

Adikavi Nannaya University
B.Sc. Biotechnology Syllabus under CBCS

w.e.f. 2015-16 admitted batch

Structure and Syllabus Under CBCS

III YEAR	* Any one Paper from VII A, B and C	VII (A)*	Developmental Biology	100	03		
			Practical - VII A	50	02		
		VII (B)*	Ecology	100	03		
			Practical - VII B	50	02		
		VII (C)*	Biostatistics, bioinformatics and IPRS	100	03		
			Practical - VII C	50	02		
		** Any one cluster from VIII, A, B and C	VIII (A)**	Cluster Electives - I :			
				VIII-A-1: Plant Physiology	100	03	
				VIII-A-2: Animal Physiology	100	03	
	VIII-A-3: Inheritance Biology			100	03		
	Practical VIII A-I			50	02		
	Practical VIII A-2			50	02		
	Practical VIII A-3			50	02		
	VIII (B)**		Cluster Electives - II ::				
			VIII-B-1: Diversity in Life	100	03		
VIII- B-2 :Evolution			100	03			
VIII-B-3 :Project			100	03			
Practical VIII B-I			50	02			
Practical VIII B-2		50	02				
Viva-Voce VIII B-3	50	02					
VIII (C)**	Cluster Electives - III ::						
	VIII-C-1: Plant Biotechnology and Animal Biotechnology	100	03				
	VIII-C-2 :Environmental Biotechnology	100	03				
	VIII-C-3 :Industrial Biotechnology	100	03				
	Practical VIII C-I	50	02				
	Practical VIII C-2	50	02				
	Practical VIII C-3	50	02				

*Candidate has to choose only one paper

** Candidates are advised to choose Cluster (A) if they have chosen VII (A) and Choose Cluster (B) if they have chosen VII(B) etc. However, it is suggestive.

Biotechnology

VI Semester

Elective A: DEVELOPMENTAL BIOLOGY

Unit I

Potency, commitment, specification, induction, competence, determination and differentiation; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants

Unit II

Production of gametes; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III

Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis– vulva formation in Caenorhabditis elegans, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit IV

Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum

Unit V

Programmed cell death, aging and senescence

PRACTICALS

1. Structure of young anther wall, microsporogenesis, mature anther (permanent slides).
2. Study of monosporic (Polygonum) type of embryo sac development (permanent slides/photographs).
3. Study of embryo sac through electron micrographs showing egg apparatus.
4. Determination of stomatal index of leaf of the given plant material.
5. Determination of an effect of an environmental factor on the rate of transpiration by an excised twig using photometer.

Biotechnology

VI Semester

Elective B: ECOLOGY

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Unit II

Population Ecology: Characteristics of a population; population growth curves; population regulation;

Unit III

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Unit IV

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit V

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

PRACTICALS

1. To determine basal cover of trees in a forest ecosystem/forest plantation.
2. Quantitative analysis of soil organic carbon.
3. Quantitative analysis of soil pH.
4. To study pore space, water holding capacity and bulk density of soil.
5. Identification of rocks and minerals on the basis of physical characters.

Biotechnology

Semester- VI

Elective C: BIOSTATISTICS, BIOINFORMATICS AND IPRS

UNIT I

Collection, Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram, Frequency curve and frequency polygon. Mean, median, mode, Standard deviation.

UNIT II

Random variable,(discrete and continuous), Probability density function(discrete and continuous), Distribution function for discrete random variable. Distribution function for continuous random variable, Joint probability distribution, Conditional and marginal distribution. Mathematical expectations: Introduction, The expected value of a random variable, moments, Moment generating functions, Product moments, Conditional expectations. Standard distributions -: Uniform distribution. (Discrete and continuous).Exponential distribution Gamma distribution, Beta distribution. Binomial distribution, Poisson distribution, Normal distributions. Standard normal distributions.

UNIT III

Correlation and Regression analysis: Correlations and regressions-: Relation between two variables, scatter diagram, definition of correlations. Probability theory: Random experiments, sample space, probability theory, conditional probability. Baye's theorem.

UNIT IV

Sequence Analysis: Introduction to biological databases: NCBI, EMBL, EXPASY, PIR, Pfam. Concept of World Wide Web: HTML, HTTP. Similarity measures - Euclidean, Mahalanobis distance, Edit distance, similarity matrices (PAM, BLOSUM) Searching sequence databases using BLAST. Multiple sequence alignment – progressive alignment – profiles – multidimensional dynamic programming.

UNIT V

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

PRACTICALS

- Calculation of Mean of given data
- Draw pie chart of the following data
- Align the given sequences and calculate genetic similarity of the sequences
- Calculate median and mode of the following given data
- Arrange the given data in continuous and discrete form

- Calculate standard deviation of the given following data
- Identify the sequence of the given gene through blast
- Align the sequences using multiple alignment tool.

Note: perform any 5 practicals

Biotechnology

Semester- VI

Cluster Elective- A1: PLANT PHYSIOLOGY

Unit I

Photosynthesis-Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation -C₃, C₄ and CAM pathways.

Unit II

Respiration and photorespiration–Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit III

Nitrogen metabolism- Nitrate and ammonium assimilation; amino acid biosynthesis

Unit IV

Solute transport and photoassimilate translocation–uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates

Unit V

Sensory photobiology-Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks

PRACTICALS

1. Osmosis – by potato osmoscope experiment
2. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of *Rhoeo* / *Tradescantia*.
3. Structure of stomata (dicot & monocot)
4. Determination of rate of transpiration using cobalt chloride method.
5. Demonstration of transpiration by Ganong's photometer
6. Demonstration of ascent of sap/Transpiration pull.
7. Effect of Temperature on membrane permeability by colorimetric method.
8. Study of mineral deficiency symptoms using plant material/photographs.
9. Separation of chloroplast pigments using paper chromatography technique.
10. Rate of photosynthesis under varying CO₂ concentrations.
11. Effect of light intensity on oxygen evolution in photosynthesis using

NOTE: Perform any 6 practical

Biotechnology
Semester- V

Cluster Elective- A2: ANIMAL PHYSIOLOGY

Unit I

Blood and circulation- Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

Unit II

Respiratory system- Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit III

Nervous system- Neurons, action potential, neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs - Vision, hearing and tactile response.

Unit IV

Digestive system -Digestion, absorption, energy balance, BMR.

Unit V

Endocrinology and reproduction- Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

PRACTICALS

1. Detection of protein, carbohydrate and lipid.
2. Study of Human salivary enzyme activity in relation to pH.
3. Detection of nitrogenous waste products - Ammonia & Urea
4. Exercise on Haematology - Counting of RBC /WBC and Blood grouping in blood samples.
5. Estimation of Haemoglobin in blood samples.

Biotechnology
Semester- VI

Cluster Elective- A3:INHERITANCE BIOLOGY

Unit I

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.

Unit II

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Unit III

Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit IV

Mutation: Types, causes and detection, mutant types– lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.

Unit V

Recombination: Homologous and non-homologous recombination including transposition.

PRACTICAL

1. Scoring of Drosophila and Maize cobs for Monohybrid and Dihybrid segregations.
2. Problems on Mendelian Segregations (Monohybrid, Dihybrid & Trihybrid Crosses).
3. Problems on Multiple alleles and non-allelic interactions.
4. Problems on Linkage analysis and mapping of genes.
5. Phenotyping of ABO blood groups.
6. Screening for Barr body.

Biotechnology
Semester- VI

Cluster Elective- B1: DIVERSITY IN LIFE

Unit I

Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms.

Unit II

Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.

Unit III

Natural history of Indian subcontinent: Major habitat types of the subcontinent, geographic origins and migrations of species.

Unit IV

Organisms of health & agricultural importance: Common parasites and pathogens of humans, domestic animals and crops.

Unit V

Organisms of conservation concern: Rare, endangered species. Conservation strategies.

PRACTICALS

1. Identification of museum specimens of some economically important fishes.
2. Study of flora and fauna through charts and maps.
3. Preparation of field report based on the visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve.
4. Preparation of field report based on the survey of local flora.
5. Study of centre of diversity of plants from maps.

Biotechnology
Semester- VI

Cluster Elective- B2: EVOLUTION

Unit I

Emergence of evolutionary thoughts Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Unit II

Origin of cells and unicellular evolution: Origin of basic biological molecules; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit III

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification;

Unit IV

The Mechanism: Population genetics- Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift;

Unit V

Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

PRACTICALS

- 1) Give detailed description of different symbolic representation of Pedigree analysis
- 2) Give diagrammatic representation of X-linked recessive trait
- 3) In a plant species the ability to grow in soil contaminated with nickel is determined by a dominant allele.
 - i. If 60% of the seeds in a randomly mating population are able to germinate in contaminated soil, what is the frequency of the resistance allele?
 - ii. Among the plants that germinate, that proportion is homozygous?
- 4) $\alpha\beta\gamma$ is an autosomal recessive disorder of man. The frequency of effected newborn infants is about 1 in 14000. Assuming random mating, what is the frequency of heterozygotes?
- 5) DNA isolation and Polymerize chain reaction of the DNA

- 6) Agarose gel electrophoresis of the amplified solution and check the amplified bands in UV transilluminator/UV Gel documentation.

Biotechnology
Semester- VI

Cluster Elective- B3: PROJECT

Biotechnology
Semester- VI

Cluster Elective- C1: PLANT AND ANIMAL BIOTECHNOLOGY

UNIT I:

Cell and tissue culture: Introduction to cell and Tissue culture Laboratory facilities, Explant. Tissue culture media (composition and preparation) Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones.

UNIT II:

Tissue and micropropagation: Direct and indirect regeneration, production of haploids, protoplast culture and Somatic hybridization.

UNIT III:

Cloning in plants -Ti plasmid organization. Concept of transgenic plants Bt-cotton and other plant applications.

UNIT IV:

Various techniques of animal cell and tissue culture: Culture media, growth factors, laboratory facilities for animal cell culture. Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors. Primary culture, immortal cells, cell lines. Maintenance of cell lines in the laboratory.

