admission will be based on the merit of the entrance test to be conducted by HP University or any other mode as to be decided by the University from time to time.

5. The tuition fee and other monthly/annual charges will be as per University rules.
# OUTLINE OF COURSES FOR B. Sc. WITH MAJOR IN BIOTECHNOLOGY

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses to be opted</th>
<th>Course name</th>
<th>Credits</th>
<th>Course</th>
<th>Cumulative</th>
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Selection of various courses

A. Compulsory courses [Minimum 3 courses; 3 X 3 = 9 credits]
   (a) Languages
      i. Compulsory English
      ii. Compulsory Hindi
   (b) Social Sciences/Commerce/Management
      iii. Compulsory Social Science/ Commerce/management course
      iv. Compulsory Geography of Himachal Pradesh
      v. Compulsory Indian Constitution
      vi. Compulsory Himachal Past, Present and Future
   (c) Science
      vii. Compulsory Basic Science (not for students majoring in science subjects)
      viii. Climate Change and its impact on mountain sustainability
      ix. Compulsory Environmental Science (Audit Pass Course)
   (d) Skill based courses
      x. Functional English
      xi. Office Computing
      xii. Functional Hindi
      xiii. Application Packages for finance
      xiv. Secretarial practice
      xv. Short hand and word processing
      xvi. Web applications

B. Major Core courses (BIOTECHNOLOGY)

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<th>Code</th>
<th>Core Courses</th>
<th>L: Lecture</th>
<th>T: Tutorial</th>
<th>P: Practical</th>
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Minor (Elective) Biotechnology Courses

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C. Minor Elective Courses

Details of the syllabus will be as prescribed by the University. Chemistry shall be compulsory minor elective for B.Sc. students majoring in Biotechnology and second minor elective will be one of following subjects:

1. Economics
2. Public Administration
3. Computer
4. Physics
5. Mathematics
6. Sociology
7. Geography

D. General Interest (GI) and / or Hobby (H)

Details of the syllabus will be as prescribed by the University.

1. Commercial arts
2. German language
3. Russian language
4. Spoken English
5. Photography
6. General computer applications
7. Fine arts
8. Playing musical instrument(s)
COURSE: B.SC.BT101
BIOMOLECULES

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit I

Unit II
Proteins: Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organisation of proteins (primary, secondary, quaternary domain structure), protein classification and function. Forces stabilizing primary, secondary and tertiary structure. Laboratory synthesis of protein, lectin antibodies

Unit III
Lipids: Classification of lipids and fatty acids, general functions of major lipid subclasses, acylglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpens, sterols, steroids. Prostagladins, Prostaryclins, Leukotrienes etc.

Unit IV
Nucleic acids: Structure of nucleosides, nucleotides and nucleic acids, biologically important nucleotides and their functions. Applications of biochip and microarray. Vitamins and hormones: Types of vitamins and their chemistry vitamins as cofactors, steroids and peptide hormones

Suggested books:
1. Biochemistry- Rawn, J.D.
3. Biochemistry- Stryer, L.
5. Carbohydrate Biotechnology Protocols- Bucke C.
7. An Introduction of practical biochemistry- Plummer D.T.
8. Practical Biochemistry- Bansal, D.D., Khardori, R & Gupta, M.M.

List of Practical:
1. Preparation of physiological buffers
2. Verification of Beer lamberts law for P-nitrophenol or cobalthchloride
3. Determination pKa value of p-nitrophenol
4. The colorimetric estimation of inorganic phosphates
5. Estimation of carbohydrates in given solution by Anthron method.
6. Estimation of sugars in biological samples
7. Protein estimation by lowry’s method.
8. Protein estimation by Bradford methods.
9. Analysis of urine for urea, glucose, uric acid and chloride.
10. The determination of acid value of a fat
11. Saponification value of a fat
12. Separation of lipids by thin layer chromatography.
Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

**Unit-I**
Cell as a basic unit of living systems. The cell theory. Precellular evolution: artificial creation of cells.

**Broad classification of cell types:** PPLO’s, bacteria, eukaryotic, microbes, plant and animal cells. A detailed classification of cell types within an organism. Cell, tissue organ and organisms as different levels of organizations of otherwise genetically similar cells.

