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BE BOUNDLESS

BENGALURU CITY UNIVERSITY

REGULATIONS AND SYLLABUS FOR
B.Sc. Biotechnology

CHOICE BASED CREDIT SYSTEM

(SEMESTER SCHEME)

2020-2021

B.Sc. CBCS SEMESTER SCHEME
BIOTECHNOLOGY
SCHEME OF INSTRUCTIONS AND CREDITS

Paper No.	Title of Paper	Type of Paper	Hours/ Week	Duration of Examination	IA Marks	Exam Marks	Total Marks	Credits
	I Semester							
BTP- 101	Biotechnology – I Cell biology, Genetics & Biochemistry	Theory	4	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for I semester						150	6
	II Semester							
BTP-201	Biotechnology - II Microbiology	Theory	4	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for II semester						150	6
	III Semester							
BTP-301	Biotechnology – III Molecular biology	Theory	4	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for III semester						150	6
	IV Semester							
BTP-401	Biotechnology – IV Genetic Engineering	Theory	4	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for IV semester						150	6
	V Semester							
BTP-501	Biotechnology – V Environmental Biotechnology & Immunotechnology	Theory	3	3	30	70	100	4
		Practical	3	3	15	35	50	2
BTP-502	Biotechnology – VI Plant & Animal Biotechnology	Theory	3	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for V semester						300	12
	VI Semester							
BTP-601	Biotechnology –VII Industrial Biotechnology	Theory	3	3	30	70	100	4
		Practical	3	3	15	35	50	2
BTP-602	Biotechnology – VIII Bioinformatics, Bio entrepreneurship & Research	Theory	3	3	30	70	100	4
		Practical	3	3	15	35	50	2
	Total Marks and Credits for VI semester						300	12

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B Sc Biotechnology (CBCS) Syllabus 2020-21

B Sc I Semester – Biotechnology Paper I: Cell Biology, Genetics and Biochemistry

B Sc II Semester – Biotechnology Paper II: Microbiology

B Sc III Semester – Biotechnology Paper III: Molecular Biology

B Sc IV Semester – Biotechnology Paper IV: Genetic Engineering

B Sc V Semester – Biotechnology Paper V: Environmental Biotechnology and Immunotechnology

Biotechnology Paper VI: Plant and Animal Biotechnology

B Sc VI Semester – Biotechnology Paper VII: Industrial Biotechnology

Biotechnology Paper VIII: Bioinformatics, Bio entrepreneurship and research

B Sc I Semester

Biotechnology Paper I: Cell Biology, Genetics and Biochemistry

Theory: 60 Hours

Unit 1 Introduction

1.1 Introduction, Scope and applications of Biotechnology. 4Hr

1.2 Mendel's laws of heredity. Interaction of genes: supplementary genes-comb pattern in fowls, complementary genes- flower colour in sweet peas, epistasis- plumage colour in poultry and multiple allelism- blood groups in human being. 8 Hr

1.3 Mutations – Spontaneous and induced. Mutagens- physical and chemical. 3 Hr

Unit 2 Cell: the unit of life

2.1 General introduction and ultrastructure of a plant cell and animal cell. 2 Hr

2.2 Structure and functions of cell wall and Plasma membrane – ultra structure (fluid mosaic model) and functions – passive transport and active transport. 5 Hr

2.4 Structure and functions of nucleus, mitochondria, chloroplast, ER and ribosome. 3Hr

2.5 Chromosomes – Structure of metaphase chromosome, types based on position of centromere and ultrastructure (nucleosome model). 2Hr

2.6 Cell cycle – Mitosis, Meiosis and apoptosis. 3Hr

Unit 3 Biomolecules

3.1 Carbohydrates – structure, properties, classification and biological importance. 4Hr

3.2 Lipids -structure, properties and biological role. 3Hr

3.3 Proteins – Amino acids – names, symbols (3 & single letter), general structure and properties; Classification of proteins with examples; structure- primary, secondary, tertiary and quaternary; biological importance of proteins. 6Hr

3.4 Vitamins – water soluble and lipid soluble vitamins and their dietary sources. 2Hr

Unit 4 Enzymes and Hormones

4.1 Enzymes – Introduction, chemical nature, nomenclature and classification with examples. 3Hr

4.2 Mechanism of enzyme action – active sites, enzyme-substrate complex formation, lock and key model and induced fit theory. 3Hr

4.3 Factors influencing enzyme activity – substrate concentration, temperature, pH, inhibitors and activators; Enzyme inhibition – competitive and non-competitive. 3Hr

4.4 Enzyme kinetics – Michaeli's and Menten equation. 1Hr

4.5 Cofactors and coenzymes. 1Hr

4.6 Hormones – General introduction, protein hormones (insulin and growth hormone) steroid hormones (glucocorticoids, androgens, oestrogens and progesterone) and their basic functions. Mechanism of action of steroid hormones. 4Hr

Practical I: Cell biology, Genetics and Biochemistry

15 Units of 3 Hours each

1. Study of simple and compound microscope and colorimeter. 1 unit
2. Study of Mitosis - preparation of temporary squash from onion root tips. 2 units
3. Study of meiosis - preparation of temporary squash from onion flower buds. 2 units
4. Definition of molarity, normality and calculations. 1 unit
5. Estimation of protein by Biuret and FC methods. 2 units
6. Estimation of glucose by Somoji's method. 2 units
7. Estimation of maltose by DNS method. 1 unit
8. Estimation of amino acid by Ninhydrin method. 1 unit
9. Estimation of salivary amylase activity. 2 units
10. Study and analysis of human karyotypes – normal and abnormal. 1 unit

B Sc II Semester

Biotechnology Paper II: Microbiology

Theory: 60 Hours

Unit 1 **Fundamentals of microbiology**

1.1 General introduction, scope and relevance of microbiology. Important contributions of Robert Koch, Leeuwen Hoek, Edward Jenner, Louis Pasteur, Alexander Fleming and Iwanowsky. 3hr

1.2 Concept of prokaryotes and eukaryotes. General account on structure, classification and reproduction of bacteria, virus and fungi; bacteria classification based on shape, flagella and staining reaction; virus classification based on host and genetic material, plant virus- CaMV, animal virus-HIV, bacteriophage-lambda phage. 8hr

1.3 Microbial diseases- causative agents, mode of transmission, symptoms and preventive measures of pneumonia, tuberculosis, typhoid, cholera, hepatitis, dengue and dermatomycosis. 4hr

Unit 2 **Microbial techniques**

2.1 Principles and applications of sterilization – a) Physical -autoclave, hot air oven, LAF, Seitz filter, sintered glass filter and membrane filter, b) Chemical – alcohols, aldehydes, phenols, halogens, gaseous agents and antibiotics (Penicillin and Tetracycline), c) Radiation – UV and gamma rays. 4hr

2.2 Bacteria staining techniques – simple and differential staining (Gram's staining), Types of stains – simple stains, structural stains and acid fast stains. 3hr

2.3 Microscopy: Construction and working principles of Bright field, dark field, phase contrast and Electron (SEM & TEM) microscopes. 4Hr

2.4 Bacterial counting techniques – plate (colony) counting, coulter-counter counting and turbidometry. 2Hr

2.5 Antimicrobial sensitivity tests – diffusion test and dilution test. 2Hr

Unit 3 **Microbial growth and metabolism**

3.1 Isolation, culture, identification and preservation of bacteria. Nutritional types of bacteria, essential macro and micro nutrients for growth of bacteria and growth curve. 3Hr

3.2 Microbial respiration – aerobic and anaerobic respiration, EMP, HMP and ED pathway, Krebs's cycle and oxidative phosphorylation. 5Hr

3.3 Microbial photosynthesis – Photosynthetic pigments in prokaryotes, photophosphorylation and dark reaction. 3Hr

Unit 4 **Microbial food spoilage and food preservation**

4.1 Microbial spoilage of food: cereal grains, fruits and vegetables, milk, bread, meat and egg. 4Hr

4.2 Preservation of food – high temperature, low temperature, dehydration, osmotic pressure, chemical and radiation methods. Emphasis on Pasteurization. 6Hr

4.3 Testing of microbial contamination of water – MPN method. 2Hr

4.4 Microbial foods – Curd, Yogurt, Buttermilk and Cheese. 3Hr

Practical II: Microbiology

15 Units of 3 Hours each

1. Safety measures in the laboratory, cleaning and sterilization of glassware. 1 unit
2. Preparation of nutrient agar, nutrient broth, MRBA and PDA media. 2 units
3. Instrumentation -Autoclave, Hot-air oven, Incubator, pH meter, LAF, Inoculation loop and glass spreader. 1 unit
4. Isolation of bacteria and fungi from soil and water- serial dilution technique. 3 units
5. Inoculation techniques- pour plate, spread plate, stab, point and streak plate methods. 1 unit
6. Microbial growth determination by turbidometry. 1 unit
7. Bacterial staining techniques- simple staining, Gram staining and endospore staining techniques. 3 units
8. Enumeration of microorganisms- total count- Haemocytometer, bacteria and yeast. 2 units
9. Biochemical Tests- Catalase, starch hydrolysis and gelatin liquefaction. 2 units

B Sc III Semester

Biotechnology Paper III: Molecular biology & Biophysics

Theory: 60 Hours

Unit 1 **Introduction to DNA** and **DNA Replication**

1.1 Genetic material – Characteristics of genetic material, Experiments to prove DNA and RNA as genetic material. Structure and chemical nature of DNA (B, A & Z Models), RNA and their functions. 3 Hr

1.2 Concept of Gene – functional unit, prokaryotic and eukaryotic gene, promoters, introns and exons. 3 Hr

1.3 Replication in prokaryotes and eukaryotes - Enzymes in DNA replication and mechanism of replication. Models of replication (Theta, rolling circle and semiconservative models). Differences between prokaryotic and eukaryotic replication. 4 Hr

1.4 DNA Repair – causes of damage and mechanisms of repair – photoreactivation, excision repair, mis-match repair and SOS repair. 3 Hr

1.5 DNA Recombination - Transformation, conjugation and transduction in prokaryotes. 2 Hr

Unit 2 **Protein synthesis**

2.1 Transcription - Central Dogma. Genetic code, its properties and Wobble hypothesis. Transcription in prokaryotes and eukaryotes – promoters, RNA polymerases, Direction of transcription and mechanism of transcription. Post transcriptional modification of eukaryotic mRNA. 7 Hr

2.2 Translation - in prokaryotes and eukaryotes – ribosome, enzymes and factors involved in translation. Mechanism of translation – activation of amino acid, aminoacyl tRNA synthesis, initiation, elongation and termination of polypeptide chain. Brief note on protein folding and modifications. 8 Hr

Unit 3 **Regulation of gene expression**

3.1 Gene regulation in prokaryotes – Transcription control mechanism, negative control and positive control. Operon concept: Lac operon and tryptophan operon. 6 Hr

3.2 Gene regulation in eukaryotes – Transcriptional activation and galactose metabolism in yeast. 3 Hr

3.3 General account of Insertional elements and transposons. Transposable elements in *Maize* and *Drosophila*. 3 Hr

3.4 Gene organization and expression in Mitochondria and chloroplast. 3 Hr

Unit 4 **Biophysics**

4.1 Basics of biophysics: pH and buffer concepts and chemical bonds stabilizing biomolecules (ionic bond, covalent bond, hydrogen bond, hydrophobic interactions and Van der Waals forces). 3 Hr

4.2 Spectroscopy: Beer and Lambert's Laws, Principles and applications of Colorimetry, UV and visible spectrophotometry, absorption spectroscopy, fluorescence spectroscopy, X-ray crystallography and NMR imaging. 6 Hr

4.3 Separation techniques: Principles and applications of Chromatography – paper, thin layer, adsorption, affinity, ion exchange chromatography and HPLC. 4 Hr

4.4 Centrifugation: Basic principles, types and applications. 2 Hr

Practical III: Molecular biology

15 Units of 3 Hours each

1. Colorimetric estimation of DNA by DPA method. 2 units
2. Colorimetric estimation of RNA by Orcinol method. 2 units
3. Determination of Tm value of DNA. 1 unit
4. Separation of amino acids or plant pigments by ascending paper chromatography. 2 units
5. Column Chromatography. 2 units
6. Extraction and estimation of protein from plant tissue by salt precipitation method. 2 units
7. Extraction and estimation of protein from animal tissue by organic solvent method. 2 units
8. Preparation of DNA models. 1 unit
9. Preparation of Charts of conjugation, transformation and transduction. 1 unit

B Sc IV Semester

Biotechnology Paper IV: Genetic engineering

Theory: 60 Hours

Unit 1 **Introduction and Tools of Genetic engineering**

1.1 Importance, history, concepts, developments and steps of genetic engineering. 3 hr

1.2 Enzymes used in genetic engineering: Restriction endonucleases – nomenclature, types and mode of action, DNA ligase, alkaline phosphatase, phosphokinase, DNA polymerases, Taq polymerase and reverse transcriptase. 6 hr

1.3 Gene cloning vectors: Introduction, general characteristics and types- plasmids (pUC18 and pBR322), bacteriophage vectors (lambda and M13) and cosmids, shuttle vectors and expression vectors. 6 hr

Unit 2 **Creation of recombinant DNA and techniques**

2.1 Techniques used in genetic engineering: Principle, procedure and applications of Electrophoresis (AGE and PAGE), PCR, DNA sequencing (Sanger's and Maxam-Gilbert method), DNA finger printing and Blotting techniques. 6hr

2.2 In vitro construction of recombinant DNA molecule: Isolation and preparation of desired DNA – isolation from genomic DNA, preparation of cDNA and chemical synthesis; restriction digestion and ligation of desired DNA with vector DNA. 4 hr

2.3 Introduction of recombinant DNA molecule into hosts: Bacteria – calcium chloride method and electroporation method; plant host – Agrobacterium mediated and Gene gun method; animal host–Microinjection and Liposome fusion method. 5 hr

Unit 3 **Screening and selection of recombinants and expression of cloned gene**

3.1 Screening and selection – Insertional inactivation of antibiotic resistance gene and lac Z gene, Colony hybridization and immunological screening. 4 hr

3.2 Expression of cloned gene – in prokaryotes and eukaryotes. 3 hr

3.3 Gene libraries – construction of genomic DNA and cDNA libraries and applications. 4 hr

3.4 Human genome project: Introduction, salient features, general techniques used and applications of human genome project. 4 hr

Unit 4 **Applications of genetic engineering**

4.1 Applications in human health care – Production of recombinant insulin, growth hormone, recombinant vaccine (hepatitis) and interferon; gene therapy (in cancer). 5 hr

4.2 Applications in agriculture - production of GM crops -pesticide resistant plants (Bt cotton), nutritionally rich crops (Golden rice) and improved shelf life (Tomato - antisense mRNA technology). 4 hr

4.3 Application in environment and forestry – clearing of oil spills (GM *Pseudomonas putida*), invitro propagation of forest plants and medicinal plants and conservation of germplasm. 3 hr

4.4 Applications in food and dairy industry – genetically modified foods, transgenic fish, biotechnological approach in food processing and dairy. 3 hr

Practical IV: Genetic Engineering

15 Units of 3 Hours each

1. Handling of instruments- Centrifuge, Electrophoresis unit, micro pipettes. 1 unit
2. Isolation of DNA from bacteria, animal and plant tissue. 4 units
3. Quantification of DNA by spectrophotometry. 2 units
4. Agarose gel electrophoresis of DNA. 2 units
5. Competent cell preparation. 2 units
6. Bacterial transformation. 1 unit
7. Testing of efficiency of competent cells. 1 unit
8. Visit to agriculture/ forest research institute or food processing/ dairy industry and submission of report in practical exam. 2 units

Semester V

Paper V: ENVIRONMENTAL BIOTECHNOLOGY AND IMMUNOTECHNOLOGY

Theory: 45 hours

Unit 1: **Environmental biotechnology**

1.1 Renewable and Non-renewable sources of Energy:
Conventional fuels and their environmental impact -firewood, plant and coal. Modern fuels and their environmental impact. Methanogenic bacteria in production of biogas. Microbial hydrogen production, conversion of sugars to alcohol and gasohol. 6 hr

1.2 Biofertilizers and biopesticides:
Brief account of nitrogen cycle. Role of symbiotic and non- symbiotic nitrogen fixing bacteria in enrichment of soil (*Rhizobium* and *Azatobacter*). Algal and fungal biofertilizers (VAM and Trichoderma). Vermi composting. 5 hr

1.3 Bioremediation
Biodegradation of lignin and cellulose.
Treatment of municipal wastes and industrial effluents. 4 hr

Unit 2: **Immunology**

2.1 Introduction
Cells and organs of immune system, blood cell components, Primary and secondary lymphoid organs and their functions. Immunity-innate and acquired, Active and passive, Humoral and cell mediated immunity. 6 hr

2.2 Antigens and their types, epitopes, haptens and factors that influence antigenicity, Antibodies-structure, types, properties and functions. Monoclonal antibody production. 4 hr

2.3 Antigen- antibody reactions - Precipitation, haeme agglutination, ABO blood typing and Rh typing. Immuno-electrophoresis- RIA, ELISA, SRID, ODD, RIEP and immunofluorescent techniques. 5 hr

Unit 3. **Complement system, Hypersensitivity and vaccines**.

3.1 Complement system- components, MHC types, properties and functions. Hypersensitivity and its types. 5 hr

3.2 Organ transplantation- types, graft rejection, immune suppressors and auto immune diseases (Rheumatoid arthritis and multiple sclerosis). 5 hr

3.3 Vaccines and immunization - passive and active immunization. Types of vaccines - inactive, attenuated and recombinant vaccines (DNA and peptide). Interferons – general account. 5 hr

Semester V

Practical V: Environmental Biotechnology and Immunotechnology

15 units of 3 hours each

1.	Estimation of BOD of water sample.	2 units
2.	Estimation of Total hardness of water samples.	1 unit
3.	Temporary preparation of VAM and *Rhizobium* from roots.	1 unit
4.	Bacterial examination water by MPN method.	3 units
5.	Human Blood typing.	1 unit
6.	WIDAL and VDRL tests.	2 units
7.	Differential counting of WBC.	1 unit
8.	Separation of Immunoglobulin from serum.	2 units
9.	Preparation of biofertilizer formulation (*Rhizobium*) and study of effect on seed germination.	2 units

Paper VI: PLANT AND ANIMAL BIOTECHNOLOGY

45 hours

UNIT 1: **Plant biotechnology**

1.1 Introduction to Plant biotechnology and In-vitro methods in Plant tissue culture. Aseptic techniques, nutrient media, use of Plant growth regulators- auxins, cytokinin and gibberellins. 5 hr

1.2 Micropropagation of elite species: selection of explant, sterilization and inoculation and culture maintenance, transferring to shooting and rooting media and hardening in green house. Cell suspension culture for invitro production of secondary metabolites - safranin and capsaicin. 5 hr

1.3 Organ culture -Ovary, ovule, anther, embryo and endosperm (triploid plant). Somatic embryogenesis- technique and applications. Soma clonal variations and their significance. 5 hr

UNIT2: **Animal biotechnology**

2.1 Introduction to Animal biotechnology. culture media- natural (plasma clot, biological fluids, tissue extracts, embryo extracts). Importance of serum in media. Chemically defined media and examples. Growth factors-EGF, FGF, PDGF, IL-1, IL-2, NGF and erythropoietin. 5 hr

2.2 Primary explantation techniques- slide or coverslip culture, carrel flask culture, roller test tube culture. Primary cell culture - Isolation and disaggregation of tissue- mechanical and enzymatic methods, Culture of cells-monolayer, suspension and immobilized cell systems. 6 hr

2.3 Organ or embryo culture - plasma clot, raft, agar gel, grid methods, whole embryo culture and its applications. Secondary culture- transformed cell lines and continuous cell lines. 4 hr

UNIT 3: **Applications of plant and animal biotechnology**

3.1 Protoplast culture: Protoplast isolation- mechanical and enzymatic methods, Culturing and regeneration of protoplasts. Protoplast fusion methods, Selection of somatic hybrids and cybrids. Cryopreservation of plant cultures. 5 hr

3.2 Edible vaccines from plants- muskmelon. Synthetic seed preparation and their applications. Applications of micropropagation in forestry. Invitro fertilization – nuclear transfer, ES methods. Cloning of Dolly. 5 hr

3.3 Stem cells-characteristic features, types, culture and applications. Transgenic animals and their significance. Transgenic cattle and transgenic mice. 5 hr

Practical VI: Plant and Animal Biotechnology

15 Units of 3 hours each

1.	Lay out plan for Plant and Animal biotech laboratories.	1 unit
2.	Surface sterilization of plant explants.	1 unit
3.	Plant tissue culture media preparation-MS medium.	2 units
4.	Inoculation of explants on media for callus culture- leaf disc and shoot tip.	2 units
5.	Preparation of synthetic seeds.	1 unit
6.	Cell viability test- trypan blue method.	1 unit
7.	Preparation of Hank's basal salt solution.	1 unit
8.	Isolation of liver parenchyma cells form goat liver.	1 unit
9.	Protoplast isolation by mechanical method.	1 unit
10.	Isolation of leucocytes (PMN leucocytes) from human blood sample.	2 units
11.	Visit to Plant biotech industry and writing a report. (Report in the practical record itself.)	2 units

B.Sc. VI Semester

Biotechnology Paper VII: Industrial Biotechnology

Theory: 45 Hours

Unit 1: **Introduction to industrial Biotechnology**

1.1 Introduction and scope of industrial fermentation. Basic principles of fermentation technology. Isolation and screening of industrially useful microorganisms, strain improvement by mutant selection and recombinant DNA method and maintenance of strain. 5 hr

1.2 Fermentation types – Batch and continuous fermentation. Solid state and submerged fermentation. Single stage and multistage fermentation. Media for fermentation- natural and synthetic media. 4 hr

1.3 Types and design of fermenters or bioreactors- Stirred tank, bubble column, air-lift, tower and tray fermenters. Process of aeration, agitation, temperature regulation and foam control. 6 hr

Unit 2: **Process development and Downstream process**

2.1 Scale-up process – shake flask culture to pilot plant. 2 hr

2.2 Sterilization of fermenter, media and air: heat sterilization, radiation and filtration methods (sintered glass filter and membrane filter). 4 hr

2.3 Inoculum preparation. 1 hr

2.4 Downstream process – separation of cells and spent media- filtration and centrifugation. Disintegration of cells. Extraction, concentration and purification of product. 6 hr

2.5 Product quality assurance and packaging. 2 hr

Unit 3: **Industrial production of microbial products**

3.1 Production of alcohol- ethanol and alcoholic beverages Wine and Beer. 3 hr

3.2 Production of organic acid-citric acid, antibiotic-penicillin G, amino acids- glutamic acid (MSG), Vitamins- Vitamin B12, microbial polysaccharide- Xanthan gum, SCP- production of SCP from bacteria. 7 hr

3.3 Production of industrially used bacterial and fungal amylases and proteases. Uses of enzymes in detergents, leather industry, food and beverage industry and pharmaceutical industry. 5 hr

Practical VII: Industrial biotechnology

15 units of 3 hours each

1. Estimation of lactic acid from milk. 2 units
2. Culturing of *Aspergillus*, Yeast and *Agaricus*. 3 units
3. Production and estimation of citric acid from *Aspergillus*. 2 units
4. Preparation of wine from grapes. 2 units
5. Estimation of alcohol by specific gravity method. 1 unit
6. Immobilization of enzyme (invertase) from yeast culture and estimation. 2 units
7. Visit or tour to biotech industries and submission of report on the same in Practical examination for 5 Marks. 3 units

B.Sc. VI Semester

Biotechnology Paper VIII: Bioinformatics, Bio entrepreneurship and bioresearch

Theory: 45 Hours

Unit 1: **Bioinformatics**

1.1 Introduction to bioinformatics. Knowledge base in biology. IT in biology. Skills required to become a successful bioinformatician. Basics of computers- hardware and software, system software, application software, operating systems and software related to bioinformatics. Applications of bioinformatics. 4 hr

1.2 Data bases: Database structure and management of data base. File formats, annotated sequence databases, genome and organism specific data bases. Retrieval of biological data. Accessing databases – PubMed, Nucleic acid sequence databank-NCBI and EMBL, Protein sequence databank- NBRF-PIR, SWISSPROT, Structural databases-protein databank-PDB.6 hr

1.3 Tools of biological data retrieval -RASMOL, FASTA, BLAST, PubMed. Sequence alignment, scoring matrices, multiple sequence alignment. Brief account of 3D structure prediction and docking studies. Concept of Genomics – structural and functional, Transcriptomics, metabolomics and Proteomics. 5 hr

Unit 2: **IPR, Bioethics and Bio entrepreneurship**

2.1 Biotechnology and IPR. Patents, Trade secrets, copyright, Trade Mark and geographical index. Choice of IPR. Plant genetics resource (PGR), GAAT, TRIPS and examples of IPR in India. 5 hr

2.2 Bioethics – positive and negative effects. Examples- Rice with Vitamin A, no-till agriculture. Biological pest control. Ban on Glyphosate GM plants and environmental concerns. Biodiversity regulations in India. 4 hr

2.3 Bio entrepreneurship – Introduction and scope. Types of bio-industries. Basic requirements and challenges of an entrepreneur. Entrepreneurship development programs of public and private agencies-MSME, DBT, BIRAC and Make in India. Negotiating the road from lab to the market – Strategies and processes of negotiation with financiers, government and regulatory agencies. 6 hr

Unit 3: **Importance of research in biology**

3.1 Introduction and importance of research in biology. Objectives, motivation and types of research. Significance of research. Major biological research institutes in India – IISc, NCBS, CCMB, ICMR, IBAB, NIV, Serum Institute, JNCASR & IARI. Major biotech companies in India and world and their products. 5 hr

3.2 Research problem identification and formulation. Necessity of a research design, features of a good research design and experimental design. Data preparation, data analysis and data interpretation. 5 hr

3.3 Research Paper and Project writing – Layout of a research paper. Use of encyclopaedias, research guides and handbooks. Publication, Impact factor for Journals and Plagiarism. Basic skills of project writing, Importance of documentation. 5 hr

Practical VIII: Project Work

15 units of 3 hours per week

- The Project work may be carried out individually or in groups of maximum 3 students under guidance of an assigned department faculty in the allotted practical classes.
- The Project work may involve laboratory work, survey or data mining and compilation which may be carried out within or outside the department concurrence from faculty and HOD and detailed Report of the Project shall be submitted.
- Project work Report shall be evaluated by 2 examiners during Practical examination for 25 marks and viva voce on Project for 10 Marks.

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CELL BIOLOGY

1.Molecular Biology of Cell - Bruce Alberts et al, Garland publications. 2. Animal Cytology and Evolution – MJD, White Cambidge University Publications. 3. Molecular Cell Biology –Daniel, Scienific American Books. 4. Cell Biology - Jack d Bruke, The William Twilkins Company. 5. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications. 6. Cell Biology – ambrose & Dorouthy M Easty, ELBS Publications. 7. Fundamentals of Cytology – Sharp, McGraw Hill Company. 8. Cytology – Willson & Marrison, Reinform Publications. 9. Molecular Biology – Smith Faber & Faber Publications. 10. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Saunder College. 11. Cell Biology – C.B Powar, Himalaya Publications.

GENETICS

1. Basic Genetics – Daniel L. Hartl, Jones &Barlett Publishers USA. 2. Human Genetics and Medicine lark Edward Arnold P London. 3. Genetics – Monroe W Strickberger, Macmillain Publishers, New York. 4. Genes V - Benjamin Lewin, Oxford University Press. 5. Genes I - Benjamin Lewin, Wiley Eastern Ltd., Delhi. 6. Genes II - Benjamin Lewin, Wiley & Sons Publications 7. Genes III- Benjamin Lewin, Wiley & Sons Publications. 8. Principles of Genetics – Winchester Sinnot & Dom. 9. Genetics – Blue print of life by Sandhya Mitra, Tata McGraw Hill Publication. 10. Genetics – Edgar Altenburg Oxford & IBH publications. 11. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Son Publications.

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7. Textbook of Organic Chemistry (A Modern approach) P.L. Soni, Sultan Chand and Sons, Publishers. 8. The Biochemistry of Nucleic acid-tenth Edition-Roger L.P. Adams, John T. Knower and David P. Leader, Chapman and Hall Publications.

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1.Essentials of Biophysics, New Age Int. Pub. New Delhi. 2. Bliss, C.J.K. (1967) Statistics in Biology, Vol. I McGraw hill. New York. 3. Campbell R.C. (1974) Statistics for Biologists, Cambridge Univ, Press, Cambridge. 4. Daniel (1999) Biostatistics (3rd edition) Panima Publishing, Compotation. 5. Sward law, A. C. (1985) Practical Statistics for Exponents Biologists, John Wiley and Sons, Inc. 6. Khan (1999) Fundamentals of Biostatistics Publishing Corporation. 7. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.

MOLECULAR BIOLOGY

1. Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.
2. Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA
6. Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
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2. Nicholls D.S.T; An Introduction to Genetic Engineering, Cambridge University Press.
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5. Lewin B; gene VI, Oxford University Press.
6. Jogdand S.N; Gene Biotechnology, Himalaya Publishing House.
7. Kumaresan V; Biotechnology, Saras Publication.
8. Glick B.R and Pasternak J.J; Molecular Biotechnology, Principles and Applications of recombinant DNA technology, ASM Press, Washington D.C.
9. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.

Bioinformatics

1. Dubey R. C.; A Text Book of Biotechnology, S Chand Publicatins.
2. Kumaresan V; Biotechnology (6th Edition), Saras Publication.
3. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.
4. Gladis Helen Hepsyba & Hemalatha C.R; Basic Bioinformatics, MJP Publishers.
5. Sundaralingam R. & Kuaresan V; Bioinformatics, Saras Publication

Environmental Biotechnology

1. Alexander N., Glazer Hiroshi N Ikaido; Microbial Biotechnology, W.H. freeman and Company.
2. Fungal Ecology and Biotechnology, Rastogi Publications.
3. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.

Immunology

1.Willium E.Paul; Fundamental Immunology, Raven Press, New York.
2. Willium R Clark; The Experimental Foundations of Modern Immunology, John Wiley and Sons, NY.
3. Shyamasree Ghosh; Immunology & Immunotechnology, Books and Allieds Publication.
4. Dulsy Fatima and Arumugam N; Immunology; Saras Publication
5. Ivan M. Roitt; Immunology, Blackwell Scientific Publication.

Animal Biotechnology

1. Ian Freshney; Animal Cell culture (4th Edition)
2. Gupta P.K; Elements of Biotechnology, Rastogi Publications
3. Kumaresan V; Biotechnology(6th Edition), Saras Publication.
4. Dubey R. C.; A Text Book of Biotechnology, S Chand Publicatins
5. Animal Biotechnology; MJP Publishers.
6. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.

Plant Biotechnology

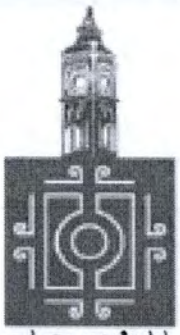
1. Ravishankar G. A and Venkataraman L.V; Biotechnology- Applications of Plant Tissue culture, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bhan; Tissue Culture, Mittal Publications, New Delhi.
3. Ramawat K. G; Plant Biotechnology, S Chand Publications.
4. Islan A.C; Plant Tissue Culture, Oxford & IBH Publishing Co. Pvt. Ltd.
5. Kumar H.D; a Text Book of Biotechnology, Affiliated East West Press , New Delhi.
6. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.

Industrial Biotechnology

1. Bisen P S; Frontiers in Microbial Technolog (1st Edition), CBS Publishers.
2. Glazer Hiroshi N Ikaido; Microbial Biotechnology, W.H. freeman and Company.
3. Prescott & Dum (2002); Industrial Microbiology, Agrobios (India) Publishers.
4. Kumaresan V; Biotechnology(6th Edition), Saras Publication.
5. Kalaichelvan; Bioprocess technology, MJP Publishers.
6. Stanbury P. F, Whitaker H, Hall S. J; Principles of Fermentation Technology, Aditya Books Ltd.
7. Ramavat K. G, Shaily Goyal; Comprehensive Biotechnology(4th Revised Editon), S Chand & Co.

Others titles

1.L.P Verma; Applied Biotechnology, MJP Publishers.
2. Shaleesha AS Stanley; Bioethics.
3. Sathyanarayana U; Biotechnology, Books & Allieds Publication.



BENGALURU CITY UNIVERSITY

REGULATIONS AND SYLLABUS FOR
B.Sc. Biotechnology

CHOICE BASED CREDIT SYSTEM

Scheme of Examination in Theory and Practical

2020-2021

Theory Examination Scheme - B.Sc. I Semester to VI Semester

Duration of examination: 3 hours

Maximum Marks: 70

Question Paper Pattern:

Section – A: Short Notes – 5 x 2marks = 10

Section – B: Short answer- 4 out of 5; 4 x 5marks=20

Section – C: Essay type- 3 out of 5; 3 x 10marks=30

Section – D: Answer in one word or a sentence- 10 x 1mark=10

(No objective type or fill in the blanks questions).

Total: 70 Marks

Internal Assessment:

Theory: 30 Marks

Tests – 10
Assignments/Seminars/Training project/Add-on course – 15
Attendance - 05

Practical: 15 Marks

Tests – 10
Attendance - 05

Note: To improve quality of education and to provide hands-on practical knowledge to individual students, in a practical class 10-12 students (maximum 12 students) per batch per teacher to be allotted.

Practical Examination Scheme

B.Sc. I Semester:

Biotechnology Paper I (Cell and Biochemical Technology):

Duration – 3 Hours Maximum Marks – 35

Q 1. Prepare a temporary squash of given material (Mitosis/Meiosis) and report the stage identified with diagram. 8

Q 2. Estimate the amount of Protein/sugar in the given sample (Biuret/FC /DNS method). 12

Q 3. Principle & procedure writing of the assay of activity of salivary amylase. 6

Q4. Spotters (human karyotype - normal, down's, turners, klinefelters) any one. 4

Q 5. Class record. 5

Scheme of valuation:
Q1. Performanace – 5m
Identification and diag- 3m

Q2. Performance- 7m
Protocol table-2m
Graph & result- 3m
Note: Candidate must perform the experiment for 7 tubes

Q3: Principle – 2m
Procedure- 4m

Q4: Identification – 1m
Points of relevance – 3m

B.Sc. II Semester:

Biotechnology Paper II (Microbial Technology):

Duration – 3 Hours | Maximum Marks – 35

Q 1. Prepare a temporary slide of given material by Grams Staining and report the identified specimen with diagram. 7

Q 2. Enumerate the microorganism from the given sample by haemocytometer (bacteria/yeast). 5

Q 3. Prepare the temporary slide of the given fungal sample and report the identified specimen with diagram. 5

Q4. Perform Catalase test for given sample, report and comment. 4

Q5. Spotters a) Instruments(any two)
b) media(any one) 9

Q 6. Class record. 5

Scheme of valuation:
Q1. Performanace – 3m
Principle - 2m
Identification and diag- 2m

Q2. Calculation & result-5m

Q3: Performance & Identification – 3m
Diagram- 2m

Q4: Report & comment – 4m

Q5 - Identification – 1m
Points of relevance – 2m

B.Sc. III Semester:

Biotechnology Paper III (Molecular Technology):

Duration – 3 Hours | Maximum Marks – 35

Q 1. Estimate DNA or RNA from the given sample by DPA/Orcinol method. 8

Q 2. Determine the Tm value of given sample of DNA. 5

Q 3. Separate the compounds (amino acids) in the given sample by ascending paper chromatography and report the Rf value. 6

Q 4. Spotters a) forms of DNA(any one)
b) Bacterial recombination(any one chart) 3+3=6

Q 5. VIVA VOCE 5

Q6. Class record 5

Scheme of valuation:
Q1. Performanace – 4m
Protocol table - 2m
Graph & result – 2m
Note: Candidate must perform the experiment for 7 tubes

Q2. Calculation & result-5m

Q3: Performance – 4m
Calculation & result – 2m

Q4: Identification – 1m
Points of relevance – 2m

Q 5. Viva voce – questions related to practical syllabus only.

B.Sc. IV Semester:

Biotechnology Paper IV (Genetic Engineering)

Duration – 3 Hours | Maximum Marks – 35

Q 1. Isolate genomic DNA from the given sample(animal/plant). 8

Q 2. Quantify the given sample of DNA by Spectrophotometry. 8

Q 3. Spotters a) instruments(any one)

b) Photographs of competent cell preparation or screening techniques. 3x2= 6

Q 4. Industrial Report (industry/institute) 3

Q 5.VIVA VOCE 5

Q6. Class record 5

Scheme of valuation:

Q1. Performance – 4m
Principle - 2m
Result – 2m

Q2. Performance – 4m
Principle - 2m
Result – 2m

Q3: Identification – 1m
Points of relevance – 2m

Q 5. Viva voce – questions related to practical syllabus only.

B.Sc. V Semester:

Biotechnology Paper V (Environmental & Immunotechnology)

Duration – 3 Hours | Maximum Marks – 35

Q 1. Estimate the total hardness of the given water sample. 8

Q 2. Prepare a temporary slide of VAM or ***Rhizobium***. 5

Q 3. Perform the differential count of WBC. 7

Q4. Perform RPR/WIDAL / ABO blood grouping from the given sample. 5

Q 5.VIVA VOCE 5

Q6. Class record 5

Scheme of valuation:

Q1. Performance – 4m
Principle - 2m
Calculation & result - 2m

Q2. Performance – 4m
Result – 1m

Q3: Performance – 3m
Calculation & result – 4m

Q4: Principle – 2m
Performance & result – 3m

Q 5. Viva voce – questions related to theory & practical syllabus of this paper only.

B.Sc. V Semester:

Biotechnology Paper VI (Plant & Animal Biotechnology)

Duration – 3 Hours | Maximum Marks – 35

Q 1. Isolate the protoplast from the given sample. 7

Q 2. Isolate and stain the parenchymal cell from the given sample. 8

Q 3. Prepare synthetic seeds from the sample provided. 4

Q4. Spotters a) PBT
b) ABT 3x2=6

Q5. VIVA VOCE 5

Q6. Class record & report 5

Scheme of valuation:

Q1. Performance – 3m
Principle & Procedure - 3m
Result - 1m

Q2. Performance – 4m
Principle & procedure -3m
Result – 1m

Q3: Performance – 2m
Comment – 2m

Q4: identification – 1m
Relevant points - 2m
Spotters PBT- Photographs of callus culture, anther culture, embryo culture, somaclonal variations, somatic hybridisation.
Spotters ABT- EGF, FGF, PDGF, Serum, BSS, Roux bottle, Roller bottle.

Q 5. Viva voce – questions related to theory & practical syllabus of this paper only.

B.Sc. VI Semester:

Biotechnology Paper VII (Industrial Biotechnology)

Duration – 3 Hours | Maximum Marks – 35

Q 1. Estimate the amount of lactic acid/citric acid from the given sample. 8

Q 2. Immobilise and estimate the amount of enzyme invertase from the yeast culture. 12

Q 3. Estimate the percentage of alcohol from the given sample by specific gravity method. 5

Q 4. Industrial Tour Report. 5

Q5. Class record 5

Scheme of valuation:

Q1. Performance – 4m
Principle & Calculation - 3m
Result - 1m

Q2. Performance – 6m
Principle & protocol table -4m
Graph & Result – 2m
Note: Standard graph values to be provided.

Q3: Performance – 2m
Calculation & result –3m

B.Sc. VI Semester:

Biotechnology Paper VIII (Project Work)

Duration – 3 Hours | Maximum Marks – 35

Q1. Evaluation of Project Report	25
Q2. VIVA VOCE on the Project Work	10