AP STATE COUNCIL OF HIGHER EDUCATION
CBCS PATTERN FOR BIOTECHNOLOGY

YEAR	SEMESTER	PAPER	TITLE	MARKS	CREDITS
I	I	I	Microbiology and cell biology	100	03
			Practical – I	50	02
	II	II	Macromolecules and metabolism	100	03
			Practical – II	50	02
II	III	III	Biophysical Techniques	100	03
			Practical – III	50	02
	IV	IV	Immunology	100	03
			Practical – IV	50	02
III	V	V 501	Molecular Biology	100	03
			Practical – V	50	02
		VI 502	RDNA Technology	100	03
			Practical – VI	50	02
	* Any one Paper from A, B and C ** Any one cluster from I, II and III	VII A* 601	Genetics	100	03
			Practical - VII A	50	02
		VII B* 602	Plant and Animal Biotechnology	100	03
			Practical - VII B	50	02
		VII C* 603	Industrial Biotechnology	100	03
			Practical - VII C	50	02
	VI	VIII (I)**	**Cluster Elective - I :: IVF and ET**		
			I. *In vitro* Fertilization	100	03
			II. Embryo Technology	100	03
			III. Ethical Issues and IPR	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02
			Project Work	50	02
		VIII (II)**	**Cluster Elective - II ::Fermentation and Downstream Processing**		
			I. Basics of Fermentation	100	03
			II. Fermentor design and Downstream processing	100	03
			III. Bioprocess Technology	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02
			Project Work	50	02
		VIII (III)**	**Cluster Elective - III :: SCP and Mushroom Cultivation**		
			I. Introduction to SCP & Mushrooms	100	03
			II. Production of SCP & Mushrooms	100	03
			III. SCP & Mushrooms Marketing and Extension	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02

ACHARYA NAGARJUNA UNIVERSITY
CBCS PATTERN FOR BIOTECHNOLOGY

YEAR	SEMESTER	PAPER	TITLE	MARKS	CREDITS
I	I	I	Microbiology and cell biology	100	03
			Practical – I	50	02
	II	II	Macromolecules and metabolism	100	03
			Practical – II	50	02
II	III	III	Biophysical Techniques	100	03
			Practical – III	50	02
	IV	IV	Immunology	100	03
			Practical – IV	50	02
III	V	V	Molecular Biology	100	03
			Practical – V	50	02
		VI	RDNA Technology	100	03
			Practical – VI	50	02
	* Any one Paper from A, B and C ** Any one cluster from I, II and III VI	VII A*	Genetics	100	03
			Practical - VII A	50	02
		VII B*	Plant and Animal Biotechnology	100	03
			Practical - VII B	50	02
		VII C*	Industrial Biotechnology	100	03
			Practical - VII C	50	02
		VIII (I)**	**Cluster Elective - I :: IVF and ET**		
			I. *In vitro* Fertilization	100	03
			II. Embryo Technology	100	03
			III. Ethical Issues and IPR	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02
			Project Work	50	02
		VIII (II)**	**Cluster Elective - II ::Fermentation and Downstream Processing**		
			I. Basics of Fermentation	100	03
			II. Fermentor design and Downstream processing	100	03
			III. Bioprocess Technology	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02
			Project Work	50	02
		VIII (III)**	**Cluster Elective - III :: SCP and Mushroom Cultivation**		
			I. Introduction to SCP & Mushrooms	100	03
			II. Production of SCP & Mushrooms	100	03
			III. SCP & Mushrooms Marketing and Extension	100	03
			Practical – VIII: 1	50	02
			Practical – VIII: 2	50	02
			Project Work	50	02

B.Sc., Biotechnology: Choice based Credit System

Semester	Course Code	Title of course	Number of Credits	Number of teaching hrs	Marks		
					Internal	SEE	Total
I	BTT- 101	Microbiology and cell biology	3	5	25	75	100
I	BTP- Lab	Microbiology and cell Biology lab	2	2	0	50	50
II	BTT- 201	Macromolecules and metabolism	3	5	25	75	100
II	BTP- Lab	Macromolecules and enzymology lab	2	2	0	50	50
III	BTT-301	Biophysical Techniques	3	5	25	75	100
III	BTP- Lab	Metabolism and Biophysical Techniques lab	2	2	50	75	50
IV	BTT- 401	Immunology	3	5	25	75	100
IV	BTP- Lab	Immunology lab	2	2	0	50	50
V	BTT- 501	Molecular Biology	4	5	25	75	100
V	BTP-Lab	Molecular Biology lab	2	2	0	50	50
VI	BTT- 502	RDNA Technology	3	5	25	75	100
VI	BTP- Lab	rDNA Technology	2	2	0	50	50
VII A*	BTT- 601	Genetics	4	5	25	75	100
VII A*	BTP- Lab	Genetic (Lab)	2	2	0	50	50
VII B*	BTT- 602	Plant and Animal Biotechnology	4	5	25	75	100
VII B*	BTP- Lab	Plant and Animal Biotechnology (Lab)	2	2	0	50	50
VII C*	BTT-603	Industrial Biotechnology	4	5	25	75	100
VII C*	BTP- Lab	Industrial Biotechnology (Lab)	2	2	0	50	50