**Unit-II**
Ecological amplitude of cells in high altitude, sediments, arctic, hot-spring, arid, brackish, extremophytes and freshwater environments.

**Biochemical composition of cells** (proteins, lipids, carbohydrates, nucleic acids and the metabolic pool)

**Biological Membranes:** Supramolecular architecture of membranes; solute transport across membranes, model membranes and liposomes.

**Unit-III**
Structure and function of cell organelles, ultra structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.) Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus chromatin).

**Unit-IV**
Cell division and cell cycle: mitosis, meiosis, stages of cell cycle, binary fission amitosis.

Cell-cell interaction

Cell locomotion (amoeboid, flagellar and ciliar)

Cell senescence and death: Apoptosis and necrosis

Cell differentiation in plants and animals: totipotent, multipotent, pleuripotent cell.

**Suggested books:**
1. *Cell and Molecular Biology* - De-Robertis, F.D.P. and De-Robertis Jr. E.M.F.
3. The Cell: A Molecular Approach - Geoffrey, M

**List of Practical:**
1. Microscopy:
   a. Principles of compound, phase contrast, electron microscopy
   b. Use and care of Light compound microscope.
2. Study of cells:
   a. Prokaryotic cells: *Lactobacillus, E.Coli*, Blue green algae
   b. Eukaryotic cells. Testicular material (for studies of spermatogenesis)
4. Preparation of permanent slides: Principles and procedures; section cutting of tissues and staining of tissues with Haematoxylin/eosin method.
5. Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas testis, ovary, tongue, skin etc.)
6. Cytochemical techniques to study carbohydrates, nucleic acids and proteins.
7. Preparation and study of meiosis slides from meristem tissue by squash method.
Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus.
There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit I
History of Microbiology: A.Leeuwenhoek, L.Pasteur, R.Koch, J.Lister, J.Tyndall, etc.
Biogenesis vs Abiogenesis, Koch’s Postulates, Discovery of antibiotics.
Principle of Microscopy: Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy.

Unit II
Microbial classification: Bacteria, Fungi and Algae.
Morphology of bacteria, Viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, Sporulation/germination process.

Unit III
Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rates, monoauxic, diauxic and synchronous growth, chemostat.
Microbes in extreme environment like high temperature and high/low pH values. Physical and chemical agents to kill microbes, sterilization and pasteurization processes

Unit IV
Normal micro flora in humans/animals. Types of microbial pathogens and disease caused by them. Microbial interactions like symbiosis and antibiosis etc. Host defense mechanism against pathogens.
Nitrogen fixing microbes in agriculture.
Microbial metabolism, unique pathways, photosynthesis, fermentation and its products, production of heterologous proteins in microbes.

Recommended books:
1. Microbiology- Davis, B.D Dulbecco, R., Eiser, H.N. and Ginsberg, H.S.
3. General Microbiology- Stanier, R.Y.
4. Microbiology- Pelczar, M.T.
5. General microbiology- Schlegel, H.G.
6. Industrial Microbiology- Prescott and Dunn
7. Microbiology: fundamentals and Applications- Purohit, S.S.
8. Microbes and Man- Postgate, J.
9. Microbiology: Laboratory manual- Cappuccino, J.G and Sherman, N.

List of Practical:
1. Aseptic techniques
2. Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization
3. Personal hygiene-microbes from hands, Tooth-scums and other body parts.
4. Isolation of microorganisms from air, water and soil samples
5. Dilution and pour plating techniques.
6. Enumeration of microorganisms total vs viable counts.
7. Identification of isolated bacteria
8. Gram staining, other staining methods, metabolic characterisation (e.g ImVIC) Tests
9. Growth curve of microorganisms.
10. Antibiotics sensitivity of microbes. Use of antibiotic discs.
11. Testing of water quality
12. Test for antibodies against given Bacteria
13. One step growth of bacteriophage.
14. Culture from body fluids (stool, urine, blood).
15. Alcoholic and mixed acid fermentation.
Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Nature of genetic material, nucleic acids, DNA replication
Organism of Chromosomes: Genome size and complexity, the supercoiling of DNA, the structure of prokaryotic and eukaryotic chromosome, Polytene chromosomes, euchromatin and heterochromatin, satellite DNA, centromere and telomere structure.

