

INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

B.Sc. HONOURS

SUBJECT: BIOTECHNOLOGY

YEAR: II

SEMESTER: III PAPER: HONOURS I

Bioinformatics and Biostatistics

Max. Marks: 100

Introduction to Bioinformatics-

Definition, role, scope and limitation of bioinformatics, branches of bioinformatics. Terminologies-computer architecture, network, internet, http browser software, hardware, operating system, algorithms. Database: introductory database management system. Biological data type and classification, sequence databases-NCBI, EMBL, DDBJ, UniprotKB, Secondary database-PROSITE, Pfam, KEGG pathway and ENZYME database. Sequence file format-FASTA, GENBANK, CLUSTALW, PDB.

Sequence Analysis

Introduction and significance of sequence alignment, global and local alignment, methods of alignment-dot matrix, dynamic programming (Needleman-Wunsch and Smith-Waterman algorithm). Homology sequence searching-BLAST and FASTA. Concept of Scoring matrix (PAM and BLOSUM) and Gap penalty. Multiple sequence alignment-Introduction, application and tools. Phylogenetic analysis introduction, importance and methods.

Structural Bioinformatics

Coordinate system and molecular structure storage, Structure . Visualization tool introduction and application of Raswin, Jmol, molecular modeling-structure models, molecular energy minimization. Application of Structural bioinformatics-computer aided drug discovery, In silico protein engineering and protein structure prediction.

Statistical methods-

Introduction to statistics and its application, data-definition, collection of data, types of data classification, sampling. Tabulation-types of tabulation, graphical representation of data, frequency distribution-Normal, Poisson, Binomial.

Data Interpretation

Arithmetic mean, median, mode, measures of dispersion. Range, mean deviation, variants, coefficients of variation, basic concept of skewness and kurtosis, correlation and regression, test of significance: T-test, F-Test, Chi square test.

Reference books:

Bioinformatics - R.C. Rastogi
Bioinformatics - Xin xiong
Biostatistics - P.N Arora
Bioinformatics - C.S.V. Murthy
Introduction to Biostatistics - Pranav Kumar Banerjee

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

B.Sc. HONOURS

SUBJECT: BIOTECHNOLOGY

YEAR: II

SEMESTER: III

PAPER: HONOURS II/Subsidiary

GENETICS

Max. Marks: 100

Mendelian genetics

History, Mendel's laws - Law of dominance, law of segregation and Law of independent assortment. Co-dominance and Incomplete dominance, Interaction of Genes- Complementary genes. Epistasis. Inhibitory gene. Genetic variation- Multiple allele, lethal genes and Extra chromosomal inheritance

Population Genetics, Linkage and Crossing Over

Population Genetics - Hardy Weinberg equilibrium. genotypic frequency
Linkage, Crossing Over, Theories of Crossing over, Holliday model of recombination

Sex Determination

Sex Determination. Sex linked inheritance. Genic Balance Theory & Chromosomal Theory of Sex Determination. Pedigree analysis (brief)

Gene Structure and function

Classical concept. molecular concept (One gene one enzyme hypothesis. one gene one polypeptide hypothesis. overlapping gene, split genes, jumping genes. TATA box and Pribnow Box) in brief

Mutation

Gene mutation- types. mutagens (physical and chemical). DNA damage and Repair

Chromosomal Aberrations and Genetic Diseases

Chromosomal aberration - numerical and structural
Klinefelter syndrome. Turner syndrome. Cry du chat syndrome and Down's syndrome.

Reference books:

Genetics: P.S. Verma
Genetics: Strickberger
Principles of genetics: S.B. Basu
Genetics Vol I and II: C.B. Powar
Genetics: Gardner

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Principles of animal cell culture: Freshney
Animal cell culture: M.M. Ranga

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PRACTICAL – HONOURS I

BIOINFORMATICS AND BIOSTATISTICS

Max. Marks: 100

1. Study of biological databases and data retrieval-
 - a) GenBank
 - b) EMBL
 - c) PDB
 - d) KEGG
2. Homology Sequence Searching
 - a. FASTA
 - b. BLAST
3. Molecular visualization tools- RasMol
4. Drawing and visualizing drug molecule through chemsketch.
5. Collection of biological data and tabulation.
6. Graphical representation of collected data.
7. Measurement of central tendencies
 - a. Mean
 - b. Median
 - c. Mode
8. Measure of Dispersion
 - a) Mean deviation
 - b) Standard deviation
 - c) Range
 - d) Variance

1. Glycine 2. Ser 3. Methyl 4. B 5. Sugars 6. RNA 7.
8. RNA 9. Shaded 10. Proteins 11. Type

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B.Sc. HONOURS

SUBJECT: BIOTECHNOLOGY

SEMESTER: III

PRACTICAL – HONOURS II

GENETICS

Max. Marks: 100

1. Problems based on Mendelian Genetics– Monohybrid cross, Dihybrid cross, Test cross, and Back cross
2. Study based on numerical changes in chromosome
3. Study based on structural change in chromosome
4. To induce UV damage in bacterial cultures.
5. Dark and light repair in UV damaged cultures.
6. Isolation of antibiotic resistant colonies by gradient plate method.
7. Hardy Weinberg law
8. Pedigree analysis

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LIFE SCIENCES I (BOTANY)

Max. Marks: 100

Classification of plant kingdom

Algae - general characters and classification, life cycle of Volvox, Chara.
 Bryophyta - general characters and classification, life cycle of Marchantia
 Pteridophyta - general characters, stele system and classification, life cycle of Selaginella. Introduction to Palaeo Botany, General Characteristics of Rhynia
 Gymnosperms - general characters and classification, life cycle of Cycas

Anatomy and Taxonomy of Angiosperms

Simple tissues - Parenchyma, Collenchyma, Sclerenchyma. Anatomy of dicot (sunflower, cucurbita) and monocot (maize) stem. Anatomy of dicot and monocot root. Angiosperms - Introduction, classification system of Bentham and Hooker. General characters and economic importance of families Malvaceae, Brassicaceae, Asteraceae, Solanaceae, Euphorbiaceae, Liliaceae

Physiology of plant

Plant water relation - Diffusion, osmosis and its types, relation among turgor pressure, wall pressure and osmotic pressure. Interrelationship among DPD, SP, OP and WP. Water potential concept, plasmolysis and deplasmolysis

Absorption of water - water absorbing parts of plant, active and passive absorption, factors. Ascent of sap - introduction, physical theories
 Transpiration - significance, types, mechanisms and factors. Evaporation, structure and types of stomata

Physiology of plants

Photosynthesis - brief history, photosynthetic apparatus, pigments, mechanism - light reaction, photosystem I and II, photophosphorylation, dark reaction - Calvin cycle, CAM cycle, factors affecting photosynthesis
 Respiration - types of respiration, respiratory quotient, mechanism - Glycolysis, Krebs cycle, ETS (oxidative phosphorylation), factors affecting respiration.
 Growth - growth regions, phases of growth, growth curve, measurement, factors.

Economic botany

Introduction to food plants, fiber and fiber yielding plants, vegetable and fatty oils, bamboos, spices, rubber, medicinal plants, Petro crops

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Reference Books

Botany for Degree Students – Algae by B.R. Vasishta

Algae - O.P. Sharma

Bryophyta - B.R. Vasishta

Pteridophyta - P.C. Vasishta

The Biology and Morphology of Pteridophytes - N.S. Parihar.

Gymnosperms - P.C. Vasishta

College Botany - Gangulee & Kar

Plant Physiology - Taiz & Zeiger

Fundamentals of Plant Physiology - V.K. Jain

Plant Physiology - Salisbury Ross

Plant Physiology - S.N. Pandey and B.K. Sinha

Plant Anatomy - B.P. Pandey

Plant Anatomy - S.N. Pandey

Taxonomy of Angiosperms - V.N. Naik

Taxonomy of Angiosperms - A.K. Sharma & Rageshwari Sharma

Taxonomy of Angiosperms - S.K. Singh & Seema Shrivastava

Taxonomy of Angiosperms - B.P. Pande

Plant Taxonomy - O.P. Sharma

Flowering Plants Taxonomy and Phytogeny - B. Bhattacharya & B.M. Johri

Plant Taxonomy – Sunder Rajan

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PLANT AND ENVIRONMENTAL BIOTECHNOLOGY

Marks: 100

Introduction to cell and tissue culture

Tissue culture as a technique to produce novel plants and hybrids - Tissue culture media (composition and preparation), callus culture and maintenance. Transfer and establishment of whole plants in soil

Types of Plant Tissue culture

Micropropagation, Shoot tip culture, anther, pollen and ovary culture for production of haploid plants. Embryo culture and Embryo rescue technique, Somaclonal variation, somatic embryogenesis.

Protoplast culture. Somatic hybridization- Isolation, protoplast fusion, testing of viability, regeneration and its applications

Plant transformation technology

Techniques of plant cell transformation- Direct method and *Agrobacterium* mediated transformation

Application of plant transformation – transgenic plants for herbicide resistance (glyphosate resistance), insect resistance (Bt cotton), disease resistance and extended shelf life (FlavrSavr).

Environmental Biotechnology

Basic concepts – Ecosystem, environment management. Environment, Climate change global warming (Greenhouse effect). Biodegradation of xenobiotic.

Applied Environment Biotechnology

Biomagnification, Bioremediation, Biological control (Biopesticides), Biofuel, Biopolymers, Bioleaching, Waste management (solid and liquid).

Reference books:

Plant tissue culture: Razdan and Bhojwani
Plant tissue culture: H.S. Chawla
Plant biotechnology: B.D. Singh
Biotechnology: B.D. Singh
Biotechnology: U. Satyanarayan

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PRACTICAL – HONOURS I

LIFE SCIENCE I (BOTANY)

Max. Marks: 100

1. To prepare slides of *Volvox* and *Chara*.
2. To study external morphology and internal structure of *Marchantia* thallus (prepare slide).
3. To prepare slide of T.S. of *Selaginella* stem.
4. To prepare slide of *Cycas* leaflet.
5. Description of Angiospermic plants of families mentioned in the syllabus
6. Section cutting of dicot, monocot stem and dicot, monocot root
7. Physiology experiments:
 - i) To perform experiments related to diffusion, osmosis, plasmolysis and deplasmolysis.
 - ii) To measure the rate of transpiration.
 - iii) To study the effect of different factors on the rate of transpiration.
 - iv) To study the structure of stomata.
 - v) To determine the stomatal index of different leaves.
 - vi) To perform the experiments related to photosynthesis.
 - vii) To perform the experiments related to respiration
8. To study the different plants of economic importance.
9. To study the permanent slides, specimen as per syllabus.

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

SUBJECT: BIOTECHNOLOGY

SEMESTER: IV

PRACTICAL – HONOURS II

PLANT AND ENVIRONMENTAL BIOTECHNOLOGY

Max. Marks: 100

1. To study soil profile- soil texture, temperature, moisture, pH and inorganic components.
2. To determine the DO and BOD of water.
3. To determine COD of water
4. To determine total dissolved solids, total suspended solids and total solid content in sewage water sample.
5. To enumerate Most Probable Number (MPN) in water sample.
6. To prepare and study Winogradsky column.
7. To study the effect of Biopesticides (BioHit) on plant growth.
8. To study the effect of *Rhizobium* on plant growth.
9. To Clean and sterilize glassware's for plant tissue culture.
10. To Prepare MS medium.
11. To sterilize explants by different agents for PTC.
12. To perform Root tip / shoot tip culture.
13. To perform callus culture and organogenesis.
14. To perform embryo culture.

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Life sciences II (Zoology)

Max. Marks: 100

Invertebrates: Classification and type study

General characteristics and classification of following Non-chordates and Higher chordate types. Lower-Non chordates (Coelenterata – Obelia, Platyhelminthes – Fasciola) and Higher non-chordates (Annelida – Pheretima, Arthropoda – Palaemon)

Chordates: Classification and type study

General characteristics and outline classification of Chordates according to Parker and Haswell (revised by Marshall and Williams) Type studies: Hemichordata (*Balanoglossus* - general anatomy and affinities), Urochordata (*Herdmania*), Cephalochordata (*Amphioxus*), Pisces (*Scoliodon*), Aves (Pigeon), Mammalia (Rabbit - 5 systems - Nutrition and digestion; Urinogenital system; Respiratory system; Heart and circulatory system).

Physiology of mammals

Nerve Physiology: structure and types of Neuron, mechanisms of conduction of Nerve impulse.

Muscle Physiology: Structure and properties of Muscle, Theories of Muscle contraction.

Circulation: Composition and function of blood, Mechanism of Blood clotting.

Endocrinology: Structure and functions of endocrine glands - Pituitary, Thyroid, adrenal, thymus, islets of Langerhans, ovary, testes.

Placentation in mammals

Developmental Biology and Evolution

Gametogenesis (Spermatogenesis and Oogenesis), Fertilization, Types of Eggs, Patterns of cleavage & Blastulation in Frog and chick, Fate maps, Organizer Concept, Gastrulation in Frog and chick upto formation of germinal layers.

Origin of life, Theories of evolution (Lamarckism, Darwin and neo Darwin).

Animal Behaviour And Applied Zoology

General introduction to Ethology. Innate and learned behavior (instinct, imprinting and motivation). Social behavior (insect and primates). Neural and hormonal control of behavior. Biological clocks (circadian and circannual rhythm). Communication. Perception of environment (auditory and visual).

Aquaculture (Prawn and fish culture), Lac culture, Sericulture and Apiculture. Population Concept - Characteristics of population, Population Growth and Factors affecting population.

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Reference books

Invertebrate Zoology by Parker & Haswell, Revised - Marshall & Williams

Vertebrate Zoology by Parker & Haswell, Revised - Marshall & Williams

Biology of Vertebrates - Young

Animal Behaviour - Mohan P. Arora

Animal Behaviour - Mannings

Animal Behaviour - Reena Mathur

Animal Behaviour - Hajender Singh

Animal Behaviour - Alcock

Developmental Biology - Berill & Karp

Developmental Biology - Balinsky

Developmental Biology - Agrawal & Verma

Ecology - P.D. Sharma

Applied Zoology - Shukla & Upadhyay

Invertebrate - Verma & Zordan

Vertebrate - Verma & Zordan

Animal Physiology - A.K. Berry

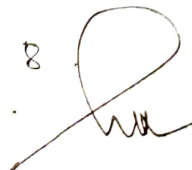
Animal Physiology - H.R. Singh

Animal Physiology - Dalela & Verma

Physiology - Chatterjee & Chatterjee

Ecology - P.L. Kochar

Ecology - C.V. Bahura

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IMMUNOLOGY AND ANIMAL TISSUE CULTURE

Max. Marks: 100

Introduction to immune system

Historical prospects of immunity, classification immunity- innate and acquired.
Mechanism of innate Immunity, Antigens- Salient features, Classification, Types
Immunogenicity v. Antigenicity.
Adjuvants, Epitopes, Paratopes, Avidity and Affinity, Haptens.
General structure of antibody, types of immunoglobulins -
Hybridoma technique, Structure and function of monoclonal antibodies
Antigen antibody interaction- precipitation, agglutination, RID, ODD.
Immunoelectrophoresis, ELISA, RIA, FIA

Cells and organs of immune system

Cells of immune system - eosinophils, mast cells, basophils, macrophages, natural killer cells, B- cells and T-cells. Lymphoid organs - thymus, bone marrow, spleen and MALT.
Humoral and Cell mediated response-
MHC Class I and II molecules, antigen processing and presentation, primary and secondary immune response, antibody production.

Immune effector mechanism

Hypersensitivity, Autoimmunity- introduction and types, Immunodeficiency disease - AIDS, SCID

Animal Cell Culture

Introduction to animal tissue culture. Equipments and sterilization techniques, Culture media, culture techniques-dispersion and disruption of tissue, Primary cell culture, sub culturing, and isolation of cell lines, cryopreservation, biology of cultured cells

Specialized techniques

Cell viability and cytotoxicity, Cell Immobilization technique, Amniocentesis, application of animal tissue culture

Reference books:

Immunology: Kuby
Principles of immunology: N.V. Shastri
Textbook of immunology: V. Annadurai
Immunology: Mohan P Arora
Immunology: C.V. Rao
Principles of animal cell culture: Freshney
Animal cell culture: M.M. Ranga

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Session 2021-22

SUBJECT: BIOTECHNOLOGY

SEMESTER: V

PRACTICAL – HONOURS I

Life sciences II (Zoology)

Max. Marks: 100

1. Study of museum specimens of different phylum.
2. Study of permanent slides of different sections.
3. Study of different developmental stages of frog and chick.
4. Major dissection
 - a. Prawn: Nervous system
 - b. Pila: Nervous system
 - c. Earthworm: Anatomy
 - d. Labeo: Cranial nerves V, VII, IX and X
5. Minor dissection
 - a. Hastate plate and appendages of Prawn
 - b. Mouth parts of cockroach
 - c. Redula of Pila
6. Mounting – Statocyst of prawn, gill lamellae, osphradium of Pila, scales in fish.
7. Study of life history of silk worm (Bombyx mori), honey bee, termite, housefly and mosquito.
8. Animal behaviour – taxes, reflexes, social behaviour in honey bee/Primates.
9. Study of various components and working of Microtome.

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Session 2021-22

SUBJECT: BIOTECHNOLOGY

SEMESTER: V

PRACTICAL – HONOURS II

IMMUNOLOGY +ATC

Max. Marks: 100

1. Identification of Blood group of given samples.
2. Blood film preparation and identification of cells.
3. Isolation of serum from blood.
4. To perform Widal test.
5. To perform Radial Immunodiffusion.
6. To perform Ouchterlony Double diffusion.
7. Demonstration of Rocket electrophoresis by kit.
8. To calculate total WBC count by Haemocytometer
9. To study and calculate differential WBC count.
10. Demonstration of DOT ELISA
11. Preparation of Animal Cell culture medium
12. Primary cell culture of lymphocytes.
13. Demonstration of animal cell culture techniques by charts and powerpoint presentations.

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL
Session 2021-22

B.Sc. HONOURS

SUBJECT: BIOTECHNOLOGY

YEAR: III

SEMESTER: VI PAPER: HONOURS I

BIOPROCESS AND INDUSTRIAL BIOTECHNOLOGY

Max. Marks: 100

Introduction to bioprocess engineering

Fermentation- historical background, isolation, preservation and maintenance of industrial important microorganisms, strain improvement and screening of industrially important microorganisms

Bioreactors and Fermentation processes

Principle, fermentor design, types of fermentor- CSTR, air lift, plug flow, fed batch.

Fluidized bed, rotator disc/drum reactor

Batch process, fed batch process, continuous process, liquid state and solid-state fermentation. Fermentation dynamics – aeration, agitation, mass transfer, heat transfer, yield coefficient. Basic principle of Scale up

Upstream process and Downstream process–

Sterilization, Development of inoculums and Media for industrial fermentation, Removal of microbial cells, Release of Intracellular Products, Cell Disruption, Evaporation, Liquid – Liquid Separation, Precipitation, Adsorption and chromatography, solvent extraction

Industrial Biotechnology

Fermented beverages- Beer, Wine and Dairy products- cheese, yoghurt, Food Spoilage and methods of food preservation, Concept of Probiotics, Spirulina and its economic importance, Biofertilizers in sustainable development, biodiesel (Petrocrops), Biogas production, Microbial production of enzyme (lipase), organic acid (vinegar), ethanol, antibiotic (streptomycin), amino acid (glutamic acid) Vitamin B₁₂ Vermicomposting, Mushroom cultivation.

Biosafety and Industrial Rights

Risk assessment, Biosafety guidelines and biohazards, Intellectual Property Right, Forms of Protection, Patents, Copyright, Trademarks, Trade secrets, PBR, WTO, GATT, GATS and TRIPS.

Reference books:

Industrial microbiology: A.H. Patel
Textbook of biotechnology: H.K Das
Principles of fermentation technology: Whitaker
Industrial microbiology: M.J Wailes
Biotechnology: B.D. Singh

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

B.Sc. HONOURS

SUBJECT: BIOTECHNOLOGY

YEAR: III

SEMESTER: VI PAPER: HONOURS II

GENETIC ENGINEERING

Max. Marks: 100

Tools of Genetic Engineering

Restriction and modifying enzymes, nucleases, polymerases, topoisomerase and ligase.
Homopolymer tailing, linkers and adaptors, blunt end ligation.

Cloning and Expression vectors

Properties of vectors, plasmids, cosmids, bacteriophages, plant virus - TMV, animal virus - retrovirus, baculovirus expression system, YAC. Reporter genes - selectable and scorable markers.

Gene Cloning

Genomic and cDNA library, gene cloning - preparation of recombinant, transfer of recombinant in host - transformation and transfection, selection and screening of recombinants - direct selection and insertional inactivation methods.

Techniques of Genetic Engineering II

Blotting techniques - southern, northern and western.

DNA sequencing - Maxam-Gilbert chemical cleavage method, Sanger-Coulson dideoxy method, PCR - principle, types and applications.

Applications of Genetic Engineering

Hybridoma technology, DNA fingerprinting using RFLP, Recombinant Vaccines (in brief), Transgenic animals - sheep, Gene therapy - somatic and germline gene therapy.

Reference books:

Genetic engineering: P.S. Verma

Genomes 3: T.A. Brown

Gene Cloning: T.A. Brown

Genetic engineering and cloning: Mohan P. Arora

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

SUBJECT: BIOTECHNOLOGY

SEMESTER: VI

PRACTICAL – HONOURS I

BIOPROCESS AND INDUSTRIAL BIOTECHNOLOGY

Max. Marks: 100

1. To isolate lactic acid bacteria from dairy products.
2. To isolate fungi from spoiled food and their characterization by LPCB staining
3. To observe antimicrobial effect of plant extracts on microorganisms.
4. To formulate medium and development of inoculum for alcohol production.
5. To Ferment various fruits for alcohol and gas production.
6. To isolate industrially important microorganisms from soil.
7. To Immobilize of enzymes and cell.
8. To isolate rhizobium from root nodules.
9. To study production of spirulina.
10. To perform quality testing of milk.
11. To demonstrate Fermenter- batch fermenter and continuous fermenter.
12. To demonstrate vermicomposting.
13. To demonstrate mushroom cultivation.

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INSTITUTE FOR EXCELLENCE IN HIGHER EDUCATION, BHOPAL

Session 2021-22

SUBJECT: BIOTECHNOLOGY

SEMESTER: VI

PRACTICAL - HONOURS II

GENETIC ENGINEERING

Max. Marks: 100

1. To isolate genomic DNA from plant source.
2. To isolate genomic DNA from animal source.
3. To demonstrate plasmid DNA isolation from bacteria.
4. To perform agarose gel electrophoresis of DNA sample.
5. To study protein profiling by SDS-PAGE.
6. To prepare of competent cell by kit
7. To perform cell transformation of bacteria by kit.
8. To Demonstrate PCR

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