FOUNDATION COURSES

1st Year:

Semester-I: Foundation Course- 1 HVPE (Human Values & Professional Ethics),
Foundation Course-2 Communication & Soft Skills-1

Semester-II: Foundation Course-3 Environmental Sciences
Foundation Course-4A ICT-1 (Information & Communication Technology)

2nd Year:

Semester-III: Foundation Course- 5 Entrepreneurship
Foundation Course-2B Communication & Soft Skills-2

Semester-IV: Foundation Course-2C Communication & Soft Skills-3
Foundation Course- 6 Analytical Skills
Foundation Course- 7 CE (Citizenship Education)
Foundation Course- 4 B ICT-2 (Information & Communication Technology)

3rd Year:

Semester-V: Skill Development Course-1 (University's Choice)
Skill Development Course- 2 (University's Choice)

B.Sc., SEMESTER I
BTT- 101 MICROBIOLOGY AND CELL BIOLOGY

UNIT I

History, Development and Microscopy

History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner. Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance, principles and applications of dark field, phase contrast, fluorescent microscopy. Electron microscopy: Principle, ray diagram and applications, TEM and SEM, comparison between optical and electron microscope, limitations of electron microscopy.

Stains and staining procedures: Acidic, basic and neutral stains, Gram staining, Acid fast staining, Flagella staining, Endospore staining.

UNI
T II

Bacteria: Bacterial morphology and subcellular structures, general morphology of bacteria, shapes and sizes, generalized diagram of typical bacterial cell.Slime layer and capsule, difference between the structure, function and the position of the two structures. Cell wall of gram +ve and Gram -ve cells, Prokrayotic classification.General account of flagella and fimbriae.Chromatin material, plasmids; definition and kind of plasmids (conjugative and non-conjugative) F, R, and Col plasmids.Endospores: Detailed study of endospore structure and its formation, germination, basis of resistance. A brief idea Bergey's manual. Morphology of archaea, archaeal cell membrane (differences between bacterial and archaeal cell membrane), other cell structures, concept of the three distinct archaea groups.

Viruses: General characteristics of viruses, difference between virus and typical microbial cell, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids, phage and animal cell viruses,

example of each and their importance. Brief idea of lytic cycle and lysogeny.

UNIT III

Microbial Nutrition: Basic nutritional requirements: Basic idea of such nutrients as water, carbon, nitrogen, sulfur and vitamins etc., natural and synthetic media, nutritional classification of bacteria. Selective and Differential media, Enriched media, Enrichment media.

UNIT IV:

Microbial growth and control:Growth: Growth rate and generation time, details of growth curve and its various phases.Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat). Measurement of growth.Physical conditions required for growth: Temperature (classification of microorganisms on the basis of temperature requirements), pH etc. Pure cultures and cultural characteristics. Maintenance of pure culture.Microbial Control: Terminologies - Sterilization, disinfection, antiseptic, sanitization, germicide, microbistasis, preservative and antimicrobial agents.Mechanism of cell injury: Damage to cell wall, cell membrane, denaturation of proteins, inhibition of protein synthesis, transcription, replication, other metabolic reactions and change in supercoiling of DNA.Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), dessication, surface tension, osmotic pressure, radiation, UV light, electricity, ultrasonic sound waves, filtration.
Chemical control: Antiseptics and disinfectants (halogens, alcohol,
gaseous sterilization. Concept of biological control.

UNIT V

Cell Biology: Eukaryotic Cell - Structure and function of the following: nucleus, nuclear membrane, nucleoplasm, nucleolus, golgi complex, Mitochandria, Chloroplast, endoplasmic reticulum, lysosomes, peroxisomes, glyoxisomes and vacuoles.

PRACTICAL:BTP- MICROBIOLOGY & CELL BIOLOGY

1. Demonstration, use and care of microbiological equipments.
2. Preparation of media, sterilization and isolation of bacteria.
3. Isolation of Bacteriophage from sewage / other sources.
4. Demonstration of motility of Bacteria.
5. Simple staining of bacteria
6. Gram staining of Bacteria
7. Acid fast staining of Bacteria
8. Endospore staining.
9. Demonstration of starch hydrolysis by bacterial cultures.
10. Growth of fecal coliforms on selective media.
11. Isolation of pure culture by pour plate method.
12. Isolation of pure culture by streak plate method.
13. Anaerobic cultivation of microorganisms.
14. Cultivation of yeast and moulds.
15. Antibiotic sensitivity assay.
16. Oligodynamic action of metals.
17. To study germicidal effect of UV light on bacterial growth.
18. Stages of mitosis.
19. Stages of meiosis.