Unit-II
Gene organization and expression in prokaryotes and eukaryotes. Introduction to Genes and Proteins, Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA, Secondary structure, Triplet Coding, Protein sequences, Protein Structure, Secondary, Tertiary and Quaternary structures.

Unit-III
Gene linkage and chromosome mapping: Linkage and recombination of genes in chromosomes, crossing over and its molecular mechanism, gene mapping by three point test crosses, mapping by tetrad analysis, somatic cell hybridization for gene linkage studies, recombination within genes.

Unit-IV
Mutation: Spontaneous versus induced mutations, types of mutations, the molecular basis of mutations, mechanisms of DNA repair, mutations, frequency, correlation between mutagenicity and carcinogenicity, mutagenic agents, chemical and radiation.
Population Genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies, introduction of eugenics.
Basic microbial genetics: Conjugation, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathway, one gene– one enzyme hypothesis.

Recommended Books:
1. Microbial Genetics- Maloy, S.R. Crown, J.E., and Freifelder, D.
2. Genetics- Hartl, D.L.
3. Genetics: Analysis and Principles- Brooker, R.J.
4. The Science of Genetics- Antherly A.G. Girton, J.R.
5. Microbial Genetics- Freifelder, D.

List of Practicals:
1. Demonstration of Law of segregation and Independent assortment (use of coloured beads, capsules etc.) Numericals for segregation and independent assortment. Use of Chi2 for prediction of phenotype/genotype frequencies of parents from progeny and vice-versa, Epistasis.
2. Segregation demonstration in preserved material (Maize)
3. Detection of Blood groups (A B O & Rh factors)
4. Inheritance of other human characteristics, ability to test PTC, Thiourea
5. Calculation of variance in respect of pod length and number of seeds/pod
6. Calculation of gene frequencies and random mating (coloured beads, capsules)
7. Paternity disputes (blood groups)
8. Preparation and study of mitosis slides from buccal mucosa and onion root tips by squash method.
9. Demonstration of sex chromatin from buccal smear using thionin stain.
COURSE: B.SC.BT203
FOOD BIOTECHNOLOGY

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks

Theory: 36 Credit Hours (9 Credit Hours/Unit)
Practical: 12 Credit Hours

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and shall cover entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each of the units including compulsory question. All questions will carry equal (8 marks) marks.

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**Unit-I**
Historical Background, Composition of Food, Improvement of food resources through Biotechnology (e.g. Golden Rice, Potato etc.).

**Unit-II**
Food Fermentations: Fermented milk, Cheese, Butter, Yoghurt
Alcoholic beverages (Beer, Wine and Whisky), Sauerkraut, Pickles, Soy products, Tea, coffee etc.

**Unit-III**
Value addition products like High Fructose Syrup, Invert Sugars etc. SCPs (Spirulina, Yeast etc.) as food supplements, Edible fungus: Mushrooms, Potential of Probiotics, Flavour enhancers: Nucleosides, nucleotides and related compounds, Organic acids (Citric acid, Acetic acid) and their uses in foods/food products, Importance of Vitamins and their supplementation in foods and feedstock. Food preservation and storage; Food Processing

**Unit-IV**

**Recommended books:**

1. Food Sciences and Food biotechnology- G.F.G. Lopez, G. Canaas, E. V. Nathan
2. Genetically Modified Foods- M. Ruse, D. Castle (Eds.)
3. Biotechnology of Food Crops in Developing Countries- T. Hohn and K. M. Leisinger (Eds.)
7. Modern Food Micro-Biology - J. M. Jay
List of practicals:
1. Estimation of Total Plate Count in any food sample.
2. Detection of *Salmonella* and *E. coli* in food material.
3. MBRT test of milk samples.
4. Malt preparation for beer making.
5. Cheese making (Non-ripened cheese).
7. Acetic acid/ Vinegar production and estimation of the product.
8. Toxin detection in the food materials.
9. Effect of internal factors on microbial growth in food *i.e.* pH, temperature, water activity.
COURSE- B.SC.BT301
CONCEPTS IN IMMUNOLOGY

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Semester end examination : 40 marks
Practical examination : 30 marks
Internal Assessment : 30 marks

Instructions for setting end semester examination question paper:
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Unit-I
Introduction: Types of immunity-innate and adaptive; features of immune response-memory. Specificity and recognition of self and non-self; terminology and approaches to the study of immune system; immunity to viruses bacteria; fungi and tumours; vaccines.

Cells and organs of the immune system.
Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic

Unit-II
Humoral Immunity
Antigen-antibody interactions; affinity and avidity; high and low affinity antibodies, immunoglobulins, classes and structure, molecular mechanism of generation of antibody diversity, complement fixing antibodies and complement cascade.

Cell Mediated Immunity
T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of T-cell antigen receptors.

Unit-III
Immunodiagnostic Procedures.
Various types of immunodiffusion and immunoelectrophoretic procedures, Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, Haemagglutination and Haemagglutination inhibition.

Suggested books:
1. Immunology- Roitt, I.M. Brostoff, J. and Male, D.K.
2. Immunology- Kuby, J.
4. Fundamental Immunology- Paul, W.E.
5. Monoclonal Antibodies Principles and Application- Britch, J.R. and Lennox, E.S.
6. Medical Immunology- Strites, D.P. Terr, A.I. & Oparslow T.G.
7. Clinical Immunology and Serology: A laboratory perspective- Steverns, C.D.

List of Practical:
1. To perform ELISA.
2. To perform single radial immunodiffusion (Mancini’s technique) using antigen and antibody.
3. To perform precipitation test
   a). Ring test
   b). Slide test
   in solution given an antigen and antibody.
4. Determination of titer if antiserum.
5. To perform immunoelectrophoresis.
6. Purification of antigen and immunoglobulins.
COURSE: B.SC.BT302  
BASICS OF RECOMBINANT DNA TECHNOLOGY

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Semester end examination : 40 marks  
Practical examination : 30 marks  
Internal Assessment : 30 marks

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Introduction, Historical Enzymes Restriction enzymes, Ligases, DNA polymerase, kinases, Reverse transcriptase, Endonucleases, Phosphatase.

Unit-II
Vectors: Plasmid, Cosmids, Lambda, Vectors (Intentional and Replacement vectors) M-13, Phagemids

Unit-III
Radioactive and non-radioactive DNA and RNA labelling techniques: Nick translation, random priming, Sequencing

Unit-IV
Southern and Northern blotting, hybridization  
Introduction to site directed mutagenesis  
PCR and its Applications  
Transformation of E.coli Yeast, animal and plant cells, Genomic cloning, cDNA cloning and colony hybridization.  
Application of rDNA technology to medicine, agriculture and environment.

Recommended Books:
4. Recombinant Gene Expression Protocols- Tuan Rockey S
5. PCR Cloning Protocols- White Bruce A

List of Practical:
1. DNA isolation from plants
2. DNA isolation from E.coli
3. Spectrophotometer analysis of DNA
4. Agarose gel electrophoresis of DNA
5. Plasmid DNA isolation
6. Restriction digestion of DNA
7. Southern Blotting
8. Making competent cells
COURSE: B.SC.BT401
INSTRUMENTAL METHODS AND ANALYSIS

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Semester end examination : 40 marks
Practical examination : 30 marks
Internal Assessment : 30 marks

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit I
Centrifugation: Principle, types, application
Electrophoresis: Principle, types, application
PCR techniques and DNA isolation

Unit II
Spectrophotometry (UV & Visible) and spectrofluorimetry, Atomic absorption spectrophotometry
Infrared and Raman spectroscopy, ORD and circular dichroism, Nuclear magnetic Resonance and Electron Spin Resonance spectroscopy, Magnetic Resonance Imaging.
Concepts of microscopy-sections

Unit III

Unit IV
Radioisotope techniques: radiotracers GM Counter, Proportional and Scintillation counters, autoradiography, Mass spectrometry-GCMS and LCMS.

Recommended Books:
1. Principles and Techniques of Practical Biochemistry- Keith Wilson & John Walker (Eds.)
2. Spectroscopy of Biological Molecules: Modern Trends- P. Carmona, R. Navarro, A. Hernanz (Eds.)
4. Protein NMR for the Millennium (Biological Magnetic Resonance)- N. Rama Krishna, Lawrence J. Berliner (Eds.)

