

Integral University, Lucknow

**Department of Biosciences
B.Sc. (Biochemistry)**

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Immunology

V sem
Subject Code: BS211

(Revised w.e.f 2016-2017)

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UNIT I **8**
Basics of Immunology: History and scope of Immunology, Types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity.

UNIT II **8**
Immune Responses: Cell and organs of immune responses and their functions, B & T cells.

UNIT III **8**
Antigens and Antibodies Antigens: haptens, epitopes and Factors influencing immunogenicity, Antibodies: Structure, types, production and functions of immunoglobulins Clonal selection theory. Antigen Antibody reaction: Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA.

UNIT IV **8**
Histocompatibility: structure of MHC class I, II & III antigens and their mode of antigen presentation, MHC restriction; Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity.

UNIT V **8**
Vaccines and Immunization: Passive and Active immunization, Types of Vaccines: Inactivated, Attenuated, Recombinant and Sub Unit Vaccines, Peptide and DNA Vaccines.

Suggested Reading:

1. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
3. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
4. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
5. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
6. Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Nutritional Biochemistry

V sem
Subject Code: BS341

(w.e.f 2020-2021)

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- UNIT I** **8**
Introduction to nutrition and energy metabolism: Food as a source of nutrients, function of foods, definition of nutrition, nutrients, adequate, optimum and good nutrition, malnutrition. Unit of energy measurements of food stuffs by Bomb calorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.
- UNIT II** **8**
Minerals and Vitamins: Minerals Classification: Macronutrients and Micronutrients, Functions, sources, Bioavailability, and deficiency of minerals. Vitamins - Classification, Bioavailability, sources, functions and deficiency: Fat soluble vitamins, Water soluble vitamins and few members of B-complex.
- UNIT III** **8**
Water metabolism: distribution & composition of fluid in human body, ECF, ICF, Functions of water, fluid balance disorder of water metabolism, Homeostasis.
- UNIT IV** **8**
Carbohydrates: Classification, composition, food sources, functions, storage in body. Fat and Oils: Composition, saturated unsaturated fatty acids, classification food sources, functions of fats. Proteins: Composition, sources, essential, non essential amino acids, source of proteins, functions, protein deficiency.
- UNIT V** **8**
Biochemical test: Introduction to liver function test, Liver function test LFT profile, Glucose tolerance test, renal function test, Evaluation of filtration barrier, Total Protein Albumin/Globulin Ratio (A-G Ratio).

Suggested Reading:

1. Tom Brody: Nutritional Biochemistry (Second Edition), Academic Press.
2. David A. Bender: Nutritional Biochemistry of the Vitamins, Second Edition, University College London, Cambridge University Press.
3. Harper's Illustrated Biochemistry, 29th edition, Mc Graw Hill Education, Lange.
4. Denise R. Ferrier, Richard A. Harvey, Biochemistry (Lippincott Illustrated Reviews Series), 6th edition. Wolters Kluwer/Lipincott, Williams and Wilkins.

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Genetic Engineering

V sem
Subject Code: BS303

(Revised w.e.f 2016-2017)

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UNIT I **8**
DNA manipulative enzymes: Restriction enzymes and DNA ligases, Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmids.

UNIT II **8**
In vitro construction of recombinant DNA molecules (pBR332, pUC19), Isolation of passenger and vector DNA, creation of r-DNA, Transformation of r-DNA by different methods.

UNIT III **8**
Screening and selection of recombinant host cells: Immunological screening and colony hybridization, Gene Libraries: Genomic DNA and cDNA cloning techniques, Expression of cloned DNA in *E. coli*.

UNIT IV **8**
Techniques: Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Sanger's method, Blotting techniques: Southern, Western and Northern blot.

UNIT V **8**
Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.

Suggested Reading:

1. Glick, B.R & Padernak J.J (1994) Molecular Biotechnology, Principles and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (186) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopins, N.H Roberts, J.W.Stetz J.A and Weiner A.M(1988). Molecular biology of society for Microbiology
7. Lewin b. (1994) Genes VI, New York,Oxford University Press.