Note: - Mandatory to perform at least ten practical.

B. Sc. SEMESTER II

BTT- 201 MACROMOLEULES, ENZYMOLOGY AND BIOENERGETICS

UNIT I

Nucleic Acids and Chromosomes: Chemical structure and base composition of nucleic acids, Chargaff's rules, Watson Crick Model (B-DNA), deviations from Watson-Crick model, other forms of DNA (A- and Z-DNA), forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations, base stacking).

UNIT II

Amino acids and Proteins: Structure of amino acids occurring in proteins, classification of amino acids (pH based, polarity based and nutrition based physico-chemical properties of amino acids. Primary, Secondary, Tertiary & Quaternary structure of proteins.

UNIT III:

Carbohydrates:Definition, classification, nomenclature of carbohydrates, structures of monosaccharides, disaccharides and polysaccharides. Concept and examples of heteropolysaccharides.

Lipid:Types of lipids, structures of saturated and unsaturated fatty acids, triglycerides, phospholipids, Concept of acid value, saponification value and iodine value. Chemistry of Porphyrines, Heme, Cytochromes, and Chlorophylls

UNIT IV

Enzymes: Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc. Classification and nomenclature of enzymes. Substrate Specificity (bond specificity, group specificity, absolute specificity, stereo-specificity), lock and key and induced fit models.

Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of p H and temperature, temperature. Enzyme inhibition kinetics (reversible inhibition types – competitive, uncompetitive and non-competitive), brief idea of irreversible inhibition.

UNIT V

Bioenergetics: Concept of free energy, Entropy, Enthalpy & Redox Potential. Concept of high energy bonds as related to the structure of ATP, Phosphoenolpyruvate, Creatine phosphate etc. Glycolysis (pathway, entry of other monosachharides and disaccharides, regulation, inhibitors) Gluconeogenesis: Bypass reactions. Structure of mitochondria.

PRACTICALS: BTP- MACROMOLECULES & ENZYMOLOGY

1. Qualitative estimation of Carbohydrates
2. Qualitative estimation of Amino acids
3. Quantitative Estimation of proteins by Biuret method
4. Estimation of DNA by Diphenylamine method
5. Estimation of RNA by Orcinol method
6. Quantitative estimation of sugars (Dinitrosalicylic acid method).
7. Estimation of glucose by Benedict’s quantitative method
8. Quantitative estimation of proteins by Lowry’s method.
9. Determination of saponification value of Fats
10. Determination of Acid Value of Fats

11. Immobilization of enzymes / cells by entrapment in alginate gel 19. Effect of temperature / pH on enzyme activity
12. Assay of protease activity.
13. Assay of alkaline phosphatase
14. Preparation of starch from Potato and its hydrolysis by salivary amylase
15. Isolation of urease and demonstration of its activity

*** Minimum of Ten practical's are mandatory**

B.Sc., SEMESTER III
BTT- 301: BIOPHYSICAL TECHNIQUES

UNIT – I:

Spectrophotometry: Spectrum of light, absorption of electromagnetic radiations, Beer's law - derivation and deviations, extinction coefficient. Instrumentation of UV and visible spectrophotometry, Double beam spectrometer; dual-wavelength spectrometer, Applications of UV and visible spectrophotometry. Spectrofluorometry: principle, instrumentation and applications. Absorption & emission flame photometry: principle, instrumentation and application.

UNIT II:

Chromatography: Partition principle, partition coefficient, nature of partition forces, brief account of paper chromatography.Thin layer chromatography and column chromatography.Gel filtration: Concept of distribution coefficient, types of gels and glass beads, applications.Ion-exchange chromatography: Principle, types of resins, choice of buffers, applications including amino acid analyzer.Affinity chromatography: Principle, selection of ligand, brief idea of ligand attachment, specific and non-specific elution, applications.HPLC

UNIT III

Electrophoresis: Migration of ions in electric field, Factors affecting electrophoretic mobility. Paper electrophoresis, Gel electrophoresis: - Types of gels, Solubilizers, Procedure, Column & slab gels Detection, Recovery & Estimation of macromolecules.SDS-PAGE Electrophoresis and applications. Isoelectric focusing,Pulsed-field gel electrophoresis.