List of Practical:
2. To perform salting out for partial purification of protein(s) in a given mixture.
3. Preparation of serum by centrifugation.
4. To separate a mixture of amino acids by Ascending Paper Chromatography.
5. To separate a mixture of amino acids by Thin Layer Chromatography.
6. Agarose Gel electrophoresis of DNA.
7. SDS-PAGE of proteins.
8. Polymerase Chain reaction.
9. Sandwich ELISA.
10. To check the purity of DNA by UV Spectrophotometry.
COURSE: B.SC.BT402
INTRODUCTION TO BIOINFORMATICS

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Semester end examination : 40 marks
Practical examination : 30 marks
Internal Assessment : 30 marks

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

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

UNIT II
Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques, Restriction Enzymes, Gel Electrophoresis, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry, What data each generates and what Bioinformatics problems they pose.

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

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

UNIT IV
Protein Structure: Protein structure classification, Structure Analysis, Secondary structure prediction methods, Comparative modeling
Genome Annotation: Pattern and repeat finding, Gene identification tools.

Suggested books:
2. Bioinformatics: A practical guide to the analysis of genes and proteins - Baxvanis (Ed.)
3. Bioinformatics online (Methods in Enzymology V. 266 Computer methods for macromolecular sequence) - Doolittle (Ed.)
4. Molecular Evolution: a phylogenetic approach - Page, ROM and Holmes EC
5. Bioinformatics: Sequences, structure and databanks - Des Higgins and Willie Taylor

List of Practical:
1. Sequence information resource
2. Understanding and using on web:
3. EMBL, Genbank, Entrez, Unigene, Protein information resource
4. Understanding and using on web:
5. PDB, Swissprot, TrEMBL
6. Using BLAST and interpretation of results.
7. Multiple sequence alignment using Clustal W
8. PAGE
COURSE: B.SC.BT403
FERMENTATION TECHNOLOGY

Theory: 36 Credit Hours (9 Credit Hours/Unit)
Practical: 12 Credit Hours

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and shall cover entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each of the units including compulsory question. All questions will carry equal (8 marks) marks.

UNIT I
Fermentation
Definition and scope of fermentation, Biochemical basis and overview of products based on enzyme catalysis and cell metabolism, Basic design and operation of fermenter, Economics of fermentation processes.

UNIT II
Solid state fermentation
Advantages and disadvantages of solid state fermentation, effect of environmental parameters on kinetics and growth of product formation and cellular physiology, Process variables and process control, Principles of solid state bioreactor design and operation and product leaching, Integrated process analysis of a few bio-process technology products like baker's yeast and enzymes.

UNIT III
Bio-process technology
Bio-process technology for the production of recombinant vaccines, therapeutic proteins, antibiotics and diagnostics; Energy forming bio-processes for the production of liquid fuel (ethanol), and gaseous fuel (methane), Microbial production of hydrogen.

UNIT IV
Advanced control strategies
Monitoring and control of environmental parameters in fermentation process, enzyme and microbial cell based bio-sensors.

List of books:
1. Biochemical Engineering - Aiba and Hemphery
2. Principles of Microbes and Cell Cultivation - S. John Pirt
4. Industrial Microbiology - L. E. Casida
4. Industrial Microbiology - Prescott and Dunn
5. Principles of Fermentation Technology - P. F. Stanbury and A. Whitaker

List of practicals:
1. Basic design of a laboratory fermenter.
2. Cleaning and sterilization of fermenter vessel.
3. Determination growth curve in a batch culture.
4. Determination of viability of cells in a yeast culture by Methylene Blue staining, Plate count and Haemocytometer methods
5. Production of Ethanol by simple/complex carbohydrate sources (media) using *Saccharomyces cerevisiae*.
6. Production of wine from apple / grape juice by *Saccharomyces cerevisiae*.
7. Production of citric acid by solid-state-fermentation using *Aspergillus niger*. 
COURSE: B.SC.BT501
ANIMAL CELL CULTURE

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
History of development of cell cultures, the natural surroundings of animal cells, stimulating natural conditions for animal cells, metabolic capabilities of animal cells.

