DEGREE OF BACHELOR OF SCIENCE

CHOICE BASED CREDIT SYSTEM

Syllabus for

B. SC. BIOTECHNOLOGY

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2017 - 2018 onwards)
REGULATIONS

Definitions:

Programme: “Programme” means a course of study leading to the award of a degree in a discipline.

Course: “Course” refers to a subject offered under the degree programme spread over the complete Programme of study a sunder.

Part I: means “Tamil/other languages” offered under the programme.

Part II: means “English” language offered under the programme.

Part III: means “Allied subjects” offered as allied, which is interdisciplinary in nature but related to the programme.

Part III: means “Elective subjects” related to the core subjects of the programme concerned.

Part IV i) “Tamil” means basic orientation in Tamil language for those students who have not studied Tamil upto 12 standard.

ii) “Advanced Tamil” means, the subject is meant for students who have studied Tamil language upto 12th standard and chosen other languages in college but would like to advance their Tamil language skills.

iii) “Non-Major Electives” means option is being given to students who do not come under the above two categories (i & ii).

iv) Skill based subject means the courses offered under the programme related to Advanced Skill acquisition for industrial application for which a separate Diploma will be awarded along with the Degree.

v) “Foundation Course” means courses offered as

1) Environmental Studies (1st year) 2) Value Education - Manavalakkali yoga (1 year)

Part V “Extension Activities” means all those activities which form part of NSS/NCC/Sports/YRC and other co and extracurricular activities.

A detailed explanation of the above with relevant credits are given under “Scheme of Examination along with Distribution of Marks and Credits”

Duration: Means the stipulated years of study to complete a programme as prescribed by the University time to time. Currently for the undergraduate programme the duration of study is THREE years. These regulations apply to the regular course of study in approved institutions of the University.
Credits: Means the weightage given to each course of study (subjects) attributed by the experts of the Board of Studies concerned.

Credit System: Means, the course of study under this pattern, where weightage of credits are spread over to different semesters during the period of study and the Cumulative Grade Point Average will be awarded based on the credits earned by the students. The following are the total credit points:

For Undergraduate Programme (Three years) : 140

4. AIM AND SCOPE OF THE COURSE:

- The topics included in different units of different papers would enable the students to develop technical skills in technology and applied branches.

- Skill based subjects like Biophysics and Bioinstrumentation, Developmental Biology, Nanobiotecnology and Bioinformatics and Proteomics and Genomics have been included in order to provide opportunities in employment and research in Government and Private Organizations.

- There is also scope for self employment for the students.

- Practicals included in the syllabus will improve the skills of the students in Plant tissue culture, Animal tissue culture, Molecular biology, Immunology, Genetic engineering, Bioprocess technology, Enzymology and Laboratory techniques.

1. Eligibility for Admission

Candidate for admission to the first year of the degree of Bachelor of Science Course shall be required to have passed the Higher secondary examination (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted by the Syndicate, Subject to such conditions may be prescribed therefore shall be permitted to appear and qualify for B.Sc degree examination in Biotechnology.

2. Duration of the Course

The course for the degree of Bachelor of Science shall consist of three academic years divided in to six semesters. Each semester consists of 90 working days.

3. Passing Minimum:

The candidate shall be declared to have passed the examinations if he/she secures not less than 40
DISTRIBUTION OF MARKS : THEORY

University examination = 75 marks
Internal assessment = 25 marks

INTERNAL ASSESSMENT STRUCTURE :

Test = 15 marks
Assignments = 05 marks
Attendance = 05 marks
Passing minimum for Internal Assessment = 10 marks
Passing minimum for University examinations = 30 marks

PRACTICALS :

University examinations = 60 marks
Internal Assessment = 40 marks

INTERNAL ASSESSMENT STRUCTURE:

Test = 15 marks
Observation record = 10 marks
Regularity in Practical = 15 marks
Passing minimum for internal assessment = 16 marks
Passing minimum for University examinations = 24 marks

CLASSIFICATION OF SUCCESSFUL CANDIDATES :

Candidates who secure not less than 60 % of the aggregate marks in the whole examinations shall be declared to have passed the examinations in First class.

