



1.1.2

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	



**List of Courses Focus on Employability/ Entrepreneurship/
Skill Development**

Department : *Biotechnology*

Programme Name : *B.Sc.*

Academic Year : *2019-20*

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
1.	LS/BT/C-203L	GENERAL MICROBIOLOGY
2.	LS/BT/C-305L	MOLECULAR BIOLOGY
3.	LS/BT/GE-303L	INTELLECTUAL PROPERTY RIGHT AND ENTREPRENURESHIP
4.	LS/BT/SEC-301L	MOLECULAR TECHNIQUES IN DISEASE DIAGNOSIS
5.	LS/BT/SEC-302L	ANIMAL CELL CULTURE
6.	LS/BT/SEC-512L	RECOMBINANT DNA TECHNOLOGY
7.	LS/BT/DSE-501L	BIOINFORMATICS
8.	LS/BT/DSE-501L	BIostatISTICS
9.	LS/BT/DSE-502L	INDUSTRIAL FERMENTATION
10.	LS/BT/C-613L	BIOPROCESS TECHNOLOGY
11.	LS/BT/DSE-603L	MICROBIAL TECHNOLOGY
12.	LS/BT/DSE-603L	BIODIVERSITY AND BIOPROSPECTING
13.	LS/BT/DSE-604PD	DISSERTATION



School of Sciences :(Life Science) B.Sc. Biotechnology Hon's

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / week
I	Core-1	LS/BT/C-101L	Cell Biology	4	4
	Core -1'Practical	LS/BT/C-101P	Laboratory-1 based on core-1	2	4
	Core -2	LS/BT/C-102L	Biochemistry and Metabolism	4	4
	Core -2 Practical	LS/BT/C-102P	Laboratory-2 based on core-2	2	4
	Generic Elective - 1 (GE- 1)	LS/BT/GE-101/B&B-L	Bioethics and Biosafety	4	4
	Generic Elective - Practical	LS/BT/GE-101/B&B-P	Laboratory-GE1 based on GE-1	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-101/EC	English Communication / MIL (Hindi Communication)	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)
		TOTAL	24	28	

II	Core-3	LS/BT/C-203L	General Microbiology	4	4
	Core -3 Practical	LS/BT/C-203P	Laboratory-3 based on core-3	2	4
	Core -4	LS/BT/C-204L	Genetics	4	4
	Core -4 Practical	LS/BT/C-204P	Laboratory-4 based on core-4	2	4
	Generic Elective -2 (GE-2)	LS/BT/GE-202/B&HW-L	Biotechnology and Human Welfare	4	4
	Generic Elective - Practical	LS/BT/GE-202/B&HW-P	Laboratory-4 based on core-4	2	4
	Ability Enhancement Compulsory Course (AECC)	LS/BT/AE-201/EVS	Environmental Science	4*	4
	ECA		ECA-Extracurricular activity/ Tour, Field visit/ Industrial training/ NSS/ Swachhta/ vocational Training/ Sports/ others	2	(2)



			Total	24	28
SUMMER Internship: 15 days			SwayamSwachhta / NSS / Industrial/ others	2	100
III	Core-5	LS/BT/C-305L	Molecular Biology	4	4
	Core -5 Practical	LS/BT/C-305P	Laboratory-5 based on core-5	2	4
	Core -6	LS/BT/C-306L	Bio-analytical Tools	4	4
	Core -6 Practical	LS/BT/C-306P	Laboratory-6 based on core-6	2	4
	Core - 7	LS/BT/C-307L	Chemistry-1	4	4
	Core - 7 Practical	LS/BT/C-307P	Laboratory-7 based on core-7	2	4
	Generic Elective - 3 (GE-3)	LS/BT/GE-303/IPRE-L	Intellectual Property Right and Entrepreneurship	4	4
	Generic Elective - Practical	LS/BT/GE-303/IPRE-P	Laboratory-GE3 based on GE-3	2	4
	Skill Enhancement Course (SEC - 1)	LS/BT/SEC-301/MT -L	Molecular techniques in disease diagnosis	4*	2 (4)
			Total	28	34
IV	Core-8	LS/BT/C-408L	Mammalian Physiology	4	4
	Core -8 Practical	LS/BT/C-408P	Laboratory-8 based on core-8	2	4
	Core -9	LS/BT/C-409L	Immunology	4	4
	Core -9 Practical	LS/BT/C-409P	Laboratory-9 based on core-9	2	4
	Core - 10	LS/BT/C-410L	Chemistry-2	4	4
	Core -10 Practical	LS/BT/C-410P	Laboratory-10 based on core-10	2	4
	Generic Elective - 4 (GE-4)	LS/BT/GE-404/BME-L	Bio-management of Environment	4	4
	Generic Elective - Practical	LS/BT/GE-404/BME-P	Laboratory-GE4 based on GE-4	4	4
	Skill Enhancement Course (SEC-2)	LS/BT/SEC-402/ACC -L	Animal Cell Culture	4*	2 (4)
			TOTAL	28	34
SUMMER Internship: 15 days			Swayam Swachhta / NSS / Industrial/ others	2	100
V	Core-11	LS/BT/C-511L	Plant Physiology and	4	4



			Anatomy		
	Core -11 Practical	LS/BT/C-511P	Laboratory-11 based on core-11	2	4
	Core -12	LS/BT/C-512L	Recombinant DNA Technology	4	4
	Core -12 Practical	LS/BT/C-512P	Laboratory-12 based on core-12	2	4
	Discipline Specific Elective (DSE-1)	LS/BT/DSE-501L	Bioinformatics / Biostatistics	4	4
	DSE-1 - Practical	LS/BT/DSE-501P	Laboratory-DSE1 based on DSE-1	2	4
	Discipline Specific Elective (DSE-2)	LS/BT/DSE-502L	Industrial Fermentations	4	4
	DSE-2 - Practical	LS/BT/DSE-502P	Laboratory-DSE2 based on DSE-2	2	4
			TOTAL	24	32

VI	Core-13	LS/BT/C-613L	Bioprocess Technology	4	4
	Core -13 Practical	LS/BT/C-613P	Laboratory-13 based on core-13	2	4
	Core -14	LS/BT/C-614L	Genomics and Proteomics	4	4
	Core -14 Practical	LS/BT/C-614P	Laboratory-14 based on core-14	2	4
	Discipline Specific Elective (DSE-3)	LS/BT/DSE-603L	Microbial Technology / Biodiversity and Bioprospecting	4	4
	DSE-3 – Practical	LS/BT/DSE-603P	Laboratory-DSE3 based on DSE-3	2	4
	Discipline Specific Elective (DSE-4) Dissertation	LS/BT/DSE-604/PD	Dissertation	6	8
			TOTAL	24	32
		TOTAL CREDITS	152 + 4 (SI)		

As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by any department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each. In present scheme it is proposed to have minimum two GE courses (from one subject) in first two semester after which student shall change two GE for another subject in IIIrd and IVth semester, so that the entire student can have exposure of one additional subject. (Subject to approval by the competent authority)



B.Sc. (Hons.) Biotechnology, Semester-II, Core-3
Course: General Microbiology
Course Code: C3
Course Credit: (4-0-0) 4

UNIT I

History and scope of microbiology, Microbial taxonomy, Classification of microorganisms: criteria used including molecular and polyphasic approaches, microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization of Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Viruses

UNIT II

Cultivation and maintenance of microorganisms: methods of isolation, purification and preservation. Nutritional categories of micro-organisms, Control of microorganisms by physical, chemical and chemotherapeutic agents

UNIT III

Microbial growth: Growth curve, Generation time, synchronous, batch and continuous culture, methods of measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Asexual reproduction (binary fission, endospores and sporulation in bacteria), Genetic recombination (Transformation, Transduction and Conjugation).

UNIT IV

Bacteria, fungi, algae and cyanobacteria pollutants of water, sewage composition and its disposal Important microorganisms in food: moulds, yeasts, bacteria, major food born infections and intoxications in humans, food spoilage and preservation of various types of foods.



B.Sc. (Hons.) Biotechnology, Semester-III, Core-5
Course: Molecular Biology
Course Code: C5
Course Credit: (4-0-0) 4

UNIT I

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semi-conservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombination repair. Homologous recombination: models and mechanism, nonhomologous end joining.

UNIT III

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing

UNIT IV

Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Regulation of gene expression in prokaryotes: Lac Operon and eukaryotes: tryptophan eukaryote.



B.Sc. (Hons.) Biotechnology, Semester-VI, Core-13

Course: Bioprocess Technology

Course Code: C13

Course Credit: (4-0-0) 4

UNIT I

Introduction to bioprocess technology, Range of bioprocess technology and its chronological Development, Basic principle components of fermentation technology, Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II

Design and types of bioprocess vessels: Significance of Impeller, Baffles, Sparger; Types of culture/production vessels: Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing: Media preparation, Inocula development and sterilization from straw dust.

UNIT III

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV

Introduction to downstream processing, product recovery and purification, effluent treatment, Microbial production of ethanol, amylase, lactic acid and single cell proteins



B.Sc. (Hons.) Biotechnology, Semester-III, GE-3
Course: Intellectual Property Right and Entrepreneurship
Course Code: GE3
Course Credit: (4-0-0) 4

UNIT-I

Introduction to Indian Patent Law, World Trade Organization and its related intellectual property provisions, Intellectual/Industrial property and its legal protection in research, design, development in Biotechnology

UNIT II

Essential requirements for patenting, types of patent, things that are patentable and non-patentable, Drug patents in India, various types of patent application in India, patenting of living organism, traditional knowledge, commercial exploitation and protection.

UNIT III

Concept of entrepreneur, nature of entrepreneur, entrepreneurial characteristics, functions of an entrepreneur, role of entrepreneurship in developing economy.

UNIT - IV

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.



SKILL ENHANCEMENT COURSE

B.Sc. (Hons.) Biotechnology, Semester-III, SEC-1

Course: Molecular Techniques in Disease Diagnostic

Course Code: SEC-1

Course Credit: (2-0-0) 2

Unit- I

Transportation of different clinical materials to distant Laboratories, Proper storage of samples, Chemicals, antibodies and enzymes, common anticoagulants used-composition, amount, mechanism of action and methods of preparation of different types of vials, Biosafety measures and disposal of laboratory waste. Basics of quality control methods and Laboratory accreditation

Unit - II

Composition of blood and its function, drawing of peripheral blood smear, staining & stain preparation, Methods of estimation of Haemoglobin, Methods of total counts of WBC, RBC, Platelets & fluids used, Blood Group (ABO & Rh), Cytochemical stain for diagnosis/differential diagnosis of leukemia/other diseases

Unit- III

Susceptibility tests: Diffusion test procedures, Tests for bactericidal activity, Immunodiagnostic tests, Immuno fluorescence, Enzyme Immunoassays: Enzyme linked immunosorbent assay, Radioimmunoassay, Immunophenotyping, Fluorescence activated cell sorter, Magnetic cell sorter, FTR, Spectrophotometry

Unit - IV

Molecular techniques to detect genetic disorders: Polymerase chain reaction, Restriction fragment length polymorphism, Nuclear hybridization methods, Single nucleotide polymorphism and DNA finger printing



B.Sc. (Hons.) Biotechnology, Semester-IV, SEC2

Course: Animal Cell Culture

Course Code: SEC-2

Course Credit: (2-0-0) 2

UNIT I

History and scope of animal cell culture technology. Basic requirements of animal cell culture laboratory (Laminar air flow, CO₂ incubator, centrifuge, microscope) biological containment and biosafety levels, good laboratory practices to prevent contamination, common cell culture contaminants

UNIT II

Culture media and buffers, natural and defined media, basal media, serum supplemented media, serum free media, growth supplements, balanced salt solution, sterilization and filtration of media.

UNIT III

Cell culture techniques, primary and secondary culture, cell lines, monolayer culture, suspension culture, organ culture, cryopreservation of cell lines

UNIT IV

Behaviour of cultured cells in terms of growth, differentiation and metabolism, apoptosis, necrosis and senescence, appearance of viable and non-viable cells, application of cell culture, in-vitro fertilization



DISCIPLINE CENTRIC SUBJECTS

(Any two per semester in semesters 5-6)

B.Sc. (Hons.) Biotechnology, Semester-V, DSE1

Course: Bioinformatics

Course Code: DSE1

Course Credit: (4-0-0) 4

Unit -I

Introduction to bioinformatics, Applications of Bioinformatics, General Introduction of Biological Databases: Flat files, relational, object oriented databases and controlled vocabularies File Format (Genbank, FASTA). Introduction of Data Generating Techniques for Genomics: shotgun sequencing, clone contig, Nucleic acid databases

Unit-II

Introduction of Data Generating Techniques in proteomics: Mass spectroscopy. Protein databases (PDB, Swiss Prot, TREMBL). File Format (PDB). Searching Databases: SRS, Entrez

Unit-III

Pairwise sequence alignments, Local alignment and Global alignment, Mutation/Substitution Matrices. Introduction to BLAST and interpretation of result, Multiple Sequence Alignment

Unit-IV

Genome Annotation: Gene identification, Detecting Open Reading Frames, Phylogenetic analysis tools



B.Sc. (Hons.) Biotechnology, Semester-V, DSE1
Course: Biostatistics
Course Code: DSE1
Course Credit: (4-0-0) 4

UNIT I

Scope and applications of Biostatistics, samples and population concept, collection, processing and presentation of data, frequency distribution

UNIT II

Measures of central tendency: Arithmetic, Harmonic and Geometric Mean, Mode and Median, their applications, merits and demerits

UNIT III

Measures of dispersion, Variance, Standard Deviation, Coefficient of Variance, their applications, merits and demerits, Correlation analysis and Regression analysis, Concept of Probability

UNIT IV

Comparison of two data sets: testing of hypothesis, Student's t-test, Chi square test, F-test- introduction and application in biology, comparison of three and more data sets: ANOVA test.



B.Sc. (Hons.) Biotechnology, Semester-V, DSE3
Course: Microbial Technology
Course Code: DSE3
Course Credit: (4-0-0) 4

UNIT I

Introduction to Microbial biotechnology, Definition, Bioprospecting of microbial diversity,
Isolation and preservation of industrially important microorganisms

UNIT II

Production of proteins and enzymes in bacteria, recombinant vaccines, polysaccharides from
microbes

UNIT III

Microbes as biocontrol agents: microbial insecticides: their mode of action
(*Metarhiziumanisopliae*, *Bacillus thuringiensis*, Nuclear Polyhedrosis Virus), requirements of
biopesticide registration, insect resistance transgenic plants

UNIT IV

Microbial biomass production, lignocellulose biodegradation, application of
ligninolyticmicroorganisms and enzymes in biodegradation



B.Sc. (Hons.) Biotechnology, Semester-V, DSE3
Course: Biodiversity and Bio-prospecting
Course Code: DSE3
Course Credit: (4-0-0) 4

UNIT I

Components of biodiversity, Biodiversity crisis and biodiversity loss, Importance of biodiversity in daily life, Biodiversity and climate change, Types of Ecosystems, India as mega biodiversity Nation, Hot spots and biodiversity in India, Biodiversity and Ecosystem functioning, Plant and Animal systematic, Species concept in biodiversity studies

UNIT II

Modern Tools in the study of Biodiversity, endemism, endemic plants and animals, assessment of mapping of biodiversity; GIS/Remote sensing; Biotechnology and Conservation, IUCN, Germplasm banks, National Parks, Botanical Gardens, Wild life Sanctuaries, Bioresources, Health and biodiversity

UNIT III

Introduction to bioprospecting, bioprospecting from plants, plant derived drugs, botanicals for biocontrol, bioprospecting from animal sources, scope and examples

UNIT IV

Bio-prospecting from microbes, micro organisms as a source of novel enzymes, antibiotics, antiviral agents, immunosuppressive agents and other therapeutic agents



B.Sc. (Hons.) Biotechnology, Semester-V, Core-12
Course: Recombinant DNA Technology
Course Code: C12
Course Credit: (4-0-0) 4

UNIT - I

History of recombinant DNA technology, Host controlled restriction modification system, restriction endonucleases, cutting and joining of DNA molecules *in vitro*. Phosphatases, ligases and polymerases. Southern and Northern hybridization, Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription, Genome mapping, Restriction mapping, DNA fingerprinting, Principle applications and types of Polymerase chain reaction (PCR).

UNIT - II

Cloning vectors: plasmid, bacteriophage, cosmids, phagemid, expression vectors, Gene transfer methods: microinjection, electroporation, microprojectile bombardment, shot gun method, ultrasonication, lipofection, micro laser, RNA-interference, selection and screening of recombinants by genetic and immunochemical

UNIT - III

Expression of foreign genes in *E.coli* and Yeast, application of gene cloning for the analysis of gene structure and function, expression of foreign genes using strong promoters, production of protein, artificial insulin gene, recombinant vaccine and other therapeutics from cloned genes

UNIT - IV

Genetic engineering in plants: use of *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes*, Ti plasmids, application of recombinant DNA technology. Genetic engineering in animals: production of transgenic mice, embryonic stem cells for gene targeting in mice, applications of gene targeting.

T. Prasad



B.Sc. (Hons.) Biotechnology, Semester-V, DSE-2
Course: Industrial Fermentations
Course Code: DSE-2
Course Credit: (2-0-0) 2

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products, butyric acid, gluconic acid, microbial insecticides, microbial flavours and fragrances, newer antibiotics, anti cancer agents

UNIT II

Microbial products of pharmacological interest, steroid fermentations and transformations, Secondary metabolism: its significance and products, Metabolic engineering of secondary metabolism for highest productivity, enzyme immobilization in industrial processing

UNIT III

Purification & characterization of proteins, Upstream and downstream processing, centrifugation, filtration of fermentation broth, ultra-centrifugation, liquid extraction, ion-exchange recovery of biological products, Process optimization and recovery of product

UNIT IV

Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (K_a) determination, factors depending on scale up principle and different methods of scaling up.