

B.Sc. Biotechnology Part-II
BBT 10 Fundamentals of Molecular Biology

Duration :3 hrs

Max .Marks 50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT -I

Introduction to molecular biology – historical background, nature of genetic material, experimental proof for DNA as genetic material, types of nucleic acids (DNA and RNA). Watson Crick model of DNA, other forms of DNA (A-form, B form and Z-form), properties of DNA, DNA denaturation and renaturation, concept of central dogma, satellite DNA and tandem repeats.

UNIT -II

DNA replication : mechanisms of prokaryotic DNA replication, semi-conservative model of replication, mechanism of DNA replication – discontinuous synthesis of DNA, RNA primer of DNA synthesis, DNA polymerases I, II, III and their role in DNA replication; eukaryotic DNA replication, DNA damage and repair.

UNIT -III

Regulation of gene expression in prokaryotes : Transcriptional control; enzyme induction and repression, constitutive. Synthesis of enzymes, the operon hypothesis : genes involved in regulation – regulatory genes, promoter gene, operator gene, and structural gene. Lac operon, Arg operon. Brief account of eukaryotic gene regulation.

UNIT – IV

Transcription control by termination and anti-termination, mRNA splicing, genetic code, types of RNA, wobble hypothesis, translation initiation and termination in prokaryotes.

UNIT – V

Post translational modification in prokaryotes and eukaryotes, protein sorting/ trafficking and protein localization and translocation: and signal transduction: channels and ion uptake.

References:

1. Molecular Cell Biology, 7th Edition. Lodish, et. al.
2. Biochemistry, 4th edition. Donald Voet and Voet J
3. Harpers review of Biochemistry, 25th Edition. Murray RK, Rodwell VW.
4. Lehninger's Principles of Biochemistry, 5th Edition. Nelson DL and Cox MM
5. Biochemistry, 5th Edition. Garrett and Grisham
6. Molecular Biology of the Cell, 5th Edition, Bruce Alberts et. al.
7. Cytology, P.S. Verma, V.K. Agarwal, S. Chand Publications

BBT – 11 Biophysics and Instrumentation

Min. pass marks: 18

Duration: 3 hours

Max. Marks: 50

Note: Attempt any five questions, taking at least one question from each unit. Each question carries equal marks.

UNIT -1

Bioenergetics: Energy and its various forms, principle of Thermodynamics, energy exchange, conservation of energy.

Photobiology: Nature of light, Primary photochemical reactions, Photosynthesis, flowering, Solarization, Photo dynamism, Strategies in light reception, Photoreceptor in microbes, Plants and animals.

UNIT -II

Biophysics of vision, vision fault and correlations, Bio luminance. Biophysics of sound vibration, Phono-receptor, Auditory function, Location and origin of sound, Hearing aids.

Membrane conductivity, Diffusion, Active transport, Osmosis, Diffusion pressure, deficit, Biosorption, Electrical properties of biological compartments, Electrochemical gradients, membrane potentials.

UNIT -III

Molecular interaction: Intra- molecular and Inter- molecular interaction, Attractive and repulsive forces operating within molecules and their overall effects on molecular interactions.

Radiations and their interaction with matter, Electromagnetic radiation, Ultraviolet and visible spectroscopy, Raman spectra, Nuclear magnetic Resonance, Electrophoresis, Radioactive tracer techniques, Autoradiography.

UNIT -IV

Instruments, basic principle and usage: colorimeter, spectrophotometry, Centrifuges, Analytical and differential pH meters, GM counter.

Microscopy: Compound microscope, Phase contrast, Dark field, Fluorescent and Electron microscopy

UNIT -V

Elucidation of intact biological structures in living organisms: Ultrasound. Optical filters, X-ray, X-ray diffraction, Computerized Axial Tomography, Electrocardiography, Electroencephalography.

References:

- 1) Upadhyay, A., Upadhyay, K. and Nath N. (2005) Biophysical chemistry: Principles and Techniques. Himalaya Publishing House, India.
- 2) Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry: Principles and Techniques, Cambridge University Press, U.K.
- 3) Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
- 4) Freifelder, D. (1982). Physical Biochemistry. Applications to Biochemistry & Molecular Biology, W.H. Freeman & Co.

BBT 12: Basics of Plant Physiology

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT – 1

Plant water relations : importance of water to plant life, physical properties of water diffusion and osmosis, absorption & ascent of sap. Transport of water and transpiration. Mineral nutrition: Essential macro and micro elements and their role. Transport of organic substances.

UNIT – II

Photosynthesis Significance, historical aspects, photosynthetic pigments, action spectra and enhancement effects, concept of two photo systems (Cyclic & Non cyclic) z-scheme. Photophosphorylation, C-3, C-4 and CAM pathway, photorespiration.

UNIT – III

Respiration: ATP the biological energy currency, aerobic and anaerobic respiration, kreb's cycle, electron transport mechanism (chemi-osmotic theory), redox potential, oxidative phosphorylation, pentose phosphate pathway.

UNIT – IV

Nitrogen and lipid metabolism: Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation, structure and function of lipids, fatty acid 21 biosynthesis, α & β oxidation, saturated and un saturated fatty acids, storage and mobilization of fatty acids.

UNIT – V

Growth and Development : Definitions, phases of growth and development, kinetics of growth, seed dormancy Seed germination and factors of their regulation plant movements the concept of photoperiodism, plants hormones auxins, gibberellins, cytokinins, abscissic acid, ethylene, history of their discovery, biosynthesis and mechanism of actions photomorphogenesis, phytochromes and cytochromes.

References:

- 1.Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company
2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates
3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications

BBT 13 Plant Cell, Tissue and Organ Culture

Duration :3 hrs

Max .Marks 50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT -I

History, scope and applications of plant tissue culture – contribution of Indian Scientists. Concept of asepsis and methods of sterilization, Nutrient media, their composition and methods of preparation.

UNIT -II

Basic Concepts in cell culture and cellular totipotency. Callus organogenesis – dedifferentiation. Somatic embryogenesis – induction of embryogeny *in vitro*, indirect and direct somatic embryogenesis.

UNIT -III

Selection and preparation of explants for adventitious shoot bud induction and axillary bud proliferation. Steps of micropropagation-management of donor plants, culture establishment, shoot multiplication, rooting and hardening and acclimatization. Protoplast isolation, culture and differentiation.

UNIT -IV

Anther and pollen culture – production of haploids. *In vitro* fertilization, embryo, endosperm, ovary and ovule culture. Embryo rescue. Methods of cryopreservation for germplasm conservation. Somaclonal and gametoclonal variation. Meristem tip culture for elimination of viruses in plants.

Organ culture- Types, Techniques and process.

UNIT -V

Cell culture and *in vitro* production of secondary metabolites. Important alkaloids and factors affecting their production. Hairy root culture, elicitation and biotransformation.

References:

1. Bhajwani, S.S, & Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.
2. Razdan, M.K. (2003) Introduction to Plant tissue culture, Science Publishers
3. Singh, B.D. (2004). Biotechnology expanding horizons, Kalyani Publishers, New Delhi.

BBT 14: Basics of Animal Physiology

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT-I

Digestion: Nutrients: Carbohydrates, lipids, proteins, vitamins, Digestive enzymes and hormones of GIT. Digestive mechanism: Mechanical and chemical digestion. Absorption and assimilation of end products of digestion. Balanced diet, malnutrition (PEM), obesity; endoscopy.

UNIT-II

Respiration: Aerobic and anaerobic respiration. Structure of respiratory organs. Mechanism and regulation of breathing. Transport of O₂ and CO₂. Respiratory disorders: Emphysema, asthma, occupational disorders, spirometry.

UNIT-III

Circulation: Circulatory fluids: Blood, lymph; blood cells; structure of haemoglobin. Blood circulation through heart, arteries, arterioles, capillaries, venules and veins. Cardiac cycle and its regulation. Blood clotting mechanism, blood pressure. Cardiac disorders, ECG, heart transplantation (an introductory idea).

UNIT -IV

Excretion: Excretory products: NH₃, urea, uric acids, amino acids. Structure of kidney, nephron; mechanism of urine formation; micturition. Autoregulation, counter-current mechanism, renin-angiotensin system. Accessory excretory organs: Skin, liver, lungs etc. Excretory disorders, dialysis, Kidney transplant.

UNIT -V

Muscle and Neural Physiology: Structure of smooth, skeletal and cardiac muscles; myofibrils. Isotonic and isometric contraction of muscles, sliding- filament theory of muscle contraction; relaxation of muscle fibres; Properties of muscles, myopathy. Kinds of neuron, structure of myelinated and nonmyelinated nerve fibres. Reflex action, types. Sensory Physiology: Tactile receptors, pain receptors, thermoreceptors, chemoreceptors.

References:

1. Berry, A.K. Animal physiology.
2. Guyton, A.C. and Hall, J.E. A Text Book of Medical Physiology (10th Edition).
3. W.B. Saunders company.
4. Ganong, H. Review of Medical physiology. McGraw Hill.

BBT 15 Fundamentals of Immunology and Animal Cell Culture

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Concept of Innate and Adaptive immunity. Structure, Functions and Properties of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT. Antigens, Haptens, Adjuvants. Structure, Types, Functions and Properties of antibodies.

UNIT- II

Characteristics of an antigen; Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy. Structure and Functions of MHC I & II molecules;

UNIT- III

Complement- Components and biological activities. Primary and Secondary Immune Response; Generation of Humoral and Cell Mediated Immune Response. Hypersensitivity, Autoimmune diseases.

UNIT -IV

History of development of animal cell culture and methods of animal cell culture: culture media composition and preparation. Growth factors promoting proliferation of animal cell. Animal cell lines – their culture and maintenance. Stem cell cultures, embryonic stem cells and their applications.

UNIT -V

Organ culture, whole embryo culture, transfection of animal cells: selectable markers, HAT selection, antibiotic resistance etc. Somatic cell fusion, transplantation of cultured cells. Differentiation of cells, culture of animal mycoplasma. Growth kinetics of cells in culture,

References:

1. Roitt, Brostoff, Male and Mosby. Immunology.
2. Kuby et al. Immunology. W.H. Freeman and Company.
3. Rao, C.V. An Introduction to Immunology. Narosa Pub. House.
4. Coleman, R.M. Fundamental Immunology. McGraw Hill.
5. Paul, W.E. Fundamentals of Immunology. Raven Press New York
6. Masters, J. Animal Cell Culture. Panima.
7. Freshney, I. Culture of Animal Cell. John Wiley.
8. Martin, C. (Ed). Animal Cell Culture Techniques. Springer.
9. Mather and Barnes. (Ed). Methods in Cell Biology. Vol. 5-7, Animal Cell Culture Method. Academic Press.
10. Paul, J. Animal Tissue Culture. Butler, M. and Dawson, M. Lab Fax : Cell Culture. Bios Scientific Publications.

PRACTICALS

BBT 16 Fundamentals of Molecular Biology & Biophysics and Instrumentation

1. Preparation of genomic DNA from bacteria.
2. Isolation of genomic DNA from Blood.
3. Quantitation of DNA by spectrophotometry.
4. Isolation of plasmid DNA from bacteria.
5. Restriction enzyme digestion and its analysis by gel electrophoresis.
6. Absorption
7. Adsorption
8. Osmosis: Potato osmoscope
9. Transport across membrane
10. Study of DNA melting
11. Photosynthesis: Demonstration of Oxygen evolution.
12. Light/Carbon dioxide necessary for photosynthesis.
13. Principles and application of instruments:
 - a. PH meters (digital).
 - b. Light and phase contrast microscope.
 - c. Colorimeter.
 - d. Spectrophotometer (Visible and UV).
 - e. Sound level meter.
 - f. Audiometer.
 - g. GM counter and Scintillation counter
 - h. Incubator
 - i. Shaker
 - j. Laminar flow bench
 - k. Hearing aids

PRACTICALS

BBT 17 Basics of Plant Physiology & Plant Cell, Tissue and Organ Culture

1. To study the permeability of plasma membrane using different concentration of organic solvents.
2. To demonstrate the phenomenon of the osmosis by the use of potato osmometer.
3. To study the phenomenon of plasmolysis and deplasmolysis.
4. To demonstrate the rate of transpiration by use of potometers (Ganong's/Farmers)
5. To study the relative rate of transpiration from the leaf surfaces of the different plants using cobalt chloride paper.
6. To demonstrate that light is necessary for photosynthesis.
7. To demonstrate the effect of different wavelengths of light during the photosynthesis.
8. To demonstrate the carbon-dioxide, light, water and chlorophyll are essential for photosynthesis by moll's experiment.
9. To compare the rate of photosynthesis under different condition by using wilmott's bubbler.
10. Comparison of the rate of respiration (R.Q.) of various plant parts or substrates with

the help of Ganong's respirometer.

11. Separation of chlorophyll pigments by the paper chromatography.
12. Sterilization techniques for non-living, plant material.
13. Tissue culture media preparation.
14. Slant preparation.
15. Excision of embryo / ovule / Anther and their inoculation.
16. Preparation of aseptic plant . Aseptic techniques.
17. Inoculation of culture. Root culture. Leaf culture. Shoot tip and meristem culture.
Flower bud and flower culture.
18. Isolated ovary culture.
19. Callus induction and regeneration.

PRACTICALS

BBT 18 Basics of Animal Physiology & Fundamentals of Immunology and Animal Cell Culture

1. Demonstration of catalase and ptyalin enzyme activity.
2. Haematocrit value.
3. Haemoglobin percentage.
4. RBC counting.
5. WBC counting.
6. Differential counting.
7. Blood group detection
8. Preparation of Blood film.
9. Preparation of smooth, skeletal (striated & non striated), cardiac muscle fibres.
10. Structure of Myelinated and non myelinated nerve fibre.
11. Sterilization techniques for animal material.
12. Media preparation.
13. Slant preparation.