Candidates who secure above 50 % and below 60 % shall be declared to have passed the examinations in Second class.

Other successful candidates who secure below 50% shall be declared to have passed the examination in Third class.
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<th>Title of the Paper</th>
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## ELECTIVE SUBJECTS

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## SKILL BASED ELECTIVE COURSES

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## ELECTIVE SUBJECTS

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QUESTION PAPER PATTERN

SECTION A

I MULTIPLE CHOICE QUESTIONS (10×1=10)

II DEFINITION (10×1=10)

SECTION B

III ANSWER ALL THE QUESTIONS (5×5=25)

Two questions from each unit in either or choice

SECTION C

IV ANSWER ANY THREE QUESTIONS (3×10=30)

One question from each unit in open choice pattern
UNIT I

Biogenesis theory of origin of life. Cell as a Basic unit; Cell size and shape; Prokaryotic & eukaryotic cell organization. Structural comparison of microbial, plant and animal cells.

UNIT II

Cell wall and membrane: Plasma membrane-Model of plasma membrane; fluidity of membranes; Membrane proteins and their functions; Transport across the membrane- selective permeability of membrane; Cell adhesion; Cell junctions; Composition of bacterial cell wall.

UNIT III

Structure and function of cell organelle; Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, lysosomes, Ribosomes, Peroxisomes, Vacuoles, Centrioles and Cytosols. Nucleus and molecular organization of chromatin, chromosomes and specialized chromosome

UNIT IV


UNIT V

Specialized cells: Motile cells (amoeboid, ciliary, flagellar movements), Nerve cells and nerve impulse conduction, Muscle cells and muscle contraction.

REFERENCES:

B.Sc. BIOTECHNOLOGY

SEMESTER I

CORE PRACTICAL I

LAB IN CELL BIOLOGY

1. Microscopes and its parts.
2. Micrometry - Stage and Ocular Micrometer.
3. Cell Counting - Haemocytometer
4. Mounting epithelium and observing living animal and plant cells using vital staining.
5. Mitosis in Onion root tip squash
8. Observation of Permanent Slides - Cardiac muscle, Sperm cell.
10. Microtomy (Demo).
UNIT I
History of Classical and Modern Genetics, Concept and organization of Genetic material in Bacteria, Plant and Animal; Structure, types, forms and functions of DNA and RNA. Genetic model organisms and their significance (E.coli, Arabidopsis thaliana, Coenorhabditis elegans).

UNIT II
Mendelian laws of inheritance; Non-Mendelian inheritance; Chromosomal theory of inheritance. Back cross and Test cross.

UNIT III
Structural and numerical alterations of chromosome- Deletion, Inversion, Duplication, Translocation. Ploidy and their genetic implications. Mutation- (Spontaneous and Induced) mutagen. Biochemical basis of mutation.

UNIT IV
Microbial Genetics: Methods of Gene transfer – Transformation, Transduction, Sexduction, Mapping genes by interrupted Matting, fine structure analysis of genes.

UNIT V

REFERENCES:
B.Sc. BIOTECHNOLOGY

SEMESTER II

SKILL BASED ELECTIVE COURSE

SBEC I - BIOPHYSICS AND BIOINSTRUMENTATION

UNIT-I


UNIT-II

Electrophoresis - Principle and its applications - Types of electrophoresis- Agarose Gel, SDS- PAGE and 2D Gel, Blotting –Southern, Northern, Western & Immuno blotting. Gel-Documentation.

UNIT-III

Imaging techniques -EEG, ECG, CT SCAN, MRI SCAN, X-RAY, EMG, NMR, PET.

UNIT-IV

Centrifuge - Principle and its applications - Types of Centrifuge, Chromatograpy - Principle and its applications, Types- Paper, TLC, Column, Affinity, Ion-exchange, HPLC, GC-MS.

