BIOTECHNOLOGY

Unit 1: Biochemistry and Biophysics

Unit 2: Methods in Biology

Unit 3: Cell Biology
Unit 4: Molecular Biology and Genetics
DNA replication, repair and recombinatioh in prokaryotes and eukaryotes- Mechanism of
replications, enzymes, fidelity of replication, DNA damage and repair mechanisms, homologous and site-specific recombination.
RNA synthesis and processing in prokaryotes and eukaryotes- Transcription factors and
machinery, formation of initiation complex, transcription activator and repressor, RNA
polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing
and polyadenylation.
Protein synthesis and processing in prokaryotes and eukaryotes: Ribosome, formation of
initiation complex, initiation factors, elongation, termination, genetic code, aminoacylation of
tRNA, translational inhibitors, Post-translational modification of proteins.
Control of gene expression at transcription and translation level- regulating the expression of
prokaryotic and eukaryotic genes, role of chromatin in gene expression, DNA methylation,
gene silencing.
Gene mapping methods- Linkage maps, tetrad analysis, mapping with molecular markers,
mapping by using somatic cell hybrids, development of mapping population in plants.
Microbial genetics- transformation, conjugation, transduction, fine structure analysis of genes.
Human genetics- Pedigree analysis, karyotypes, genetic disorders.
Multifactorial pattern of inheritance- Criteria for multifactorial inheritance, Teratology,
Structure of gene, Molecular Screening, Cancer Genetics- Haematological malignancies,
Cancer Genetics, Pharmacogenetics Multifactorial pattern of inheritance- Criteria for
multifactorial inheritance, Teratology, Structure of gene, Molecular Screening, Cancer
Genetics – Haematological malignancies, Cancer Genetics, Pharmacogenetics
Quantitative genetics- Polygenic inheritance, heritability and its measurements, QTL
mapping. Mutation- Types, causes and detection, mutant types– lethal, conditional,
biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional
mutagenesis.
Structural and numerical alterations of chromosomes- Deletion, duplication, inversion,
translocation, ploidy and their genetic implications.

Unit 5: Gene Technology and Bioinformatics
Isolation, purification, analysis of RNA and DNA (genomic and plasmid). Molecular
cloning of DNA and RNA fragments in cloning vectors and expression. Construction of
genomic and cDNA libraries and screening. DNA sequencing methods, strategies for
genome sequencing.
Methods for analysis of gene expression at RNA and protein level, micro array, DNA chips.
PCR, RFLP, Southern and Northern blotting, AFLP techniques, Real-time PCR. In situ
localization, FISH and GISH.
Bioinformatics
Biological Databases- Types, importance and management.
Sequence Database- Nucleotide and Protein.
Computational Biology- Data mining and Sequence Analysis, Database Similarities Searches, Multiple Sequence Alignment, Phylogenetic Analysis, Predictive methods using Nucleic acid and Protein Sequences, Submitting DNA Sequences to the Databases.

Unit 6: Immunology and Immunotechnology
Innate and adaptive immune system- Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity.
Immunological techniques- ODD, immunoelectrophoresis, RIA, ELISA, Immunofluorescence, Western blot.
Tumor immunology- Neoplasms, tumor-associated antigens, immune response to tumor antigens, immunologic factors favouring tumor growth, immunotherapy.

Unit 7: Bioprocess and Microbial Technology
Primary and secondary metabolites, Batch culture, the growth cycle, effect of nutrients, energetics of growth.
Design of bioreactors- Biosensors, scale up of bioreactors
Transport phenomena in bioprocess- Mass transfer resistance, oxygen transfer coefficients, biological heat transfer, heat transfer coefficients.
Downstream processing of biologicals- Separation of cells, foam separation, flocculation, filtration, plate filters, rotary vacuum filter, centrifugation, Stokes law, basket centrifuge, bowl centrifuge, disintegration of microorganisms, mechanical and non-mechanical methods, membrane filtration, ultra filtration and reverse osmosis, chromatographic techniques, absorption, spray drier, drum dryers, freeze dryers.
Microbial products- Microbial production of vitamins, enzymes, organic acids, amino acids, antibiotics, ethanol.
Microbes for sustainable agriculture- Biological nitrogen fixation, Biofertilizers, Biological control, Biopesticides.

Unit 8: Plant Biotechnology
Cell and Tissue Culture Technology
Role of hormones in Callus Induction, Organogenesis, Somatic embryogenesis and synthetic seeds. Micropropagation- Stages and applications.
Germlasm preservation- Short and long-term storages, gene banks, applications. Haploid Technology- Methods of haploid culture and applications.
Protoplast Technology- Isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization, applications of somatic hybrids.
Secondary metabolite production- Induction of secondary metabolites by plant cell culture; Bioreactor systems for mass cultivation of plant cells.
Seed Biotechnology- Seed development and structure, Hybrid seed production technology: Genetic determinants of flowering, seed development and germination, male sterility and apomixes.
Transgenic plant transformation techniques- Methods of gene transfer in plants, Agrobacterium-mediated gene transfer, and direct gene transfer methods- electroporation, microinjection, particle bombardment, selection of transformants.

Unit 9: Animal Biotechnology
Culture of animal cells- Primary culture: Isolation of mouse and chick embryos, human biopsies, methods for primary culture, nomenclature of cell lines, sub culture and propagation and routine maintenance.
Cell characterization- cytotoxicity assays, cell quantitation, cell culture contamination-monitoring and eradication, cryopreservation, confocal microscopy. Stem cell culture and its applications.
Cell and Tissue engineering- Growth factors for in situ tissue regeneration, biomaterials in tissue engineering, approaches for tissue engineering of skin, bone grafts, nerve grafts. Haemoglobin-based blood substitutes, bio artificial or biohybrid organs. Limitations and possibilities of tissue engineering. In vitro fertilization and Embryo transfer- In vitro fertilization in Humans, Embryo transfer in Humans, Super ovulation and embryo transfer in farm animals e.g: Cow.
Transgenic animals- Transgenic animals and applications: mice and other animals, Biosafety regulations- guidelines for research in transgenic animals, public awareness of the processes of producing transgenic organisms.
Unit 10: Research Methodology and Biostatistics:
Research Methodology- Types of research, Types of research designs, Qualitative and quantitative research, applied research, Sampling methods, and Preparation of research proposal.

Sample Questions:
1. Cell membrane consists of:
   a. Lipids and proteins
   b. Lipids only
   c. Protein only
   d. None of the above

2. Which of the organelles contain DNA:
   a. Nucleus
   b. Nucleolus
   c. Golgi apparatus
   d. Ribosomes

3. To keep blood pH at 7.4 the HCO₃⁻:H₂CO₃ ratio should be:
   a. 20:1
   b. 30:1
   c. 15:1
   d. 1:1
**NUTRITION AND DIETETICS**

**Unit 1: Principles of Nutrition and Nutritional Biochemistry**


**Unit 2: Medical Nutrition Therapy/Clinical Nutrition/Dietetics/Nutrition in Health and Disease:**
Principles of diet therapy, Modifications of diets in febrile conditions, Oral and dental conditions, Gastrointestinal and hepatobiliary disorders, Disorders of energy metabolism—obesity, underweight, Non-communicable diseases such as cardiovascular disorders, diabetes mellitus, hypertension and renal diseases, pulmonary disorders, Nutrition in critical care, cancer and allergies and food intolerances.

**Unit 3: Food Science and Food Microbiology**
Food groups, Food preparation methods, Food preservation techniques, Food analysis – proximate composition, Sensory analysis and Food processing techniques, Food safety, Food security, and Food hygiene. Food borne illnesses, hazard analysis and critical control points and good manufacturing practices, Role of microorganisms in food processing, Food additives, Food fortification and Food packaging.

**Unit 4: Nutritional Epidemiology**
Nutrition research methods- observational, case-control, cohort, randomized control trials, Nutrition surveys and surveillance in India, Nutritional assessments-anthropometry, biochemical, clinical and dietary surveys, Monitoring and evaluation of nutrition programmes, and nutrition education.

**Unit 5: Public Health Nutrition**
Nutrition security, Nutritional status, Malnutrition, under- and over nutrition, trends in nutritional status in India, Strategies to overcome nutritional challenges- under-nutrition, anaemia, obesity, non-communicable diseases, Nutrition intervention programmes in India, Sustainable development goals, World Health Assembly targets, Trends in breast feeding practices in India, Role of national and international agencies to combat malnutrition, Nutrition education, Maternal and child nutrition programmes in India.
Unit 6: Nutrition through Lifecycle
Balanced diet, Meal planning, Nutrition during pregnancy, lactation, infancy, toddlerhood, preschool stage, school going children, and adolescence. Growth and development during different stages of lifecycle, nutrition for adults, older adults and old populations.

Unit 7: Human Physiology
Human body systems – Cardiovascular system, Digestive system, Urinary system, Blood, Lymphatic system, Respiratory system, Musculoskeletal system, Endocrine and Reproductive system.

Unit 8: Food Service Management
Meal planning, Portion sizing, Food service institutions, Types of food service, Food service equipment, lay outs, designs, Principles of meal service and planning, Catering service management and Institutional food service.

Unit 9: Research Methodology and Biostatistics:
Research Methodology- Types of research, Types of research designs, Qualitative and quantitative research, applied research, Sampling methods, and Preparation of research proposal.

Sample Questions:
1. The conversion factor for estimating crude protein content of food from its nitrogen content is
   (A) 6.25
   (B) 16.0
   (C) 5.5
   (D) 4.0

2. The most sophisticated and extremely formal style of service is
   (A) Waiter service
   (B) Self service
   (C) Room service
   (D) Banquet service

3. Following are the methods of conducting dietary survey:
   I. Bioimpedence analysis
   II. 24 hour recall
III. FFQ
IV. Diet record

Codes
(A) II, III and IV
(B) I, II and IV
(C) I, III and IV
(D) I, II and III
HEALTHCARE MANAGEMENT

Unit 1: Introduction to Public Health
Evolution of Public Health. Important Public Health Acts, Health problems of developed and developing countries, Health problems in India, Environment and Health.

Unit 2: Basic Epidemiology
Definition and Concepts of Epidemiology, Concepts of Health and Disease. Role of Genetics in Health and Disease, Levels of Prevention, Types of Epidemiology, Uses of Epidemiology.

Unit 3: Health Systems in India
Health planning in India including various committees and National Health Policy and Health Goals set from time to time. Organised sector with reference to Centre, State, District and Block level structures and local bodies and Panchayati Raj Organisation and functions of community health centres and Primary Health Centres (PHCs). Health Manpower, Primary Health care and concept, Alternative systems of medicine, like Ayurveda, Homeopathy, etc. Holistic Approach Non-Governmental Organisations (NGOs) and Private Voluntary Organisations (PVOs). Unorganized Sector.

Unit 4: Population Indicators

Unit 5: Nutrition and Communicable & Non-communicable diseases

Unit 6: Introduction to Management
The evolution of Management, Definition and importance of Management, Different schools of Management thought- classical school, Management Sciences School, Behavioral School,
Human Relation School, Operational approach, system approach and contingency approach to Management. Hospital Planning, Organizing, Staffing, directing and controlling.

**Unit 7: Hospital Operation Management**

**Unit 8: Hospital Operational Management**
Management of Quality Assured services of professional service units of hospitals. Quality control mechanisms.

**Unit 9: Outpatient & In Patient Services in the Following Fields (Basic knowledge only)**
Radiotherapy, Nuclear medicine, surgical units, and OT Medical units, G & Obs. units & LR. Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation. Skin, Eye, ENT, Neurology, Dental, Gastroenterology, Endoscopy, Pulmonology, Cardiology, Cath lab, Nephrology & Dialysis, Urology, Orthopedics, Transplant units, Burn Unit.

**Unit 10: Medical Record Science**
Definition and types of medical record, Importance of medical record, Flow chart of function, Statutory requirements of maintenance, coding, indexing and filing, Computerization of record, Report and returns by the record department, Statistical information and ICD.

**Unit 11: Inventory Control & Purchase Management**

**Unit-12 Research Methodology and Biostatistics:**
Research Methodology- Types of research, Types of research designs, Qualitative and quantitative research, applied research, Sampling methods, and Preparation of research proposal.

**Sample Questions:**

1. Free Health Care Delivery At Government expenditure is called:
   (A) Primary Health Care
   (B) Comprehensive Health Care
   (C) Socialised Medicine
   (D) Social Medicine

2. WHO theme was adopted in following order (to be arranged in chronological order):
   I. “Smoking or Health – the choice is yours”
   II. “Safe blood starts with me – blood saves life”
   III. “Healthy cities – for better living”
   IV. “Pregnancy is special – let us make it safe”

   (A) 1, 3, 2, 4
   (B) 1, 3, 4, 2
   (C) 1, 2, 4, 3
   (D) 2, 1, 4, 3