UNIT – IV:

Isotopic tracer technique: Radioactive & stable isotopes, rate of radioactive decay. Units of radioactivity. Measurement of radioactivity: - Ionization chambers, proportional counters, Geiger- Muller counter, Solid and liquid scintillation counters (basic principle, instrumentation and technique), Cerenkov radiation. Measurement of Stable isotopes: Falling drop method for deuterium measurement, Mass spectrometry. Principles of tracer technique, advantages and limitations, applications of isotopes in biotechnology (distribution studies, metabolic studies, isotope dilution technique, metabolic studies, clinical applications, autoradiography).

UNIT V:

Centrifugation: Basic principles, concept of RCF, types of centrifuges (clinical, high speed and ultracentrifuges).Preparative centrifugation: Differential and density gradient centrifugation, applications (Isolation of cell components).Analytical centrifugation: Sedimentation coefficient, determination of molecular weight by sedimentation velocity and sedimentation equilibrium methods.

BiostatisticsBasic concepts of mean, median, mode, Standard deviation and Standard error.

Introduction to ANOVA

PRACTICALS : B T P - METABOLISM & BIOPHYSICAL TECHNIQUES

1. Spectrophotometric analysis of DNA denaturation.
2. Determination of absorption spectrum of oxy- and deoxyhemoglobin and methemoglobin.
3. Protein estimation by E280/E260 method.
4. Paper chromatography of amino acids/sugars.
5. TLC of sugars/amino acids.
6. Cellular fractionation and separation of cell organelles using centrifuge.
7. Isolation of mitochondria and assay of marker enzyme.
8. Estimation of Urea by diacetyle monoxime method.
9. Estimation of Sugars by Folin Wu method
10. Validity of Beer's law for colorimetric estimation of creatinine.
11. Absorption spectrum of NAD & NADH
12. Preparation of standard buffers and determination of pH of a solution
13. Titration of a mixture of strong & weak acid
14. Paper electrophoresis of proteins
15. Gel electrophoresis of proteins.
16. SDS-PAGE of an oligomeric protein.
17. Calculation of mean, median, and mode (manual/computer aided).
18. Calculation of standard deviation and standard error (manual/computer aided).
19. Biostatistical problem based on standard deviation.

Note: - Mandatory to perform atleast 10 practicals

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B. Sc. SEMESTER IV
BTT-401: IMMUNOLOGY

UNIT I

Immune system: Organs and cells of immune system Immunity, innate immune mechanism, Acquired immune mechanism, Antigen,
Humoral immunity, main pathways of complement system.

UNIT II

Antibody and Antigen: Antibody structure and classes, Antibody diversity, Types of Antigens Antigenecity (factors affecting antigenecity). Complement system .

UNIT III

Immunity: Cell mediated immunity: TC mediated immunity, NK cell mediated immunity, ADCC, brief description of cytokines and MHC (MHC types and diversity)

UNIT IV

Hypersensitivity and vaccination : General features of hypersensitivity, various types

of hypersensitivity, Vaccination: Discovery, principles, significance, Types of Vaccines

UNIT V

Immunological Techniques:Antigen-antibody reactions: Precipitation, agglutination, complement fixation, immunodiffusion, ELISA. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.

PRACTICALS: BT- IMMUNOLOGY & BIOPHYSICAL TECHNIQUES

1. Antigen – antibody reaction – determination of Blood group , Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterloney immunodiffusion
5. Radial immunodiffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

Note: - Mandatory to perform atleast 6 practicals

B. Sc. III –Semester V
BTT- 501: MOLECULAR BIOLOGY

Unit I:

Genome Structure: Watson and Crick model of DNA; Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size. Concepts of Genetic Material, Gene, Chromosome and Genome. Experiments to prove DNA as genetic material (Griffith experiment, Hershey- Chase experiment)

Unit II

DNA Replication:Enzymology of replication (DNA polymerase I, pol II and III, helicases, topoisomerases, single strand binding proteins, DNA melting proteins, primase. Proof of semiconservative replication, Replication origins, initiation, elongation, and termination. Rolling circle replication of DNA

Unit III

Transcription : Enzymatic synthesis of RNA: Basic features of transcription, structure of prokaryotic RNA polymerase (core enzyme and holo enzyme, sigma factor), concept of promoter (Pribnow box, -10 and -35 sequences), Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release). Reverse transcription.

Unit IV

Gene Expression and regulation

Regulation of gene expression; Clustered genes and the operon concepts - Negative and positive control of the Lac Operon, trp operon, Control of gene expression. Poly and Mono cistronic m-RNA,

Unit V:

Genetic Code and Protein Synthesis

Genetic code: Features of genetic code, Structure of m RNA, brief structure of tRNA, the adaptor hypothesis, attachment of amino acids to tRNA. Codon-anticodon interaction - the wobble hypothesis. Initiation, elongation, termination of protein.

PRACTICALS BTP: MOLECULAR BIOLOGY

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E.coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Separation of DNA by Agarose gel Electrophoresis
10. Purity analysis of the Nucleic acids

B. Sc. III – Semester V
BTT- 502: rDNA TECHNOLOGY

Unit I:

Restriction and Modification. Classification of restriction endonucleases. Enzymes used in molecular cloning; Polymerases, ligases, phosphatases, kinases and nucleases; Advanced Molecular biology techniques, Electrophoresis and Blotting techniques.

Unit II

Cutting and joining DNA (cohesive end ligation, methods of blunt end ligation). Transfection and transformation. Selection of transformed cells. Screening methods (Genetic marker and blue white screening)

Unit III:

Cloning vehicles - Plasmid, Bacteriophage, Construction of genomic and cDNA libraries. Advantages of cDNA libraries.

Unit IV.

Methods of gene sequencing – Maxam - Gilberts and Sanger's dideoxy chain termination methods; Polymerase chain reaction technique (Components in PCR and PCR conditions)

Unit IV:

Methods of gene transfer in fungi, yeast and higher plants using microinjection, microprojectile bombardment (gene gun method, Electroporation and Agrobacterium mediated transformation

Unit V:

Applications of recombinant DNA technology in Agriculture (Transgenic Plants) Medicine (production of Insulin, Growth harmone, Tissue plasmogen activator and HBsAg vaccine)

PRACTICALS BTP : rDNA TECHNOLOGY

1. Problem in Genetic engineering.
2. Transformation in Bacteria using plasmid.
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA.
7. Demonstration of PCR

B. Sc. III –Semester VI
Paper - VII A*
BTT- 601: GENETICS

UNIT I

Mendels Laws and Inheritance: Mendel experiments, Mendel Laws and deviations: incomplete dominance and Co dominance Penetration and pleiotropism, Recessive and Dominant epistatic gene interactions. Concept of multiple alleles

UNIT II

Genes and their variations: Structure of gene, gene and environment, gene copies of prokaryotic and Eukaryotic chromosomes. Eukaryotic chromosome organization, histone proteins.

Unit III:

Gene mutations: Mutagenesis - Spontaneous and induced (Chemical and physical) mutations; Natural and induction of mutations, point mutations, frameshift mutations, auxotrophic conditional and suppressor mutations.

UNIT IV:

DNA Damage and DNA Repair: Light induced repair, Excision repair and mismatch repair, Post replication repair, Rec gene and its role in DNA repair, SOS repair and SOS response

Unit V:

Transposable elements: Structure and Molecular basis of AC-DS transposition in maize, "P" element of Drosophila and hybrid dysgenesis, Yeast "T_7" elements, Retroposans

Practical -Paper - VII A*

PRACTICALS BTP : GENETICS

1. Study of different phases of mitosis in onion root tips and meiosis in *Allium cepa* flower buds.
2. Karyotyping in Allium or Drosophila.
3. Determination of multiple allele frequencies of leaf scars in Trifolium.
4. Problems and assignments in Mendilian genetics.

5. Determination of linkage and calculation of recombination frequencies (maize/ Drosophila).
6. Induction of chromosomal aberrations by chemical mutagenesis in Allium (or any plant).
7. Isolation of auxotrophic mutants (plants or insects).
8. Repair of DNA by Photo activation of Photolyase in bacteria.
9. Mutation of bacteria by UV.
10. Chemical induced mutation in bacteria

B. Sc. III – Semester VI
Paper VII B*
BTT- 602: PLANT AND ANIMAL BIOTECHNOLOGY

UNIT I:
Cell and tissue culture: Introduction to cell and Tissue culture Laboratory facilities, 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, regeneration, production of haploids, protoplast culture and somatic hybridization. Cloning in plants - Ti plasmid organization. Concept of transgenic plants Bt cotton and other plant applications.

UNIT III:
Various techniques of animal cell and tissue culture: Culture media, growth factors, laboratory facilities.
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. d) Maintenance of cell lines in the laboratory.

UNIT IV:
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.

UNIT V:
IPR: Intellectual property rights. Protection of Copy rights. Patents and their significance. Management studies: society and ethical aspects of Biotechnology.

Practical - Paper VII B*

PRACTICALS: BTP- PLANT AND ANIMAL BIOTECHNOLOGY

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.

B. Sc. III – Semester VI
Paper VII C*
BTT: 603 Industrial Biotechnology

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. Classification 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 Harmone, Recombinant vaccines, Monoclonal Antibody).

Practical Paper VII C*

PRACTICALS BTP: Industrial Biotechnology

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.

B. Sc. III – Semester VI
PAPER VIII (I)**

Cluster Elective - I :: IVF and ET

I. *In vitro* Fertilization

Unit –I

Reproduction, Reproductive systems of male and female animals, human reproduction – Pituitary hormones / Thyroid function / anatomy and physiology of male and female reproductive systems.

Unit -II

Reproductive system hormones, male and female reproductive hormones, hormones role in the menstrual cycle, Importance of Hormones, FSH (follicle stimulating hormone), LH (luteinizing hormone), Estrogen and Progesterone.

Unit -III

Natural Insemination, Semen quality, components of semen, composition of spermatozoa, chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro. Factors affecting semen production and quality, preservation, composition of diluents, sperm concentration, transport of diluted semen, tests involved in the natural insemination,

Unit -IV

Preservation techniques, semen preservation, Deep freezing techniques in cows, sheep, goats, swine and poultry, detection of oestrus and time of insemination for better conception, anoestrus and repeat breeding.

Unit -V

Artificial Insemination

Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

II. Embryo Technology

Unit –I

Embryology: Cell cycle, Fertilization & cleavage structure of sperm and oocytes, Blastulation & Gastrulation, Gastrulation & Germ Layers, Germ Layer Formation, Implantation, Fetal Membranes, Placenta

Unit -II

Induction and Organogenesis, development of organs, Morphology of organs, Mechanisms of development organs like kidney, heart, lungs and reproductive organs

Unit –III

Embryo transfer technology, pre and post transfer precautions in embryo transfer technology, Post embryo transfer technology, Resting time, Hysteroscopic transfer, Transabdominal transmyometrial transfer, Transvaginal transmyometrial transfer, Tubal embryo Transfer (TET).

Unit –IV

Preparation of media, Oocyte handling and scoring Embryo selection on day 3 and day 5 for transfer, Loading catheter for embryo transfer (ET transfer), Clinical stimulation and hormone replacement protocols, Oocyte denudation, Preparation of ICSI dishes, Sperm immobilization, Oocyte injection,

Unit - V

Clinical Embryology, Medication, catheter uses, use of ultra sounds, use of ultrasound prior to transfer, transfer under ultrasound, location of transfer and sequential embryo transfer, Assisted hatching (chemical and laser)

III. Ethical Issues and IPR

Unit -I

Registration, Code of Practice, Responsibilities of the Clinic, Information and Counselling to be given to Patients

Unit -II

Desirable Practices/Prohibited Scenarios, Requirements for a Sperm Donor, Requirements for an Oocyte Donor,

Unit –III

Requirements for a Surrogate Mother, Sourcing of oocytes and surrogate mothers, Oocyte sharing, Surrogacy: General Considerations

Unit –IV

Semen banks, Posthumous AIH through a sperm bank, Preservation, Utilization & Destruction of Embryos,

Unit –V

Legitimacy of the child born through ART, Adultery in the case of ART, Consummation of marriage in case of AIH, Rights of an unmarried woman to AID, Legal protection of embryos

Practical – VIII: 1 - *In vitro* Fertilization

1. Testing Semen quality,
2. Preparation of diluents
3. Semen preservation,
4. Deep freezing techniques in cows, sheep, goats, swine and poultry,
5. Detection of Oestrus
6. Preparation of sperm banks,

Practical – VIII: 2 - Embryo Technology

1. Culture media
2. Egg identification
3. Insemination
4. Fertilization and cleavage check
5. Embryo transfer technique Blastocyst culture
6. Embryo hatching Techniques of intracytoplasmic sperm injection
7. Cryopreservation
8. Principles of cryopreservation - Semen freezing / Embryo freezing Slow freeze techniques / Nitrification

Project Work- 50 Marks

B. Sc. III – Semester VI
PAPER VIII (II)**

Cluster Elective – II :: Fermentation and Downstream Processing

I. Basics of Fermentation

Unit I:

Isolation, Screening of Microorganisms, Fundamentals of fermentation process - details of the Fermenters, Synthetic and Natural Medium, Precursors, Antifoams, Sterilization Methods and Inoculum Preparation, sampling ports, detection of contamination

Unit II:

Introduction to instrumentation: pH probes, dissolved oxygen probes, other biosensors. Large scale production of recombinant proteins and other cell culture products.

Unit –III

Fermentation broth rheology. Fluid flow and mixing. Newton's law of Viscosity. Momentum transfer. Non-newtonian fluids. Flow patterns in agitated vessels with aeration and without aeration. Oxygen requirements of microbial cultures. Oxygen transfer by aeration and agitation.