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr

Subject Name: Introduction to Tissue culture technologies

V sem

Subject Code: BS342

(w.e.f 2020-2021)

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UNIT I

8

Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokinins and Gibberellins). Callus and suspension culture.

UNIT II

8

Haploid plant production: microspore and ovule culture, Organ Culture and their applications, Somatic Embryogenesis: Techniques and applications. Protoplast Culture, somatic hybridization, methods of protoplast fusion: chemical and electro fusion, practical application of somatic hybridization.

UNIT III

8

Role of tissue culture: In agriculture, horticulture and forestry, Transgenic plants, Technique of transformation: *Agrobacterium*-mediated and physical methods (Microprojectile bombardment and electroporation).

UNIT IV

8

History and Scope of Animal Tissue Culture. Culture Media, Simulating natural conditions for growth of animal cells, Natural media: Plasma Clot, biological fluids tissue extract, Importance of Serum in media, Chemical defined media, serum free media.

UNIT V

8

Primary Culture: Cell lines, and cloning, isolation and mechanical disaggregation of tissue, enzyme. Secondary Culture: transformed animal cells and continuous cell lines. Monolayer formation, Synchronization.

Suggested Reading:

1. Ravishankar G.A and Venkataraman L.V(1997) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd.
2. H. S. Chawla "Plant Biotechnology: A Practical Approach"
3. Davis, Cell culture techniques.
4. Brown TA "Gene cloning: An introduction"
5. Ian Freshney Animal cell culture.(4th Edition)
6. Buttler. Elements of Biotechnology – P.k. Gupta (1st Edition -2000) Rastogi Publications.

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Genomics, Proteomics & Metabolomics

V sem
Subject Code: BS305

(Revised w.e.f 2016-2017)

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- Unit I** **8**
Genome sequencing, Sequencing technology: Sanger sequencing, Pyrosequencing, Illumina/Solexa, SOLiD System. Pros and cons of sequencing Maxam-Gilbert sequencing, Whole shotgun genome sequencing
- Unit II** **8**
Major genome databases: Genome analysis and their applications-Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; sequence assembly and annotation; Comparative genomics Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics
- Unit III** **8**
Proteomics: Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis. Proteomics classification. Yeast-two-hybrid system, cDNA microarrays 1D-SDS-PAGE , 2D-SDS PAGE. Detection and quantitation of proteins in gels. Pros and cons of various staining methodsBasics of mass spectrometry. MALDI TOFF and ESI, and their application in proteomics, Tandem MS/MS spectrometry, Peptide sequencing by tandem mass spectrometry, Affinity purification of protein TAP tag.
- Unit IV** **8**
Metabolomics: Technologies in metabolomics, Role of Spectroscopy, Electrophoretic and Chromatographic techniques in metabolic profiling, Nutrigenomics
- Unit V** **8**
Applications of genomics and proteomics in agriculture, human health and industry

Suggested Reading:

1. O'Reilly, "Developing Bioinformatics Computer Skills".
2. Griffiths JF, "An Introduction to Generic Analysis".
3. Hunter L, "Artificial Intelligence & Molecular Biology".
4. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown
5. Genomics and Proteomics: Functional and Computational Aspects by Suhai and Sándors,
6. The Handbook of Metabolomics by Fan, Teresa Whei-Mei, Lane, Andrew N, Higashi, Richard M.

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Applied Biotechnology

V sem
Subject Code: BS306

(Revised w.e.f 2016-2017)

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- UNIT I** **8**
Genomics and Proteomics: Introduction to genomics, Genome annotation, Human genome project and its application, Introduction to Proteomics: Protein expression and its analysis
- UNIT II** **8**
Drug Discovery and Designing: Drug and target identification, target validation, Molecular docking studies and its Insilco tools e.g. Autodock, GOLD.
- UNIT III** **8**
Bioprospecting and conservation: importance of biodiversity. biodiversity informatics, databases in biological materials. International efforts and issues of sustainability
- UNIT IV** **8**
Free Radical Biology: General theory of free radical and antioxidants. Free radical mediated damage to lipids, proteins and DNA; Natural antioxidants and their applications
- UNIT V** **8**
IPR and Patenting: Significance of IPR; Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms; International convention in IPR; Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity.

Suggested Reading:

1. Environmental Studies by Benny Joseph, Tata McGraw Hill, 2005.
2. Environmental Studies by Dr. D.L. Manjunath, Pearson Education, 2006.
3. Principles of Environmental Science and Engineering by P. Venugopal Rao, Prentice Hall of India.
4. Environmental Science and Engineering by Meenakshi, Prentice Hall of India.
5. O'Reilly, "Developing Bioinformatics Computer Skills".
6. Griffiths JF, "An Introduction to Generic Analysis".
7. Hunter L, "Artificial Intelligence & Molecular Biology".

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

PRACTICALS

B.Sc. BC III yr

V sem

Subject Name: Tissue Culture & Bioinformatics Lab
(w.e.f 2020-2021)

Subject Code: BS343

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1. Introduction to types of sequence databases (Nucleotides & Protein)
2. Pair wise Sequence Alignment (NW and SW approach)
3. FASTA & BLAST search
4. Multiple Sequence Alignment (ClustalX & Treeview)
5. Protein Structure Visualization (RASMOL, Swiss-PDB Viewer)
6. Gene Finding tools (Grail or Genscan)
7. Preparation of plant culture media and its sterilization.
8. *In vitro* germination of seeds.
9. Initiation and maintenance of Callus and suspension culture.
10. Plant propagation through axillary bud culture.
11. Plant propagation through adventitious bud culture.

Integral University, Lucknow
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PRACTICALS

B.Sc. BC III yr
Subject Name: Immunology Lab

V sem
Subject Code: BS216

(Revised w.e.f. 2016-2017)

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1. Blood grouping
2. Differential Count of WBC
3. Detergent lysis of RBC
4. Dot Elisa
5. ELISA – Demonstration
6. Ouchterlouny Double diffusion (ODD)
7. Separation of serum from blood & precipitation of Immunoglobulins

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: IPR & Biosafety

VI sem
Subject Code: BS204

(Revised w.e.f 2016-2017)

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Unit I **8**

Concept of Intellectual Property: Kinds of Intellectual Property- Patents, Copyrights, Designs, Trademarks, Geographical Indication. Infringement of IPR, Its protection and Remedies Licensing and its types.

Unit II **8**

Requirement of a patentable novelty: Issues related to IPR protection of software and database; IPR protection of life forms; International convention in IPR; Geographical indication; Distinction among various forms of IPR; Rights / protection, infringement or violation, remedies against infringement: civil and criminal.

Unit III **8**

Obtaining patent: Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity; Appropriate case studies; Indian Patent Act 1970 (amendment 2000); Major changes in Indian patent system as post TRIPS effects; Budapest treaty.

Unit IV **8**

Historical Background: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines -Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.

Unit V **8**

Bioethics: Introduction, necessity and limitation; Ethical conflicts in Biotechnology; Different paradigms of bioethics: National and International; Bioethics of genes; Bioethics in health care: Bioethical dilemmas in medical and surgical treatment; Legal implications in bioethics.

Suggested Reading:

1. Genome, T.A. Brown, John Willey & Sons Inc.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
3. Molecular Cell Biology, H. Lodish, A. Berk, S. Zipursky, P. Matsundaira, D. Baltimore and J.E. Barnell, W.H. Freeman and Company.
4. Molecular Biology of the Gene, J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison-Wesley Publishing.

Integral University, Lucknow
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B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr
Subject Name: Bionanotechnology

VI sem
Subject Code: BS312

(Revised w.e.f 2016-2017)

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- UNIT I** **8**
Introduction: Introduction to nanotechnology and overview of nanoscale materials, effect of length scale on properties, introduction to bionanotechnology, challenges and opportunities associated with biology on the Nanoscale, bionanotechnology systems, biological and medical applications of Bionanomaterials.
- UNIT II** **8**
Nanomaterials: Introduction to nanomaterials. DNA based nanostructures. General surface and colloid chemistry, principles, experimental techniques, surface potential, DLVO theory; Characteristics of nanoparticles, chemical speciation of dissolved species, Environmental behaviour of nanoparticles.
- UNIT III** **8**
Biosensors: Introduction to biosensors, the biological component, the sensor surface, Immobilization of the sensor molecule, Transduction of the sensor signal: Optical, Electrochemical and Mechanical sensors, Sensor stabilization.
- UNIT IV** **8**
Biophotonics and Bioimaging: Overview of imaging biological systems, from the cellular level through to whole-body medical imaging, Introduction to biophysics, basic physical concepts in imaging, Major techniques using ionizing and non-ionizing radiation: fluorescence and multi-photon microscopy, spectroscopy, OCT, MRI, X-ray CT, PET and SPECT imaging.
- UNIT V** **8**
Nanotoxicology: Principles of toxicology; toxicology models, experimental toxicology studies; activation and detoxification mechanisms, importance of biological membrane in toxicology; Toxicology and bioaccumulation of particles. Biological activity of nanomaterials.

Suggested Reading:

1. Engines of Creation, K E Drexler, Oxford Paperbacks, New York
2. Nanosystems: Molecular Machinery, Manufacturing and Computation, K E Drexler, Wiley, ISBN 0471575186
4. Web Resources: www.nanotechweb.org; www.nano.gov; www.nanotec.org.uk
5. Nanobiotechnology-Concepts, Applications and Perspectives edited by CM Niemeyer and CA Mirkin, Willey-VCH ISBN 3-527-30658-7
6. NanoBiotechnology Protocols in Methods in Molecular Biology Series edited by SJ Rosenthal and DW Wright, Humana Press, ISBN: 1-58829-276-2

Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry

B.Sc. BC III yr

Subject Name: Human Physiology

(w.e.f 2020-2021)

VI sem

Subject Code: BS351

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UNIT I

8

Blood: composition of blood, plasma proteins, blood cells counting and its significance, Blood coagulation – mechanism and regulation, Blood volume regulation and Blood pressure Haematopoiesis. Disease of Blood: Thalassemia, sickle cell anemia, Anemias; Cardiovascular Disorders – Atherosclerosis

UNIT II

8

Respiration: Transfer of blood gases, role of 2,3-diphosphoglycerate, Bohr's effect, and Haldane effect, chloride shift, Neural & chemical regulation of respiration. Respiratory illnesses: Asthma, COPD, Cystic Fibrosis, Emphysema, Pneumonia.

UNIT III

8

Structure of nephron, glomerular filtration, reabsorption and tubular secretion. Homeostatic regulation of water and electrolytes, Acid-base balance, composition of urine, hormones of the kidney

UNIT IV

8

Diseases: Kidney: Uremia & Glomerulonephritis, Kidney stone; Synapses, central and peripheral nervous system. Neurological: Epilepsy, Parkinson & Alzheimer's significance of diagnostic enzymology.

UNIT V

8

Digestion: functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of biomolecules. Gall Stone, Ulcers, Liver: Jaundice, Liver Function Tests: SGOT, SGPT, CPK, LDH, Hepatitis.

Suggested Reading:

1. Introduction to Physiology by Davidson H and Segal M.B. Academic Press.
2. Fox S I – Human Physiology, (McGraw Hill, 1998, ISBN: 0071157069)
3. Moffett D and Schauf C L – Human Physiology: Foundations & Frontiers, (Mosby, 1993, ISBN: 801669030)
4. Seeley R, Stephens T and Tate P – Anatomy & Physiology, (McGraw-Hill, 1999, ISBN: 0071169881)
5. Physiological chemistry by Harper.
6. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988.

**Integral University, Lucknow
Department of Biosciences
B.Sc. (Hons.) Biochemistry**

B.Sc. BC III yr

Subject Name: Project and Training

(w.e.f 2016-2017)

VI sem

Subject Code: BS315

Students would carry out individual projects at any research institution/industry/in house trainings of their choice for 3 months. The detailed project report/dissertation should be submitted in the Department followed by presentation and viva.

**Integral University, Lucknow
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B.Sc. (Hons.) Biochemistry**

Subject Name: Educational Tour

Subject Code: BS316

The students would be taken to a national scientific laboratory or industry for one week.