Sterilization techniques: Aseptic techniques in animal tissue culture; sterilization of culture media, glassware and tissue culture laboratory, detection of contamination, safety considerations in ATC laboratory.

Unit-II
Animal Cell Culture Techniques: Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary cultures, transformed animal cells, established/continuous cell lines; measurement of growth and viability of cells in culture, tissue culture media: Components their importance. Serum free media.

Unit-III
Commonly used animal cell lines, their origin and characteristic, growth kinetics of cells in culture, differentiation of cells, organ culture, expressing cloned protein genes in animal cell cultures.

Applications: Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; Bioreactors for large scale culture of cells, micro carrier culture, transplanting cultured cells.

Unit-IV
Genetic Engineering in animal cells: Transformation of animal cells, vectors and expression vectors, Genetic Engineering in production or regulatory proteins, blood products, vaccines and hormones, Transgenic animals and production of useful products in transgenic animals.

In vitro fertilization, embryo transfer, cloning: methodology and its applications, ethics in cloning.

Recommended Books:
1. Mammalian Cell Biotechnology – A Practical Approach- Butler, M.
2. Culture of Animal Cells- Freshney, R. T.
3. Human Cell Culture Protocols- Gareth, E.J.
4. The Animal Cell Culture and Technology- Butler, M.
5. Cell Biology-A Laboratory hand books- Julio, E., Celis
7. Genes in Medicine– Rasko, I., and Downes, C.S.
8. Molecular Biotechnology Therapeutic Application and Strategies- Maulik S. and Patel, S.D.
10. Culture of Animal Cells- Freshney, R.T.

List of Practical:
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. Isolation of rat macrophages from peritoneum for culturing
7. Primary Lymphoid culture
8. DNA isolation from animal tissue
9. Quantification of isolated DNA
10. Resolving DNA on Agarose Gel.
COURSE: B.SC.BT502
PLANT CELL CULTURE

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Plant nutrition and deficiency symptoms, Plant growth regulators and their physiological functions and role in morphogenesis, plant water relationships.

Unit-II
Culture media, culture techniques
Sterilization techniques: for glassware, tissue and media.

Unit-III
Totipotency, somatic embryogenesis, micropropagation and somaclonal variation.
Protoplast culture and somatic cell hybridization, Induction of haploids and polyploidy through tissue culture, embryo rescue embryo culture, Production of secondary metabolites by plant tissue culture.

Unit-IV
Gene transfer in plant cells their application production of transgenics.

Recommended Books:
1. An introduction of Plant Tissue Culture- Razdan, M.K.
2. Plant Cell and Tissue Culture- Narayanaswamy, S.
3. Plant Cell Biotechnology- Rudolf, E.

List of Practical:
1. Sources of contamination and decontamination measures.
2. How to clean glass/plastic ware
3. Operational use of an autoclave.
4. Functions and operations of a Laminar Air Flow Hood
5. Preparation of simple growth nutrient (knop’s medium), full strength, half strength, solid and liquid.
6. Preparation of complex nutrient medium (Murashige & Skoog’s medium)
7. Laboratory design set up for a PTC laboratory.
8. Plugging and sealing of culture vessels.
9. To selection, Prune, sterilize and prepare an explant for culture.
10. Significance of growth hormones in culture medium.
11. To culture different explants for raising callus cultures.
12. To demonstrate various steps of Micropropagation.
Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I


Unit-II

Enzyme catalysis: Transition state theory, role of co-enzymes as a cofactor-NAD/ NADP+, FMN/FAD, coenzymeA, biocytin, cobalamide, lipoamide, TPP, pyridoxal phosphate and tetrahydrofolate, metal ions in enzyme catalysis, covalent catalysis, acid-base catalysis, proximity and orientation effects, strain and distortion theory. Structure and mechanism of chymotrypsin, carboxypeptidases, ribonuclease, lysosyme, glutathione reductase, aconitase and papain.

