

B.Sc. (Hons.) Biotechnology Course
Department of Biotechnology, Faculty of Science
VBS Purvanchal University Jaunpur-222003 (UP)

The admission to B.Sc. (Hons.) Biotechnology programme of VBS Purvanchal University will be conducted as per UG ordinances and Guidelines of VBS Purvanchal University, Jaunpur(UP) from time to time.

- i. 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).
- ii. 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).
- iii. 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 produce 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.
- iv. Theory examination: 50 marks Practical examination: 20 marks Internal Assessment: 30 marks Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Shailendra
14/08/2021

Gyanshwer Chauriy
14/08/2021

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

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The B.Sc. (Honours) Biotechnology will be of three years full time duration course

S.No.	Course Code	Paper Name	Year	Semester	Max. Marks
1	101	Biochemistry	1 st	I	50 Marks
2	102	Cell Biology			50 Marks
3	103	Genetics			50 Marks
4	104	Bioenergetics			50 Marks
Practical based on course code 101-104					100 Marks
5	201	Molecular Biology	1 st	II	50 Marks
6	202	General Microbiology			50 Marks
7	203	Immunology			50 Marks
8	204	Bio Analytical Tools			50 Marks
Practical based on course code 201-204					100 Marks
9	301	Enzymology	2 nd	III	50 Marks
10	302	Bioinformatics			50 Marks
11	303	Biostatistics			50 Marks
12	304	R-DNA Technology			50 Marks
Practical based on course code 301-304					100 marks
13	401	Bioprocess Technology	2 nd	IV	50 Marks
14	402	Animal Physiology			50 Marks
15	403	Plant Physiology			50 Marks
16	404	Environmental Biotechnology			50 Marks
Practical based on course code 401-404					100 marks
17	501	Biochemical Engineering	3 rd	V	50 Marks
18	502	Plant Biotechnology			50 Marks
19	503	Animal Biotechnology			50 Marks
20	504	Molecular Diagnostics			50 Marks
Practical based on course code 50-504					100 Marks
21	601	IPR Entrepreneurship, Bioethics and Biosafety	3 rd	VI	50 Marks
22	602	Basics of Forensic Science			50 Marks
23	603	Food Biotechnology			50 Marks
24	604	Genomics and proteomics			50 Marks
Project/Technical Report (Inhouse/Outhouse)					100 Marks
TOTAL					1800

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Course code 101: Biochemistry

UNIT I: Introduction to Biochemistry:

A historical prospective.

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

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides.

UNIT II

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

UNIT III

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

UNIT IV

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metallozymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity.

PRACTICALS

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Estimation of blood glucose by glucose oxidase method.
4. Principles of Colorimetry: Verification of Beer's and Lambert's law.
5. Estimation of protein.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

Sheelendra
14/08/2021

Gyaneshwer Chauriy
14/08/2021

Course code 102: Cell Biology

UNIT I

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions.

UNIT III

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function, Mitochondria: Structure and function, Chloroplasts: Structure and function, Nucleus: Structure and function, chromosomes and their structure.

UNIT IV

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

PRACTICALS

1. Study of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of structure of Prokaryotic and Eukaryotic cell.
4. Cell division in onion root tip/ insect gonads.

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Gyimesher Chauray
14/08/2021

Course code 103: Genetics

UNIT I

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Cell Cycle: Mitosis and Meiosis. Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis(dominant& recessive), duplicate genes and inhibitory genes.Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequencecomposition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, Genetic organization of prokaryotic and Eukaryotic genome. Chromosome morphology, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, Structural and numerical changes in chromosomes, chromosomal aberrations, Sex determination and sex linkage. Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory. Sex linked inheritance.

UNIT IV

Genetic linkage, crossing over and chromosome mapping, Extra chromosomal inheritance: Rules of extra nuclear inheritance, Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

PRACTICALS

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses.
4. Demonstration of -Barr Body.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness..
7. Study of polyploidy in onion root tip by colchicine treatment.

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Gyaneshwer Chauriy
14/08/2021

Course code 104: Bioenergetics

UNIT I

Fundamentals of thermodynamics- Endergonic and Exergonic processes, enthalpy , entropy activation energy, free energy change, phosphoryl transfer reaction, Oxidation reduction reaction, redox potential, high energy compounds, causes of energy richness in ATP

UNIT II

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway (Oxidative and Non-oxidative) and its significance, Gluconeogenesis, Glycogenolysis. TCA cycle, Electron Transport Chain,

UNIT III

β -oxidation of fatty acids. Fatty Acid Oxidation: major and Minor Pathways of Fatty acid oxidation. Metabolic Breakdown of Amino Acids, Transamination, Deamination, Urea Cycle.

Unit IV

Biological Mebranes: Membrane Proteins, Fluid Mosaic Model of Membrane Structure, Erythrocyte membrane, bacterial cell wall.

Thermodynamics of transport, Kinetics and Mechanism of transport, active and passive transport, ATP-driven active transport, Ion Gradient driven active transport.

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Gyaneshwer Chauriy
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Course code 201: Molecular Biology

UNIT I: DNA structure and replication

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

UNIT II: DNA damage, repair and homologous recombination

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

UNIT III: Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation

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

PRACTICALS

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

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Gyanshwer Chauriy
14/08/2021

Course code 202: General Microbiology

UNIT I

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II

Cultivation and Maintenance of microorganisms: Nutritional categories of microorganisms, methods of isolation, Purification and preservation. Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

UNIT III

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways. Genetic recombination in bacteria: Transformation, Transduction and Conjugation.

UNIT IV

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods. Introduction to microbial ecology.

PRACTICALS

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

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Gyanshwer Chauriy
14/08/2021

Course code 203: Immunology

UNIT I

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

UNIT II

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT III

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

UNIT IV

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnosics – RIA, ELISA.

PRACTICALS

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

Shailendra
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Gyaneshwer Chauriy
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Course Code 204: Bio-Analytical Tools

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

PRACTICAL

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.

Sheelendra
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Gyaneshwer Chaudhary
14/08/2021

Course code 301: Enzymology

UNIT - I

Isolation, crystallization and purification of enzymes, methods of enzyme analysis. Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Double reciprocal transformation. factors affecting enzyme activity.

UNIT – II

Enzyme inhibition and its types. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency. Chemical modification of active site: Covalent modifications.

UNIT – III

Allosteric enzymes with special reference to aspartate transcarbamylase and phosphofructokinase. Qualitative description of concerted and sequential models. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multi enzyme complexes. Ribozymes.

UNIT – IV

Enzyme Technology: Methods for large scale production of enzymes. Immobilization technology and its applications. Immobilized enzyme reactors. Enzyme electrodes. site directed mutagenesis and enzyme engineering, Methods for protein sequencing.

PRACTICALS

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

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Course code 302: Bioinformatics

UNIT I

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

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 and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT III

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

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

PRACTICALS

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.

Shailendra
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Gyaneshwer Chauray
14/08/2021

Course code 303: BIOSTATISTICS

UNIT I

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

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

UNIT II

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

UNIT III

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

UNIT IV

Correlation and Regression and its applications in Biological Sciences.

PRACTICALS

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

Shailendra
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Gyanshwer Chaur
14/08/2021

Course code 304: RECOMBINANT DNA TECHNOLOGY

UNIT I

Molecular tools and applications - Restriction and modification system (restriction enzymes ligases, polymerases, alkalinephosphatase), restriction mapping. Cloning vectors: Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), DNA delivery methods: Transformation, Microinjection, Electroporation, Biolistics. Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR

UNIT II

Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in medical, agriculture and environment.

UNIT III

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis,

UNIT IV

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.

PRACTICALS

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

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Course code 401: BIOPROCESS TECHNOLOGY

UNIT I

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

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Mechanically and non-mechanically agitated reactors and their application. Principles of up stream and down stream processing.

UNIT III

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; determination of KLa value, factors affecting KLa value. Bioprocess measurement and control system.

UNIT IV

Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins. Effluent treatment.

PRACTICAL

1. Calculation of bacterial growth curve.
2. Production and analysis of ethanol.
3. Production and analysis of amylase..
4. Production and analysis of lactic acid.
5. Isolation of industrially important microorganism from natural resource.

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Course code 402: MAMMALIAN PHYSIOLOGY

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

UNIT I

Digestive system: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. Respiratory system: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift.

UNIT II

Circulatory system: Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III

Muscular system: physiology and osmoregulation, Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None principle, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Functions of nephron and Mechanism of urine formation.

UNIT IV

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

PRACTICALS

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme

Shailendra
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Gyimesher Chauriy
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Course code 403: MICROBIAL AND PLANT PHYSIOLOGY

UNIT I

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system).

UNIT II

Effect of the environmental factors on microbial growth, Effect of temperature, pH, oxygen concentration, radiation and pressure and their adaptations. Chemolithotrophs, Hydrogen oxidizing bacteria and methanogens.

UNIT III

Photosynthesis: Photosynthetic pigments, concept of photo systems, cyclic and non-cyclic photo phosphorylation. Carbon dioxide fixation: C₃, C₄ and CAM cycles, photorespiration, physiology of bacterial photosynthesis.

UNIT IV

Nitrogen metabolism: Nitrogen fixation, nitrate reduction and ammonium assimilation in plants. phytohormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.

PRACTICALS

1. Separation of photosynthetic pigments by paper chromatography.
2. Demonstration of aerobic respiration.
3. Symbiotic bacteria isolation from leguminous plant.

Shailendra
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Gyanshwer Chaudhary
14/08/2021

Course code 404: ENVIRONMENTAL BIOTECHNOLOGY

UNIT I

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

UNIT II

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

UNIT III

Treatment of municipal solid waste and Industrial effluents. Bio-fertilizers: Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Fungal and cyanobacterial biofertilizers.

UNIT IV

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes in environmental cleanup, Zoo-remediation

PRACTICALS

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. MPN test.

Shailendra
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Course code 501: INDUSTRIAL FERMENTATIONS

UNIT I

Substrate for industrial fermentation, Production of biochemicals and therapeutic agents: Propionic acid, butyric acid, gluconic acid, anti cancer compounds. Microbial insecticides;

UNIT II

Steroid fermentations and transformations. Over production of microbial metabolite, Secondary metabolite and its significance. Enzymes: Proteases, amylases and lipases.

UNIT III

Production of organic acids: Citric acid, acetic acid lactic acid

UNIT IV

Industrial production of antibiotics: Penicillin, streptomycin, ampicillin (semi-synthetic antibiotic), Microbial production of amino acids: Glutamate, lysine. microbial flavours and fragrances. Mechanism of industrial strain improvement: classical and modern methods.

PRACTICALS

1. Comparative analysis of design of a batch and continuous fermenter.
2. Isolation of protease and amylase producers
3. Isolation of antibiotics producers

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Gyaneshwer Chaudhary
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Course code 502: PLANT BIOTECHNOLOGY

UNIT I

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

Introduction to Embryo, Callus, Organs, Cell and Protoplast culture. Micropropagation: advantages and disadvantages of micropropagation, Axillary bud proliferation, Meristem and shoot tip culture, organogenesis and embryogenesis,.

UNIT II

In vitro haploid production, Anther culture, significance and use of haploids, Ploidy level and chromosome doubling, diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT III

Protoplast Isolation, Viability and fusion Methods, Protoplast development, regeneration frequency, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization and limitations. Somaclonal variation and its applications.

UNIT IV

Plant Growth Promoting bacteria: direct and indirect methods for plant growth promotion.

PRACTICALS

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. Excision of explant and culture.
4. Significance of growth hormones in culture medium.
5. Demonstration of various steps of Micropropagation.

Shailendra
14/08/2021

Gyanshwer Chaudhary
14/08/2021

Course code 503: ANIMAL BIOTECHNOLOGY

UNIT I

Gene transfer methods in Animals: Microinjection, Embryonic Stem cell, Viral mediated gene transfer.

UNIT II

Introduction to transgenesis. Transgenic Animals: Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases: Foot and mouth disease, Coccidiosis, Trypanosomiasis and role of biotechnology in disease control.

UNIT III

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

UNIT IV

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

PRACTICALS

1. Sterilization techniques: Theory and Practice
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

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Course code 504: MOLECULAR DIAGNOSTICS

UNIT I

Enzyme Immunoassays: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes, immuno blotting. histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in disease diagnosis.

UNIT II

Applications of PCR, RFLP, RAPD, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures.

UNIT III

Automation in microbial diagnosis, standardization of antigen and specific antibodies, Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

UNIT IV

GLC, HPLC, Electron microscopy, flow cytometry and cell sorting.

PRACTICALS

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

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

Shailendra
14/08/2021

Gyaneshwer Chaubey
14/08/2021

Course code 601: I.P.R. ENTREPRENEURSHIP BIOETHICS & BIOSAFETY

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

UNIT I

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT II

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.

UNIT III

Bioethics: Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT IV

Biosafety: Introduction to biosafety cabinets and health hazards concerning biotechnology. Introduction to the concept of containment level. and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

PRACTICALS

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

Shailendra
14/08/2021

Gyaneshwer Chauriy
14/08/2021

Course code 602: BASICS OF FORENSIC SCIENCE

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

Unit I

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

Unit II

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

Unit III

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

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

PRACTICALS

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. Investigation 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

Shailendra
14/08/2021

Gyaneshwer Chauriy
14/08/2021

Course code 603: FOOD BIOTECHNOLOGY

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

UNIT I

Historical Background, Composition of Food, Improvement of food resources through Biotechnology (e.g. Golden Rice, Flavor savor tomato), Traditional fermented foods (meat, fish, bread, sauerkraut, tea)

UNIT II

Food Fermentations: Fermented milk, Cheese, Butter, Yoghurt. Alcoholic beverages (Beer, Wine, distilled beverages), Pickles, Soy products.

UNIT III

Value addition products: High Fructose Corn Syrup, Invert Sugars, Edible fungus: Mushrooms. Concept of pre and Probiotics. Food preservation and storage.

UNIT IV

Growth of microorganisms in food: Intrinsic and extrinsic factors. Food Spoilage (microbial and non-microbial) Control mechanisms of food spoilage: Physical and Chemical. Food and water borne diseases: Gastroenteritis, Diarrhea, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis, Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc. Detection of food-borne pathogens.

PRACTICALS

1. Estimation of Total Plate Count in any food sample. 2. Detection of Salmonella, E. coli in food material. 3. MBRT test of milk samples. 4. Malt preparation for beer making. 5. Cheese making (Non-ripened cheese). 6. Sauerkraut production 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.

Shailendra
14/08/2021

Gyanshwer Chauray
14/08/2021

Course code 604: GENOMICS & PROTEOMICS

B.Sc. (Biotechnology) Hons. BoS on 14.08.2021

UNIT I

Introduction to Genomics, DNA sequencing methods: manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.

UNIT IV

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

PRACTICALS

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

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