Unit IV:

Methods of Determination of oxygen transfer coefficient. Factors affecting oxygen transfer coefficient. Correlation for volumetric oxygen mass transfer coefficient. Overview of methods for online and offline monitoring of bioreactors. Bioprocess measurements: physical and chemical measurements.

Unit –V

Production of microbial metabolites Alcoholic Beverages like Beer and Wine, Vinegar, Production of Citric Acid, Production of Microbial Enzymes like Amylase and Protease. Backer's Yeast and SCP Production. Production of Antibiotics : Penicillin and Streptomycin.

II. Fermentor design and Downstream processing

Unit I: ***Introduction to fermentation Technology:***

History and Scope- Bioreactor: Design, parts and accessories, functions- Modes of Operation of fermenter- Batch, fed batch, Continuous, Semi continuous, Perfusion- Types of reactors CSTR, Tower, Jet loop, Airlift, Bubble column, Packed bed- Applications of Bioprocess Technology

Unit II: ***Modelling Principles:***

Bioreactor modelling and stability analysis. Fundamentals of Modelling. Modelling of Enzyme Kinetics. Simple Microbial Kinetics. Structured Kinetic Models. Bioreactor Modelling. General balances for Tank-type Biological Reactors.

Unit III:

Definition of bioreactor, basic principles of bioreactor. Factors affecting bioreactor design. Classification of bioreactors and their configurations. Analysis of batch, continuous, fed batch and semi-continuous bioreactors.

Unit IV:

Downstream processing- Cell disruption: Mechanical and non-mechanical methods - Recovery and purification of products: Separation of insoluble products-filtration – Micro to Nano filtration, centrifugation, flocculation and coagulation.

Unit V

Separation of soluble products- liquid-liquid extraction, precipitation, adsorption, dialysis, reverse osmosis, chromatography- purification-crystallization and drying.

III. Bioprocess Technology

Unit –I: Isolation, Screening, ***Strain Improvement and Media Formulation***

Fundamentals of Bioprocess, Synthetic & Natural media, Presursors, Antifoams, Sterilization methods, Inoculum preparation, Sampling ports. Isolation, Screening, Preservation & Improvement of Industrially Important microorganisms.

Unit –II: ***Microbial Kinetics & Transport Phenomena in Bioprocessing:***

Growth Curve - Biological rate equations (Microbial Kinetics) for cell Growth, cell lysis & Cell death. Transport phenomena in Bioprocess - Fluid Flow, Mixing, Mass Transfer & Heat Transfer.

Unit –III: ***Bioreactor Design & Instrumentation:***

Definition of Bioreactor, Basic principles of Bioreactor. Bioreactor design & its components. Factors affecting Bioreactor design. Bioreactor Instrumentation & control.

Unit –IV: ***Bioreactor Configurations & their Kinetics:***

Classification of Bioreactors & their configurations. Design of Bioreactors using Monod growth Kinetics & Michaelis Menten kinetics - Batch reactor, Fed batch reactor & Continuous reactor.

Unit -V: ***Kinetics of Immobilized Enzymes:***

Kinetics of single particles containing immobilized enzymes — Liquid phase diffusions limitation. Microbial Films & Microbial Flocs. Measurement of flocculation and floc size.

Practical – VIII: 1

1. Assay of amylase activity from seedlings of rice or mungbean
2. Determination of optimum pH of an enzyme
3. Effect of time of incubation on enzyme activity
4. Effect of substrate concentration on enzyme activity
5. Effect of temperature on enzyme activity
6. Production of amylase from bacteria/potato/sweet potato
7. Assay of protease activity
8. Effect of inhibitors on enzyme activity
9. Determination of Km and Vmax of an Enzyme (Amylase)
10. Determination of enzyme activity of Urease and malate dehydrogenase
11. or catalase or peroxidase using UV-VIS Spectrophotometer

Practical – VIII: 2

1. Principles of bread making
2. Isolation of industrially important microorganisms from soil.
3. Isolation of amylase producing organisms from soil.
4. Production of α – amylase from *Bacillus Spp.* by shake flask culture.
5. Production of alcohol or wine using different substrates.
6. Estimation of alcohol by titrimetry.
7. Estimation of alcohol by calorimetric method .
8. Production of citric acid.
9. Estimation of citric acid by titrimetry.
10. Analysis of molasses by laneeynon double reduction method.

Project Work

B. Sc. III – Semester VI
PAPER VIII (III)**

Cluster Elective - III :: SCP and Mushroom Cultivation

I. Introduction to SCP & Mushrooms

Unit I

Single cell protein (SCP), History of Single Cell Protein **(SCP);** Microbial SCP production by bacteria, algae and mycoprotein from fungi for use as food and feed;

Unit II

Concept of probiotics, prebiotics, symbiotics and bioactive food; Production and composition of various probiotics; chemistry, metabolism and bioavailability of probiotics;

Unit -III

Effect of probiotics on human health and potential application in risk reduction of diseases; genetically modified probiotics/prebiotics.

Unit –IV

Historical background , Present status of mushroom culture in India, Nutritional values, Cultivation methods, Obtaining pure culture,

Unit -V

Preparation of spawns Formulation and preparation of composts, Spawning, spawn running and cropping Control of pathogens and pests

II. Production of SCP & Mushrooms

Unit -I

SCP production process by using different substrates; properties and nutritional values; Industrially used SCP (Quoron, Pruteen);

Unit -II

Nutritional values of SCP and Mushrooms, Advantage and disadvantages of SCP. Economic implications of SCP,

Unit- III

Mushroom cultivation, harvesting and post harvesting; important edible mushroom sp.

Unit -IV

Cultivation of paddy straw mushroom, Cultivation of white button mushroom, Cultivation of *Dhingri (Pleurotus sajor-caju)* Recipes of mushroom

Unit -V

Genetic Improvements in Microbial Cells, SCP & Mushrooms, different methods used for the genetic improvement methods.

III. SCP & Mushrooms Marketing and Extension

Unit –I

Genetic improvements of microbial cells, Production of algal biomass, Factors affecting bio-mass production, Harvesting the algal biomass.

Unit- II

Spirulina as SCP, cultivation and uses, Production of bacterial and actinomycetous biomass, Method of production, Factors affecting biomass production, Product recovery and Marketing.

Unit -III

Production of yeast biomass, Factors affecting growth of yeast, Recovery of yeast biomass, Production of fungal biomass (Other than Mushrooms) and its marketing.

Unit -IV

Growth conditions, Organic wastes as substrates, Traditional fungal foods.

Unit -V

Different methods involved in the marketing and extension activities for the improvement of SCP & Mushrooms.

Practical – VIII: 1

1. Preparation of media for SCP
2. Composition of Probiotics
3. Production of probiotics
4. production process for SCP (Quoron, Pruteen);

Practical – VIII: 2

1. Mushroom cultivation,
2. harvesting methods
3. post harvesting methods
4. Cultivation of paddy straw mushroom,
5. Cultivation of white button mushroom, Cultivation of *Dhingri (Pleurotus sajor-caju)*

Project Work

BIOTECHNOLOGY

ACHARYA NAGARJUNA UNIVESITY :: NAGARJUNANAGAR-522 510
III B.Sc.; SEMESTER-V
THEORY MODEL PAPER
BTT 501 — PAPER – **MOLECULAR BIOLOGY**

Time: 3 hours Max. Marks: 75

Section –A (Short Answer Questions)

Answer any five of the following questions 5 x 5= 25M

1. Watson and Crick model of DNA
2. Genome size
3. Origins
4. sigma factor
5. Clustered genes
6. Operon
7. protein
8. m-RNA

Section –B (Essay Questions)

Answer all of the following questions 5 x 10=50M

9. a) Discusses about genome organization.

Or

b) Write in detail about Hershey- Chase experiment.

10. a) Explain about DNA polymerase I, pol II and III structures.

Or

b) Give an account on Replication.

11. a) Discuss in detail about concept of promoter.

Or

b) Write about the reverse transcription mechanism.

12. a) Explain about Lac Operon.

Or

b). Describe about Control of gene expression.

13. a) Give an account in brief structure of tRNA.

Or

b) Discuss about Codon-anticodon interaction .

12/1/2017

BIO TECHNOLOGY

ACHARYA NAGARJUNA UNIVESITY :: NAGARJUNANAGAR-522 510
III B.Sc ; SEMESTER-V
THEORY MODEL PAPER
BTT502- PAPER ~~-~~ **R-DNA TECHNOLOGY**

Time: 3 hours Max. Marks: 75

Section –A (Short Answer Questions)

Answer any five of the following questions 5 x 5= 25M

1. Ligases
2. Nucleases
3. Genetic marker
4. Gene Gun
5. Bacteriophage
6. Gene
7. R-DNA technology
8. Insulin

Section –B (Essay Questions)

Answer all of the following questions 5 x 10=50M

9. a) Discusses about classification of restriction endonucleases.

Or

b) Write in detail about Blotting techniques.

10. a) Explain about selection of transformed cells.

Or

b) Give an account on blue white screening.

11. a) Explain about cDNA libraries.

Or

b) Write about construction of genomic libraries.

12. a) Discuss in detail about components in PCR and PCR conditions

Or

b). Write about the Maxam - Gilberts method of sequence analysis.

13. a) Explain about transgenic plants.

Or

b) Describe about features of HBsAg vaccine.

RCLSSD 12/7/2017