UNIT –V

Biosensors- Principle and its applications- Electrochemical, Thermometric, Potentiometric- Optical, Piezo-electric and Amperometric Biosensors. GM Counter, Scintillation Counter, Autoradiography, Flow Cytometry. Care and Maintanence of Laboratory Instruments – Autoclave, Incubator and Hot air oven.

REFERENCES:

1. H.V. Volkones., General Biophysics, Vol I&II
B.Sc. BIOTECHNOLOGY

SEMESTER II

CORE PRACTICAL II - LAB IN GENETICS

1. Mendel's law of genetics - Mono and Dihybrid crosses.
2. Rearing morphology of *Drosophila* (mutant eye identification)
3. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*) - Permanent slides
4. Isolation of spontaneous mutant cells.
5. Isolation of petite mutant yeast cell.
6. Identification of Barr body (Buccal epithelium smear)
7. Preparation of polytene chromosomes (Chironomous larvae salivary gland) - squash preparation.
B.Sc. BIOTECHNOLOGY
SEMESTER III
CORE III - GENERAL MICROBIOLOGY

UNIT I

UNIT II
Microscopy - Simple and compound microscopy, Dark field, Phase contrast, Fluorescence and Electron Microscopy. Stain and staining techniques - Simple, differential and special staining (Endospore, Capsular).

UNIT III

UNIT IV

UNIT V
Antimicrobial chemotherapy –Antibiotics –mode of actions –antimicrobial resistance -tests for sensitivity to antimicrobial agents.

REFERENCES:
B.Sc. BIOTECHNOLOGY

SEMESTER III

SKILL BASED ELECTIVE COURSE

SBEC II - DEVELOPMENT BIOLOGY

UNIT I
Spermatogenesis and Oogenesis in mammals, Menstrual cycle, Monitoring of estrus cycle, Sperm Banking. Hormones involved in reproduction.

UNIT II

UNIT III
Cell cleavage – pattern of cleavage – Chemical changes- Distribution of cytoplasmic substances in the egg – Metamorphosis (Insects and amphibians) – Hormone control of metamorphosis.

UNIT IV
Development of Microsporangium and Megasporangium, Pollination, Embryo -Embryo sac development and double fertilization in plants, seed formation and germination. Out line of experimental embryology.

UNIT V
Organization of shoot and root apical meristem, and development. Leaf development and Phyllotaxy.

REFERENCES:
B.Sc. BIOTECHNOLOGY

SEMESTER III

CORE PRACTICAL III

LAB IN MICROBIOLOGY

2. Media Preparation (solid & liquid).
3. Isolation & Enumeration of Microorganism from water and Soil.
4. Types of culture method Streak plate, Pour plate, Stab & Slant preparation.
7. Hanging drop technique.
8. Characterization of microorganisms -IMVIC tests.
10. Antibiotic sensitivity Test - Kirby Bauer method.
UNIT I

**Central dogma:** DNA as a genetic material. Modern concept of gene organization. DNA replication in Prokaryotes and Eukaryotes, Enzymes and proteins involved in replication. DNA repair mechanisms –Light and Dark.

UNIT II

**Transcription & transcriptional control:** (Prokaryotes and Eukaryotes), Initiation, elongation, termination, promoter sequences, TATA box, Hogness box, CAAT box, Enhancers, upstream activating sequences. Post transcriptional modifications, splicing, spliceosomes. Editing, Nuclear export of mRNA.

UNIT III

**Translation:** Prokaryotic and eukaryotic translation, Initiation, elongation and termination, Co and post translational modifications of proteins. Import into nucleus, mitochondria and chloroplast. Genetic code: Codon, Anti-codon,

UNIT IV

**Control of gene expression at transcription and translation level:** regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, Regulation of gene expression-Operon concepts (*lac* & *trp*). Gene silencing. Recombination – Homologous and Non – homologous recombination.

UNIT V

**Biology & Genetics of cancer:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes (P53 and PRB genes), virus-induced cancer, metastasis, interaction of cancer cells with normal cells. Molecular techniques; DNA finger printing, DNA Microarray, Gene Mapping, Protein Micro array.

**REFERENCE:**

1. Isolation of genomic DNA from bacteria.
2. Bacterial Transformation.
3. Conjugation.
5. Estimation of RNA (Orcinol method).
6. Estimation of Protein (Lowry's method).
7. Separation of DNA by AGE.
8. Isolation and purification of protein (Dialysis).
9. Separation of protein by SDS PAGE.
10. Isolation of antibiotic resistant mutant.
UNIT I

UNIT II:

UNIT III:
Shoot tip Culture (Virus Free Plants), Haploid Plant Production, Anther & Microspore Culture, Embryo Culture & Rescue, In-vitro Pollination & Fertilization, Secondary Metabolites, Cryopreservation & Germplasm conservation, Role of tissue culture in agriculture & Forestry.

UNIT IV:

UNIT V:

REFERENCES:
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

REFERENCES:
5. Ajoy Paul, Textbook of Immunology
UNIT-I

UNIT-II
Cloning vectors: plasmid - definition, properties and types. pUC19 & pBR322- phage vectors (λ & M13), Cosmid vectors, Shuttle and expression vectors; YAC(S.cerevisiae as a model )& BAC (E.coli); Screening and selection of recombinants; Gene transfer methods

UNIT-III
Hybridization techniques: Probes(radio active & non radio active), detection. PCR - Principle, types and applications; Labeling of DNA- Nick translation, Random priming method & labelling by primer extension.

UNIT-IV
Construction of genomic & c DNA libraries. Vector engineering & codon optimization, strategies of gene delivery, invitro translation, Expression in bacteria, yeast, insects, plant & mammalian cells

UNIT-V
Chromosomes engineering, targetted gene replacement, gene editing, gene regulation & silencing. Site directed mutagenesis. DNA sequencing – Maxam Gilbert (chemical) & Sanger's, Nicolson sequencing, Pyrosequencing. Gene therapy, Human Genome Project.

References:
UNIT I:

UNIT II:

UNIT III:

UNIT IV:

UNIT V:
Sequence Alignment based on Matrices (BLOSUM and PAM), tools for sequence alignment – BLAST, FASTA. Clustal W. Phylogenetic analysis – WPGMA, UPGMA methods.

REFERENCES:
5. K.K. Jain, Naobiotechnology: Molecular Diagnosis, Tailor L. Francis Group.
B Sc BIOTECHNOLOGY

B.Sc. BIOTECHNOLOGY

SEMESTER V

CORE PRACTICAL V

LAB IN PLANT BIOTECHNOLOGY

1. MS media preparation.
2. Establishment of shoot tip culture using MS medium
3. Isolation of protoplasts using enzymatic method.
4. Establishment and maintenance of callus culture.
5. Establishment and maintenance of suspension culture.
6. Establishment and maintenance of somatic embryogenesis (Demo).
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.
B.Sc. BIOTECHNOLOGY
SEMESTER V
CORE PRACTICAL VI
LAB IN GENETIC ENGINEERING AND IMMUNOLOGY

i. IMMUNOLOGY
1. Preparation of plasma and serum.
3. Agglutination tests:
   a. ABO Blood grouping.
   b. WIDAL test.
   c. ASO test.
   d. Pregnancy test.
   e. RPR test.
4. Precipitations:
   a. Radial immunodiffusion.
   b. Double immunodiffusion.
   c. Counter Current immune electrophoresis.
5. ELISA

II GENETIC ENGINEERING
6. Isolation of plasmid DNA and size analysis
7. Restriction digestion.
8. Ligation.
9. Transformations of recombinants in *E.coli* (Preparation of competent cells).
10. Selection & screening of rDNA antibiotic resistance, blue – white colony.
11. PCR amplification (demo).

Unit II

Unit III
Sericulture, Commercial production of silk, Baculoviruses as animal viral vector. Silkworm as a bioreactor. Biotechnology of aquaculture, apiculture.

Unit IV

Unit V
Applications of animal tissue culture for invitro testing of drugs. Production of transgenic animals & molecular pharming, animal cloning techniques. Cell culture based vaccines. Ethical values in animal biotechnology.

REFERENCES:
B.Sc.  BIOTECHNOLOGY  
SEMESTER VI  
CORE IX - PROTEOMICS AND GENOMICS

UNIT I
Studying the Genome: Genetic Mapping-Markers for Genetic Mapping; RFLP, SSLP - VNTR's, STR's, SNP's; Physical Mapping - In situ hybridization, Sequence Tagged Sites Mapping. DNA data bases.

UNIT II
Determination of nucleotide sequence: Chemical degradation method, Sanger's dideoxynucleotide synthetic method. Direct DNA sequencing using PCR, Sequencing by conventional shotgun method, Whole genome shot gun method, Clone contig method.

UNIT III
ORF scanning – Codon bias, Exon-Intron boundaries - Exon trapping, CpG island, Gene location – Southern and Northern blotting hybridization, Zoo blotting. Studying a transcriptome – Microarray or chip analysis, SAGE.

UNIT IV

UNIT V
Basics of Mass Spectroscopy- MALDI-TOF and ESI and their applications in proteomics. Tandem MS/MS spectrometry.

REFERENCES:
B Sc BIOTECHNOLOGY

B.Sc. BIOTECHNOLOGY

SEMESTER VI

CORE X - BIOPROCESS & ENZYME TECHNOLOGY

UNIT I

UNIT II

UNIT III
Monitoring and control of process variables (Temperature, pH and DO, mass transfer, heat transfer & O₂ transfer mechanism). Computational control of fermentors.

UNIT IV

UNIT V

REFERENCES:
1. Alexandar N. Glazer & Hiroshi Nikaido Microbial Biotechnology (Fundamental of Applied Microbiology)
UNIT I:

UNIT II:
Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti-Inflammatory, Antibacterial, Antifungal, Antiviral, Antihelminthic, Anticancer Drugs.

UNIT III:
Production of biological – Human insulin, HGH, Erythropoietins, IFN, TNF, IL, Clotting factor VIII.

Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.

UNIT IV:

UNIT V:

REFERENCE
1. S.S. Purohit, Kaknani, Saleja Pharmaceutical Biotechnology.
LAB IN ANIMAL BIOTECHNOLOGY

1. Preparation of animal cell culture media.
2. Preparation & sterilization of balanced salt solution and DBSS.
4. Culture of chick embryo fibroblast (monolayer).
5. Single cell suspension culture.
6. Viability test and cell counting.
7. Inoculation of virus and observation.
8. Applications of Co incubator & inverted microscope.
9. Membrane filter.
10. Isolation of genetic DNA from animal tissue.
B.Sc. BIOTECHNOLOGY

SEMESTER I

CORE PRACTICAL VIII

LAB IN BIOPROCESS TECHNOLOGY AND ENZYMEOLOGY

1. Enumeration of Microorganisms from bread.
2. Determination of TDT & TDP.
3. Analysis of Aflatoxin by TLC.
4. Qualitative analysis of milk.
5. Isolation of industrially important microorganism.
7. Production of wine.
8. Immobilization of yeast cells & enzymes.
B Sc BIOTECHNOLOGY

B.Sc. BIOTECHNOLOGY

SEMESTER V

ELECTIVE I - PAPER I

STEM CELL BIOLOGY AND TISSUE ENGINEERING

Unit I

Introduction to stem cell, definition, classification and source. Development stage, property of stem cell—pluripotency, totipotency. Types of stem cell—embryonic and adult stem cell

Unit II

Germ line stem cells Prostate and Mammary SCs, Induced pluripotent Stem cells, Muscle and Cardiac stem cells, Neuro stem cells, Telomeres in stem cell biology. Stem cell plasticity.

Unit III

Stem cell Techniques—Blastomere extraction, Nuclear transfer, Therapeutic cloning, Reprogramming of stem cells, Transplantation, Stem cell therapy, Stem cell politics and ethics. Stem cell bank.

Unit IV


Unit V

Cells and tissue characterization, Musculo-skeletal tissue engineering, Cardiovascular tissue engineering, Neural tissue engineering and its Clinical applications.

REFERENCES:

2. Christopher Thomas Scott. Stem Cell Now.
5. New Scientist, article 'Instant Expert: Stem Cells': expert-stem-cells.html.page=1
7. Potten, C. S., 2006 Stem Cell Elseiever
UNIT I
Classification of genetic diseases. Chromosomal disorders-numerical disorders e.g. trisomers and monosomes, structural disorders e.g. deletions, duplications, translocations and inversions, chromosomal instability syndromes.

UNIT II

UNIT III
Huntington's disease- sickle cell diseases, AAT (alpha-1 antitrypsin deficiency), Alzheimers disease, cystic fibrosis, infection of nervous system.

UNIT IV
Clinical management & metabolic manipulation – PKU, Familial hypercholesterolemia, Rickets, ADA, Congenital hypothyroidism.

UNIT V

REFERENCES:
B. Sc. BIOTECHNOLOGY

SEMESTER VI

ELECTIVE II - PAPER I - ENDOCRINOLOGY

UNIT I:
Hormones: definition, classification, biosynthesis and degradation. Mechanism of hormone action, class I and II hormone receptors, steroids. Feedback regulation of hormones.

UNIT II:
Hypothalamus and pituitary hormones: Hypothalamic releasing factors vasopressin, oxytocin; biosynthesis, secretion, transport, regulation and biological effects of growth hormones. FSH, LH, TSH, ACTH and prolactin.

UNIT III:
Thyroid hormones: biosynthesis, secretion, transport, regulation and biological actions. Hypo and hyper thyroidism, antithyroid agents, role of parathyroid hormones, calcitriol, calcium and phosphorous homeostasis. Hypo and hyperparathyroidism.

UNIT IV:

Adrenal hormones: biosynthesis, secretion, transport, mechanism of action and excretion of glucocorticoids, mineralocorticoids, adrenal medullary hormones – epinephrine and nor epinephrine, steroid hormones – androgens and estrogens.

UNIT V:

REFERENCE


B.Sc. BIOTECHNOLOGY

SEMESTER VI

ELECTIVE II - PAPER II - FOOD BIOTECHNOLOGY

UNIT I

UNIT II

UNIT III:
General principle, plant design, construction, functionality of building, Plant layout. Pest proofing / fumigation methods. Water supply to food processing unit.

UNIT IV:
Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods. Sensory evaluation of food quality, quality factors for consumer safety. FSSA, HACCP FDA.

UNIT V:

REFERENCES:
3. Narang, Food Microbiology
5. Frazier, Food Microbiology
6. Yiu Hui & G. Khachatourians, Food Biotechnology
7. ibek, Laramie & Bhunia, Fundamentals of Food Microbiology, CRC Press.
B.Sc. BIOTECHNOLOGY

SEMESTER III

NON MAJOR ELECTIVE COURSE

NMEC I - CONCEPTS OF BIOTECHNOLOGY

UNIT I

UNIT II

UNIT III

UNIT IV
Introduction of genes – Vector mode – transformation and transfection. Vector less mode – Biolistics, Electroporation, Microinjection.

UNIT V
Selection of recombinants. Marker techniques- PCR, RFLP, RAPD and blotting techniques

REFERENCES:

Note: This paper is offered for other major students.
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Transgenic animals and their applications- Mice, Sheep and Fish. Transgenic plants and their applications- BT Cotton, Flavr-Savr tomato and Golden rice.

REFERENCES: