

**Integral University, Lucknow**

**Department of Biosciences  
B.Sc. (H) Life Sciences**

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

**B. Sc. (H) Life Sciences Semester – V**  
(w.e.f. 2018- 2019)

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Subject Total	Credit Hours	Total Credit
			L	T	P	CT	TA	Total	ESE			
BS211	Immunology	Core	3	1	0	25	15	40	60	100	3:1:0	4
BS303	Genetic Engineering	Core	3	1	0	25	15	40	60	100	3:1:0	4
BS321	Plant Anatomy & Embryology	Core	3	1	0	25	15	40	60	100	3:1:0	4
BS322	Comparative Anatomy and Developmental Biology	Core	3	1	0	25	15	40	60	100	3:1:0	4
BS323	Electives: (Any one of the following) Industrial & Environmental Biotechnology	Elective	3	1	0	25	15	40	60	100	3:1:0	4
BS306	Applied Biotechnology											
BS216	Immunology Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3
BS308	Genetic Engineering Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3
		<b>Total</b>								<b>700</b>	<b>26</b>	<b>26</b>

**B. Sc. (H) Life Sciences Semester – VI  
(w.e.f. 2018- 2019)**

Course Code	Course Title	Type of Paper	Periods/week			Evaluation scheme				Subject Total	Credit Hours	Total Credit
			L	T	P	CT	TA	Total	ESE			
BS331	Computational Sciences & Bioinformatics	Core	3	1	0	25	15	40	60	100	3:1:0	4
BS332	Elective courses (Any one of the following) Plant & Animal Biotech	Elective	3	1	0	25	15	40	60	100	3:1:0	4
BM337	Entrepreneurship Development											
BS314	Bioinformatics Lab	Practical	0	0	4	25	15	40	60	100	0:0:2	2
BS315	Project & Training* (3 months)		3 Months						300	0:0:4	4	
BS316	Educational Tour (8-10 days)								100	0:0:2	2	
<b>Total</b>										<b>700</b>	<b>16</b>	<b>16</b>

**\* The Evaluation scheme for the Project Work**

	Course Code	Dissertation	Presentation	Viva/Discussion	Total
Project Work	BS 315	200	50	50	300

### Credit Précis

S.No.	Semester	Total Marks	Total Credit
1	I	700	26
2	II	700	26
3	III	700	26
4	IV	700	26
5	V	700	26
6	VI	700	16
Grand Total	-	<b>4200</b>	<b>146</b>

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Subject Name: Immunology**

**Semester: V**  
**Subject Code: BS211**

(Revised w.e.f 2016-2017)

**L T P**  
**3 1 0**

**8**

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

**8**

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

**8**

**UNIT III-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.

**8**

**UNIT IV- 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.

**8**

**UNIT V-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**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Subject Name: Genetic Engineering**

**Semester: V**  
**Subject Code: BS303**

(Revised w.e.f 2016-2017)

**L T P**  
**3 1 0**

**8**

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

**8**

**UNIT II-** *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.

**8**

**UNIT III-** 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*.

**8**

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

**8**

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

**Suggested Readings:**

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. (1986) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Stectz 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**  
**Department of Biosciences**

**B.Sc. LS III yr**

**Subject Name: Plant Anatomy and Embryology**

**Semester: V**

**Subject code: BS-321**

**L T P**

**3 1 0**

**UNIT I**

**8**

Root and shoot apical meristems; Simple and complex tissues. Epidermis, cuticle, stomata; Structure of xylem and phloem.

**UNIT II**

**8**

Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

**UNIT III**

**8**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

**UNIT IV**

**8**

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

**UNIT V**

**8**

Endosperm types, structure and functions; Dicot and monocot embryo; Apomixis and polyembryony.

**Suggested Readings**

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr** **Semester: V**  
**Subject Name: Comparative Anatomy & Developmental Biology** **Subject code: BS-322**  
**L T P**  
**3 1 0**

**Unit I**

Integumentary System: Derivatives of integument w.r.t. glands and digital tips, Skeletal System: Evolution of visceral arches, Digestive System: Brief account of alimentary canal and digestive glands. **8**

**Unit II**

Respiratory System: Gills, lungs and air sacs; Circulatory System: Evolution of heart and aortic arches; Urinogenital System: Succession of kidney, Evolution of urinogenital ducts **8**

**Unit III**

Nervous System: Comparative account of brain; Sense Organs: Types of receptors **8**

**Unit IV**

Gametogenesis, Fertilization, Egg: structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence. **8**

**Unit V**

Process of Blastulation and Gastrulation. Fate Map, Development of Chick up to formation of Primitive streak and mammal (in outline) Extra embryonic membranes of chick. Placentation and types of Placenta. **8**

**Suggested Readings**

1. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills • Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
4. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House. B.
5. *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
6. Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
7. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
8. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
9. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
10. Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.



**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**

**Subject Name: Industrial and Environmental Biotechnology**

**Semester: V**

**Subject code: BS-323**

L T P

3 1 0

**UNIT I**

**8**

Structural and Functional dynamics of microbes: diversity, activity and growth, community profiling, biosensors, bioreporters, Microchips. Methanogenesis: methanogenic, acetogenic and fermentive bacteria- technical processes and conditions.

**UNIT II**

**8**

Solid waste treatment and management, Effluent Treatment: Aerobic and anaerobic water treatment processes: activated sludge, trickling filter, fluidized expanded bed reactor, Upflow anaerobic sludge blanket reactor. Bioleaching, Bioremediation, Biodegradable plastics, Biofuels / Biodiesel, Biopesticides, Biofertilizers and Vermitechnology,

**UNIT III**

**8**

General concept and processes in fermentation, Isolation, screening, maintenance and preservation of industrial strains. Concept of strain improvement. Sterilization.

**UNIT IV**

**8**

Media for Industrial Fermentation. General design of fermenter; Scale up concept. Downstream Processing: Filtration, centrifugation, cell disruption, extraction and drying.

**UNIT V**

Brief account of the following products obtained by industrial microbiological fermentation: Alcoholic Beverage: Beer, Organic acid: Citric acid, Antibiotic: Penicillin, Amino acids: Glutamic acid, Vitamin: vitamin B12.

**8**

**Suggested Reading:**

1. Microbial Biotechnology (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular biotechnology: Principles and Applications of Recombinant DNA –Bernard R. Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
3. Fungal Ecology and Biotechnology (1993) Rastogi Publications, Meerut.
4. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers. Books (P) Ltd.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Subject Name: Applied Biotechnology**

**Semester: V**  
**Subject Code: BS-306**

(Revised w.e.f 2016-2017)

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**3 1 0**

**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".
8. Baxevanis AD,

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**PRACTICALS**

**Semester: V**

**Subject Name: Immunology Lab**

**Subject Code: BS216**

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

**L T P**  
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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

**B.Sc. LS III yr**

**Subject Name: Genetic Engineering Lab**

**Semester: V**

**Subject Code: BS308**

**L T P**  
**0 0 6**

1. Isolation of genomic DNA from bacteria, plant and animal tissue
2. Isolation of plasmid DNA (*E. coli*)
3. Restriction digestion of DNA
4. Agarose Gel Electrophoresis
5. Demonstration of PCR

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Subject: Computational Sciences & Bioinformatics**

**Semester: VI**  
**Subject Code: BS-331**

**L T P**  
**3 1 0**

**UNIT 1** **8**  
Computers: Input and Output Devices; Internet- Web Browsers, URL; Types of network - LAN and WAN. Need of Computers in Biological Sciences, Benefits of computational sciences.

**UNIT 2** **8**  
Introduction to Bioinformatics, Application of Bioinformatics in life sciences. Biological databases: primary and secondary databases; various types and categories of Biological databases.

**UNIT 3** **8**  
Nucleotide sequence databases: Genbank, EMBL, DDBJ; Protein sequence databases: SWISS PROT, TrEMBL; Structural databases: PDB and MMDB and its applications.

**UNIT 4** **8**  
Molecular Visualization tools: PyMOL, Rasmol. Introduction to NCBI and its various components; Database similarity search tools: BLAST – algorithm and its versions. FASTA – algorithm and its version.

**UNIT 5** **8**  
Advanced Bioinformatics: Protein Structure prediction studies – Homology Modeling, method and tools; Multiple sequence alignment – concept and implications – MSA in phylogenetics; Application of bioinformatics in Computer Aided drug Design.

**References:**

- “Reilly “Developing Bioinformatics computer skills”. O
- .F. Griffiths “An intro to generic Analysis” J
- Andreas D. Baxevanis “Bioinformatics: A practical Guide to the analysis of genes and proteins”

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS IIIyr**

**Subject Name: Plant and Animal Biotechnology**

**Semester: VI**

**Subject Code: BS-332**

**L T P**  
**3 1 0**

**8**

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

**8**

**UNIT II-** 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.

**8**

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

**8**

**UNIT IV-** 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.

**8**

**UNIT V-** Expression of Cloned proteins in animal cell: Expression vector, over production and downstream processing of the expressed proteins, Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies, HAT selection

**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. Bhan (1998) tissue Culture, Mittal Publications, New Delhi.
3. H. S. Chawla “Plant Biotechnology: A Practical Approach”
4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropagation (3rd Edition) timber Press, Partland.
5. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and agriculture, Jones and Barlett Publishers, Boston.
6. Ian Freshney Animal cell culture.(4th Edition)
7. Davis, Cell culture techniques.
8. Brown TA “Gene cloning: An introduction”

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Subject Name: Entrepreneurship Development**

**Semester: VI**  
**Subject Code: BM337**

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

**L T P**  
**3 1 0**

**8**

**UNIT I-** Need, Scope & Characteristics of Entrepreneurship, Identification of opportunities, Exposure to Demand based, Resource based, Service based. Import Substitute and Export Promotion Industries.

**8**

**UNIT II-**Market Survey Techniques, Need, Scope and Approaches for Project Formulation, Criteria for Principles of Product Selection and Development, Structure of Project Report, Financing Procedure and Financial Incentives, Financial Ratio and their Significance. Financial statements.

**8**

**UNIT III-**Energy Requirements and Utilization, Resource Management – Men, Machine and Materials, Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI, Creativity and Innovation, Strength Weakness Opportunity and Threat (SWOT) Techniques.

**8**

**UNIT III-**Techno-Economic Feasibility of the project, Plant Layout and Process Planning for the Product, Quality Control / Quality Assurance and Testing of Product, Elements of Marketing and Sales Management: (a) Nature of Product and Market Strategy, (b) Packaging and Advertising after sales service. Costing and Pricing.

**8**

**UNIT IV-**Copying with uncertainties, Stress Management and Positive Reinforcement (a) licensing Registration, (b) Municipal bye Laws and Insurance Coverage.

**8**

**UNIT V-**Important Provision of Factory: (a) Dilution (b) Social Responsibility and Ethics. Income Tax, Sales Tax and Excise Tax.

**Suggested Reading:**

1. Brandt, Steven C., The 10 Commandments for Building a Growth Company, Third Edition, Macmillan Business Books, Delhi, 1977
2. Bhide, Amar V., The Origin and Evolution of New Business, Oxford University Press, New York, 2000.
3. Dollinger M.J., 'Entrepreneurship strategies and Resources', 3rd edition, Pearson Education, New Delhi 2006.

**INTEGRAL UNIVERSITY**  
**Department of Biosciences**

**B.Sc. LS III yr**  
**Practical**

**Semester: VI**

**Subject Name: Bioinformatics Lab**

**Subject Code: BS314**

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

**L T P**  
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1. Introduction to types of sequence databases (Nucleotide & Protein)
2. Retrieving sequences from the databases
3. Simple sequence comparison using DOTPLOT
4. Pair wise Sequence Alignment (NW and SW approach)
5. FASTA & BLAST search
6. Multiple Sequence Alignment (ClustalX & Treeview)
7. Protein Structure Visualization (RASMOL, Swiss-PDB Viewer)
8. Gene Finding tools (Grail or Genscan)

**B.Sc. LS III yr**

**Subject Name: Project and Training**

**Semester: VI**

**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.

**B.Sc. LS III yr**

**Subject Name: Educational Tour**

**Semester: VI**

**Subject Code: BS316**

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