UNIT V:

rDNA products: Brief idea about recombinant DNA products in medicine (insulin, somatostatin, vaccines), Concept of Gene therapy, Production of recombinant vaccines–hepatitis. Concept of transgenic animals In-vitro fertilization and embryo transfer in humans and farm animals.

PRACTICALS

1. Establishing a plant cell culture (both in solid and liquid media)–seed germination, callus culture, suspension cell culture, regeneration from callus cells.
2. Suspension culture.
3. Cell count by hemocytometer.
4. Cytology of callus.
5. Establishing primary cell culture of chicken embryo fibroblasts.
6. Animal tissue culture –maintenance of established cell lines.
7. Animal tissue culture –virus cultivation.
8. Measurement of cell size.
9. Microphotography.
10. IMViC test.
11. Determination of seed viability.

Note: perform any 8 practicals

Biotechnology
Semester- VI

Cluster Elective C2: ENVIRONMENTAL BIOTECHNOLOGY

Unit I:

Principles of Ecology: Water and terrestrial ecosystems, Bio-geo chemical cycles - Carbon, Nitrogen cycles. Role of microbes in bio-geochemical cycles.

Unit II:

Inorganic and Organic pollutants of air, land and water; maintenance of standards, Environmental monitoring. Detection, treatment and prevention of pollution. Biological indicators

Unit III:

Biocides, Four stage alternatives, Refuse disposal - Treatment methods, effluent from pharmaceuticals, fertilizers, pulp and paper industry.

Unit IV:

Waste water management - Aerobic and anaerobic treatment, primary, secondary and tertiary treatment of municipal wastes, Solid waste management.

Unit V:

Bioremediation, Biodegradation of recalcitrant compounds and the role of genetically engineered microbes and genetically modified organisms in the environmental management.

PRACTICALS

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water
3. Determination of Hardness and alkalinity of water sample.
4. Determination of dissolved oxygen concentration of water sample
5. Determination of biological oxygen demand of sewage sample
6. Determination of chemical oxygen demand (COD) of sewage sample.
7. Isolation of xenobiotic degrading bacteria by selective enrichment technique
8. Estimation of heavy metals in water/soil
9. Estimation of nitrate in drinking water.
10. Preparation and formulation of microbial biopesticide (bacteria, fungi and viruses)
11. In vitro evaluation of medicinal plants against pathogenic microbes.
12. Effect of mycorrhizal fungi on growth promotion of plants.
13. Production of microbial fertilizers (Rhizobium, Azotobacter and AMF).

Note: perform any 8 practicals

Biotechnology
Semester- VI

Cluster Elective- C3: INDUSTRIAL BIOTECHNOLOGY (Cluster 703.3)

Unit I:

Isolation, Screening, Preservation and Improvement of Industrially Important Microorganisms. Synthetic and Natural Medium, Precursors, Antifoams, Sterilization Methods and Inoculum Preparation.

Unit II:

Definition of bioreactor, basic principles of bioreactor. Types of bioreactors. Analysis of batch, continuous, fed batch and semi-continuous bioreactors.

Unit III:

Ethanol Production by Fermentation using Molasses, Starchy Substances. Production of Alcoholic Beverages like Beer and Wine. Production of Citric Acid by Submerged and Solid State Fermentations.

Unit IV:

Sources of Industrial Enzymes, Production of Microbial Enzymes like Amylase and protease. Backer's Yeast and SCP Production. Production of Antibiotics: Penicillin.

Unit V:

Biotechnology Products- Production of recombinant proteins having therapeutic and diagnostic applications (Insulin, Growth Hormone, Recombinant vaccines, Monoclonal Antibody).

PRACTICALS

1. Isolation of industrially important microorganisms from soil.
2. Isolation of amylase producing organisms from soil.
3. Production of α – amylase from *Bacillus Spp.* by shake flask culture.
4. Production of alcohol or wine using different substrates.
5. Estimation of alcohol by titrimetry.
6. Estimation of alcohol by calorimetric method.
7. Production of citric acid.
8. Citric acid production by submerged fermentation.
9. Estimation of citric acid by titrimetry.

Note: perform any 6 practicals

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ADIKAVI NANNAYA UNIVERSITY: RAJAMAHENDRAVARAM

QUESTION PAPER PATTERN FOR ALL SEMESTER W.E. FROM 2016-17 ADMITTED

BATCH

(For all Papers except Foundation Course papers & Special English Paper)

Time: 3 Hours

Maximum Marks: 75

Section - A

I. Answer any five questions

(5x5=25)

1. Unit- I

2. Unit- II

3. Unit-III

4. Unit- IV

5. Unit-V

6.

7.

8.

Each one from any of the three units out of five units

Section- B

II. Answer All the Questions

(5x10=50)

1. (a) or (b) from Unit -I

2. (a) or (b) from Unit -II

3. (a) or (b) from Unit -III

4. (a) or (b) from Unit -IV

5. (a) or (b) from Unit -V