Unit-III


Unit-IV
Concepts of Bioenergetics: Principles of thermodynamics and their applications in Biochemistry-Introduction, thermodynamic system, thermodynamic state functions, first and second law of thermodynamics, concept of free energy, standard free energy, determination of ∆G for a reaction, relation between equilibrium constant and standard free energy change, Biological standard state and standard free energy change in coupled reactions. Biological oxidation – reduction reactions – introduction, redox potential, relation between standard reduction potentials and free energy change( Derivations and numerical included). High energy phosphate compounds- introduction, phosphate group transfers-free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ∆G.

Suggested books:
2. Principle of Enzymology for food science By J.R.Whitaker, 1972, Marcel Dekkers Inc.,
3. Biochemistry- Stryer, L

List of Practical:
1. Assay of salivary amylase.
3. Isolation and Purification and assay of invertase.
4. Effect of pH and temperature on enzyme activity.
5. Assay of amylases, proteases.
COURSE: B.SC.BT601
ENVIRONMENTAL BIOTECHNOLOGY

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Semester end examination : 40 marks
Practical examination : 30 marks
Internal Assessment : 30 marks

Instructions for setting end semester examination question paper:

The examiner will set nine questions in all. Q.No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit -I
Introduction: Historical importance, Environment pollution and its types, Impact of pollution on health

Unit-II
Introduction to toxicology including genetic toxicology, common assays to detect genetic toxicology, mutagenesis, carcinogenesis, Use of genetic engineering techniques in genetic toxicology.

Unit-III
Biodegradation of organic compounds, Bioremediation, Biosorportion of heavy metals, Waste water treatment, Methanogenesis, Composting, Volatile toxic gases and biofiltration

Unit-IV
Biomining and bioleaching, Biocides, Biosafety levels, Plastic menace, biodegradable plastics, Biofertilizers

Recommended Books:

1. Wastewater Engineering – Treatment, Disposal and Reuse- Metcalf and Eddy
2. Comprehensive Biotechnology- M. Moo-Young.
4. Introduction to Biodeterioration- D. Allsopp and K.J. Seal
6. Genetic Control of Environmental Pollutants- Gilbert S. Omenn and Alexander, H.
7. Experimental Toxicology- Anderson, D. & Conning, D.M.
8. Microbial Degradation of Organic Compounds- David T.G.

List of Practical

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water.
3. Determination of dissolved oxygen concentration of water sample.
4. Determination of biological oxygen demand (BOD) of a sewage sample.
5. Determination of chemical oxygen demand (COD) of sewage sample.
COURSE: B.SC.BT602
BIOPROCESS TECHNOLOGY

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Unit-I
Introduction: Fundamental principles of Chemical Engineering and biochemical engineering. Applications of physical and chemical laws on biological samples e.g., light reaction, photolysis of water, enzymatic reaction and simple kinetics.

Unit-II
Microbial Growth Kinetics: Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, internal and external feed back systems, metabolic and biomass productivities, effect of temperature, pH and inducer on product synthesis.
Sterilization: Introduction air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Unit-III

Unit-IV
Down stream processing: Introduction, removal of microbial cells and other solid matters. Foam separation, filtration, industrial filters and its principles, centrifugation and industrial centrifuges, cell disruption, aqueous two phase extraction system, super critical fluid extraction, whole broth processing, effluent treatment, aerobic and anaerobic slug treatment process, fermentation economics.

Recommended Books:
2. Environmental Biotechnology- Principles & Applications- Young M.Y.
4. Biochemical Engineering Fundamentals- Bailary, J.E. and Ollis, D.F.
5. Principles of Microbes and Cell Cultivations- S.J.Pirt

List of Practical:
1. Isolation of industrially important microorganisms for microbial processes.
2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism for design of a sterilizer.
3. (a) Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.
   (b) Compute specific growth rate (m), growth yield (Yx/s) from the above.
COURSE: B.SC.BT603
INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS & ENTREPRENEURSHIP

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Unit-I

Unit-II
Intellectual/Industrial property and its legal protection in research, design and development.

Unit-III
Patenting in Biotechnology, economic, ethical and depository considerations.
Patentable subject matter and legal aspects of transfer of Biotechnology in India. Writing a patent specification.
Information sources in Patent Literature search.

Unit-IV
Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. 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 etc.

Recommended Books: