KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY

OUTLINES OF COURSE STRUCTURE UNDER CBCS, SESSION, 2020-21

Duration of course :- 2 Years spread over 4 semesters		Full Marks – 2400, Total credits-144
Sem : Course/Paper	Course/ Paper Title	(Term end + Int. Assessment With credit)
1. CC – 101	Basic Biotechnology : Cell Biology	80 + 20=6Cr.
CC –102	Basic Biotechnology : Biomolecules-I	80 + 20=6Cr.
CC - 103	Basic Biotechnology : Biomolecules-II & Biostatistics	80 + 20=6Cr
CC – 104	Basic Biotechnology Microbial Physiology & Genetics	80 + 20=6Cr
CC – 105	Basic Biotechnology : Laboratory – 01	100=6Cr
CC – 106	Basic Biotechnology : Laboratory – 02	100=6Cr
	Total Marks(1st Sem)	=600=36Cr
2. CC – 201	Basic Biotechnology : Molecular Biology	80 + 20=6Cr.
CC – 202	Basic Biotechnology : Genetic Engineering	80 + 20=6Cr.
CC – 203	Basic Biotechnology : Plant Biotechnology	80 + 20 =6Cr.
CC– 204	Basic Biotechnology : Animal Biotechnology	80 + 20 =6Cr.
CC – 205	Basic Biotechnology : Laboratory – 03	100=6Cr.
CC – 206	Basic Biotechnology : Laboratory – 04	100 =6Cr.
	Total Marks(2nd Sem)	=600=36Cr
3. CC – 301	Applied Biotechnology : Biology of Immune System	80 + 20=6Cr.
CC – 302	Applied Biotechnology :Bioprocess Engineering &Technology	80 + 20=6Cr.
CC – 303	Applied Biotechnology : Environmental Biotechnology	80 + 20=6Cr.
CC- 304	Applied Biotechnology : Information Technology	80 +20=6Cr.
CC – 305	Applied Biotechnology : Laboratory – 05	100=6Cr.
CC– 306	Applied Biotechnology : Laboratory – 06	100 =6Cr.
	Total Marks(3rd Sem)	=600=36Cr
4. CC – 403	Project	400=24 Cr
CC– 404	Students' Seminar	200=12Cr
	Total Marks(4th Sem)	= 600= 36Cr

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – I
CC- 101 : BASIC BIOTECHNOLOGY: CELL BIOLOGY

Unit I. Cell and Its Organelles I

Cell : Structural organisation of the plant and animal cell: **Cell wall**: Structure and function: Biogenesis and Growth: **Plasma membrane**: Structure, latest models and functions: **Chloroplast**: Structure and PSI and PSII Genome organisation: **Mitochondria**: Structure: Genome organization and formations.

Unit II. Cell and its Organelles II

Endoplasmic Reticulum and Golgi bodies: Structure and function. **Lysosomes:** Structure and function, **Micro bodies** (Peroxisomes. Glyoxysomes. Spherosomes): Structure and function, **Ribosomes**: Structure: **Nucleus**: Structure, Nuclear membranes, Nuclear pores, nucleosome organization and P- bodies, role of microtubules and microfilaments, **Cell Division:** Stages and Molecular events.

Unit III. Cellular Functions

Cell membrane transport: Location of ATPases, ion carriers, channels, pumps and receptors in the plasma membrane: Mechanism of transport of nutrients ions and macromolecules across the membrane, **Cellular response**: Mechanism of signal transduction: **Cellular metabolism**: Brief idea on different metabolite pathways in the cell and the mechanism of their regulation.

Unit IV. Cell cycle and Biology of Cancer

Cell Cycle: Molecular events, models, systems and control mechanisms. Role of cyclins and cyclin dependant kinases. **Apoptosis** : Mechanism of programmed cell death; **Biology of cancer**: A generalized account of the Biology of cancer, Structure, function and mechanism of Prb and P53 tumor suppressor protein, Mutation and Mutagenesis, Ames test for Mutagenesis.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY

SEMESTER – I
CC- 102 : BASIC BIOTECHNOLGY: BIOMOLECULES-I

Unit I **Chemical Foundations of Biology:**

Chemical Bonds: Covalent and weak bonds and their role in living systems. **Principles of thermodynamics**: Laws of thermodynamics: Enthalpy: Entropy: Concept of free energy: Standard change in free energy: Determination in standard change in free energy: Properties and factors affecting free energy: **ATP**: Versatility of ATP and its Biological importance. **Redox potential:** Redox potential and its role in understanding biological reactions, **Water**: Structure, properties and ionisation: **pH**: lonisation of water: Derivation of expressions for pH and poH: pH scale: pKa: Conjugate lonisation of weak acids and bases.

Unit II **Carbohydrates:**

Classification of Carbohydrates: **Monosaccharides**:
Aldoses and Ketoses: Stereoisomerism: Different formulae used to express the structures of monosaccharides: Cyanohydrin synthesis: Detailed structure of Glucose and structures of other monosaccharides: Important properties of monosaccharides: Biological importance **Oilgosaccharides**: Structure: Properties: Biological importance: **Polysaccharides**: Classification: Structure: Properties: Biological importance.

Unit III **Amino acids and Proteins:**

Amino acids: General Structure: Classification: Properties: **Peptides**: Peptide bond- its nature and formation: **Oilgopeptides**-their Biological importance, **Proteins:** Details of Primary, Secondary, Tertiary, and Quaternary structure of proteins with examples and the relation between their structure and stability, **Ramachandran plot**: Steric hindrances, limitations and Ramachandran angles. **Fibrous and globular proteins**: Structure of some important Fibrous and globular proteins.

Unit IV **Lipids: Secondary metabolites: Nucleic acids:**

Lipids: Fatty acids: structure and nomenclature: **Glycerides**: Formation, structure, distribution and Biological role of mono, di and triglycerides: **Lipoproteins**: Structure and Biological importance: Glyceryl ethers, Terpenoids, Sterols: General idea: Role of lipids as Signals. Cofactors and Pigments: **Secondary metabolites**: General idea on pigments and isoprenoids: **Nucleic acids**: Sugar: Nitrogenous bases: Phosphate: Nucleosides: Nucleotides: **DNA**: Structure: Three dimensional forms: Function: **RNA**: Types: Structure and functions.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY

SEMESTER – I

CC-103 BASIC BIOTECHNOLGY: BIOMOLECULE-II & BIOSTATISTICS

Unit. I Physical and Analytical Techniques in Biology :

Spectrophotometry, Beer-Lambert's Law, Physical techniques in protein, nucleic acid and polysaccharide structural analysis: **UV, IR, NMR, LASER and RAMAN** spectroscopy; Mass spectroscopy. **Chromatography:** Paper, Thin layer, ion exchange, Adsorption: Exclusion. Affinity, GLC, HPLC methods and their utility in Biochemistry: **Electrophoresis:** Paper, Starch Gel. Cellulose Acetate. Ploy acrylamide. SDS-plolyacrylamide. Agarose. Idea on tube gel, slab gel, submarine, gradient gel and two dimensional electrophoresis, Isoelectric focusing: Electroblotting: Electroelution: Electroporation: **Centrifugation**: Principles of centrifugation, Normal, Ultra, Refrigerated, Differential, Density gradient methods of centrifugation and their utility in Biochemistry.

Unit. II Polypeptides, Polynucleotides and Enzymes:

Theoretical and experimental analysis: Secondary and tertiary structural features of Polypeptides and Polynucleotides, **Protein folding:** Biophysical and Cellular aspects, **Immobilization:** Immobilization of small and macromolecules inside the cell and methods of immobilization outside the cell (*invitro)*. **Enzyme action:** Mechanism of Enzyme action with chymotrypsin as an example), Regulatory and active sites; **Equations:** Michaelis-Menten equation and its significance; Line weaver-Burk equation; **Enzyme inhibition and kinetics:** allosteric mechanism, Isozymes.

Unit. III Sequencing, Denaturation, Hybridization and Ligand Interactions :

Sequencing: proteins and nucleic acids; **Denaturation:** Protein and nucleic acid; **Nucleic acid hybridization** – structural analysis and Biological studies; **Ligand interactions:** protein-protein and protein-ligand interaactions; examples from the cellular organization, **Structural arrangements:** Membranes, ribosomes, extracelluar matrix, chromatin.

Unit. IV Biostatistics:

Statistical measurements of mean, mode, median, standard deviation, SEM and variance of discrete and grouped data, probability, correlation and regression analysis.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – I
CC-104 : BASIC BIOTECHNOLGY: MICROBIAL PHYSIOLOGY AND GENETICS

Unit. I Microbial culture and Genetic system:

Methods in Microbial culture: Pure Culture techniques: Theory and practice of sterilization; Principles of microbial nutrition; Construction of culture media: Enrichment culture techniques for isolation of chemoautotrophs: **Bacterial Cell wall**: Gram stain, Flagella and motility. **Bacterial genetic system:** Transformation, conjugation, transduction and recombination. Bacterial genetic map reference to E.Coli. **Viruses**: Discovery and structure of viruses; Bacterial, Plant, Animal and Tumor viruses: **DNA viruses:** Positive strand, Negative strand and Double stranded RNA viruses, **Viroids and Prions**, Viral Genetics System, Plasmid, transposans. Genetic map of *E coli*

Unit. II Microbial taxonomy

Microbial Evolution: Primitive organisms and their metabolic strategies and molecular coding: **Classification of Microbes**: An overall idea on microbial classification; **Taxonomy of Bacteria:** New approaches to bacteria taxonomy classification including ribotyping: Ribosomal RNA sequencing, **Taxonomy of Virus**: Principles of viral classification: Mycobacteria, Rickettsias, Mycoplasma, Methanogens, Hypothermophilic arehaea: Thermoplasma: **Yeast Genetics.**

Unit. III Microbial Growth and Metabolism: -

Microbial Growth: Mathematical expression of growth; **Growth curve**; Measurement of growth and growth yields; Synchronous growth; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; **Microbial metabolism**: An overview of microbial nutrition and metabolism: Bactetrial photosynthesis; Chemolithotrophy; Hydrogen-iron-~~nitrite~~-oxidising bacteria; Nitrogen and sulphur reducing bacteria. **Methanogenesis and acetogenies:** Fermentations-diversity: Role of anoxic decomposer, **Nitrogen metabolism:** Nitrogen fixation & Hydrocarbon transformation in microbes.

Unit. IV Microbial Pathology: -

Host-Parasite Relationship: Normal micro flora of skin, oral cavity, gastrointestinal tract; Entry of pathogens into the host; Colonization and factors predisposing to infections, types of toxin (Exo, Endo, Entero) and their structure. Mode of actions: Virulence and Pathogenesis. **Food and water borne diseases**: Pathogenic fungal, Emerging and resurgent infectious diseases: **Transmission of infectious diseases:** Transmission of respiratory infections: Tuberculosis; STD including AIDS, Hepatitis; Diseases transmitted by animals (rabies, plague): insects and ticks (rickettsias, Lyme, Disease, malaria). **Chemotherapy/Antibiotics**: Antimicrobial agents, Sulfa drugs, Antibiotics: Penicillins and Cephalosporins.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – II
CC-201 : BASIC BIOTECHNOLGY: MOLECULAR BIOLOGY

Unit. I DNA Replication, Recombination and Repair:

Mechanism of DNA replication: Enzymes and accessory proteins involved in DNA replication; **Molecular mechanism of recombination;** Holiday junction; Gene targeting; Gene disruption; Cre/Lox recombination; Rec A and other recombinases**; DNA repair**- various mechanisms of DNA repair.

Unit. II Transcription and Post-transcriptional Changes in RNA:

Transcription process: RNA polymerase, General and specific transcription factors; Regulatory elements and mechanism of transcription regulation; 5' cap formation. Transcription termination 3' end processing and polyadenylation, **Splicing:** Brief description of mechanism of splicing, Inhibition of splicing**, Export of MRNA:** Editing nuclear export of mRNA; mRNA stability.

Unit. III Translation and Protein Localization:

Translation Process: Translation machinery ; Mechanism of initiation, elongation and termination; Regulation of translation; **Co-and post-translational modifications:** Mechanism and modifications of proteins; **protein import:** import into nucleus, mitochondria, chloroplast and peroxisome ; **Receptor mediated endocytosis**: Mechanism, **Antisense Ribozyme Technology**: Biochemistry of ribozyme; Hammer-head, hairpin and other ribozymes; Applications of antisense and ribozyme technologies.

Unit. IV Molecular Mapping of Genome and Genome Sequencing :

Mapping: General idea on Chromosomal mapping and physical mapping, map-based cloning; Choice of mapping population; **Strategies for sequencing genome:** Contigs, VNTRs, FISH Method, RFLP, RAPD and AFLP analysis, **Molecular markers:** Their linkage to disease resistance genes; RFLP and its application as marker, **Genomic libraries**: Methods of their preparation, YAC, BAC libraries.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR

M.SC. BIOTECHNOLOGY

SEMESTER – II

CC- 202: Genetic Engineering

Unit. I **Molecular Tools :**

Enzymes: Restriction endonucleases, Ligases, Reverse transcriptase, Terminal transferse, poly A polymerase, DNA polymerase I&III, Thermophilic polymerases, T4 Polynucleotide kinase, Alkaline phosphatase, RNases (RNase A/RNase H), S1 Nuclease, Proteinase K, Lysozyme, Uracil DNA glycosylase; **Oligonucleotides:** Linkers, Adaptors and Primers their role in Genetic Engineering**, Probes:** DNA and RNA probes preparation, labeling and amplification; **Vectors:** Plasmids, Phages, Cosmids, Phagemids, BAC, PAC, MAC, YAC and Transposons; **Expression:** Shuttle and Binary vectors; Gene cartridges, **Expression strategies for heterologous genes**: Vector engineering and codon optimization, host engineering. Expression in bacteria and yeast.

Unit. II Isolation, sequencing, synthesis and amplification of desired genes / DNA :

DNA: Isolation, purification and yield analysis; **Isolation of Genes**: Isolation methods for genes coding for RNAs, specific/tissue specific proteins and unknown proteins; **Gene sequencing**: Automated sequencing, PCR/Microarray/ Mass spectrometry based sequencing; **Gene synthesis:** Methods of gene synthesis, Gene amplification; **PCR technology:** Principle and its application; **Types:** Basic, Inverse, Anchored, Asymmetric and RT ; **Gene tagging:** T-DNA and transposon tagging in identification and isolation of genes, DNA Transfection.

Unit. III **Cloning Strategies :**

Cloning genomic DNA: General principle of genomic DNA cloning including m-RNA enrichment; Genomic DNA libraries, Northern blotting, use of ג phage and high capacity vectors for cloning, PCR as an alternative for genomic DNA cloning, subgenomic libraries; Alternative strategies of gene cloning: Cloning interacting genes- Two and three hybrid systems; Cloning differentially expressed genes, Nucleic acid microarray assay, Study of gene regulation **:** Primer Extension, SI mapping, Rnase protection assay.

Unit. IV **Trans-genes and gene products**

Site directed mutagenesis : Procedures of directed mutagenesis – Oligonucleotide directed mutagenesis with M13 Phage and Plasmid, PCR-amplified oligonucleotide directed mutagenesis, Random mutagenesis with degenerate oligonucleotide and nitrogenous base analogs, **Display of Selected Mutants**: Phage and Phasmid display of selected mutants, ***in vivo*** **mutagenesis:** Procedure with an example. **Gene product (Protein) engineering:** Increasing enzyme activity, Modifying enzyme specificity, Addition of disulfide linkages, Reduction of sulphyhydryl groups, Changing amino acids; **Processing of recombinant proteins:** Purification, refolding, characterization and stabilization, **Targeted gene:** Gene augmentation and Gene silencing.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR

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SEMESTER – II

CC- 203: Plant Biotechnology

Unit. I **Plant Tissue Culture - I :**

Introduction: Tissue culture laboratory: Culture room, Equipments and Glasswares, Culture media (Composition and preparation); **Techniques:** Sterilization, Maintenance of aseptic conditions; Methods of incubation. Totipotency, cyto differentiation and organogenesis and their significance in plant tissue culture. **Protoplast:** Isolation and culture; protoplast fusion; Techniques and mechanism, hybrid types and their identification and isolation.

Unit. II **Plant Tissue Culture - II :**

Callus, Cell suspension and Single cell Culture : Principles, types, various protocols, factors involved, application; shoot and root regeneration; **Somatic embryogenesis;** Artificial seed; **Organ culture:** Principles, protocols and applications of anther, pollen, ovary, ovule, root culture; Characteristics and Importance of haploids and homozygous lines; **Meristem culture**: shoot tip culture and production of virus free plants; **Embryo culture:** Types, methods and embryo rescue, **Cybrids:** Somatic hybridization: somaclonal variations and its importance; Slow growth culture and cryopreservation, **Applications of plant tissue culture**

Unit. III **Plant Transformation Technology - I :**

General Principles of gene transfer: Vectors mediated gene transfer: **Plasmid vectors:** Agrobacterium-mediation : Basis of tumor formation: Hairy root: Features of Ti and Ri plasmids: Mechanism of Agrobacterium based gene transfer, Role of virulence genes Agroinfection: use of 35S and other promoters; Use of reporter genes and reporter genes with introns as genetic marker and use of scaffold attachment regions, **Viral vectors**: Multiple gene transfer, **Methods of gene transfer**: Physical delivery, Chemical mediated and direct uptake, **Transgene:** Confirmation of integrity, Inheitance and Stability, **Transformation:** Chloroplast and mitochnodrial transformation: Problems of plant gene transfer.

Unit. IV **Plant Transformation Technology - II :**

Applications of plant transformation technology: (i) Herbicide resistance: Phoshoionothicin, glyphosphate, **(ii) Insect resistance:** Bt genes, importance and role of **Cry** genes and **Cry** proteins: **(iii) Viral resistance:** coat protein mediated, nucleocapsid gene; **(iv) disease resistance:** chitinase, glucanase Antifungal proteins: thioneine, and PR proteins, **(v) Abiotic stress resistance: (vi) Plant secondary metabolites**: Control mechanism and manipulation of phenylproanoid pathway, shikimate pathway; Antibodies; Edible vaccines; **(vii)Molecular marker based Breeding:** RFLP, AFLP, RAPD, SCAR, SCCP, QTL and Microsatellite based cloning and molecular marker assisted selection.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY

SEMESTER – II
CC-204: Basic Biotechnology: Animal Cell Science and Technology.

Unit. I **Animal Cell Culture :**

Animal cell Culture: Equipment and materials for animal cell culture technology; **Cell line cultures:** Primary and established cell line cultures, **Culture Medium:** Introduction to balanced salt solutions and simple growth medium; Chemical, physical and metabolic functions of different constituents of culture medium; **Additional Constituents:** Role of carbon dioxide; Role of serum and supplements; Serum and protein defined media and their application.

Unit. II **Culture Techniques and Related Phenomena:**

Basic Techniques of mammalian cell culture *invitro*: Disaggregation of tissue and primary culture: Maintenance of cell culture: Cell separation: Scaling-Up of animal cell culture. Cell synchronization; Cell cloning and micromanipulation; cell transformation; Somatic cell genetics; Organ and Histotypic culture; Measurement of cell death; Apoptosis.

Unit. III **Applied Animal Cell Culture:**

Animal Cell Culture: General applications; **Stem-cell culture:** Stem cell and embryonic stem cell culture and their applications; **Cell culture:** Preparation of vaccines; **Three dimensional culture**: Applications; **Tissue engineering:** applications.

Unit. IV **Bioethics:**

Ethical Problem: Biotechnological advancements and related ethical problems, **Intellectual property right (IPR) and Intellectual property protection (IPP)**: Type of IPP: Patents, copyrights, trademarks and trade secrets, Patenting life forms, patenting Genes and DNA sequences, Farmers' rights.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
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SEMESTER – III

CC-301: Applied Biotechnology: Biology of the Immune System.

Unit. I **Introduction:**

Phylogeny of immune system: Innate and acquired immunity; Clonal nature of immune response; Organization and structure of lymphoid organs; Nature and Biology of antigens and super antigens; **Antibody structure and function:** Antigen-antibody interactions; Major histo-compatibility complex; BCR and TCR: Generation of diversity; Complement system.

Unit. II **Immune System :**

Hematopoiesis and differentiation: Lymphocyte trafficking; B and T-lymphocytes; Macrophages; Dendritic cells; Natural killer and lymphokine activated killer cells; Esonophils, neutrophils and mast cells, **Mechanism of T cell and NK cell mediated lysis"** Antibody dependent cell mediated cytotoxicity, Macrophage mediated cytotoxicity.

Unit. III **Cell Mediated Cytotoxicity; Hypersensitivity; Autoimmunity**

Antigen processing and presentation: Generation of humoral and cell mediated immune responses; Activation of B- and T- lymphocytes; **Cytokines and their role in immune regulation:** T-cell regulation, MHC restriction; Immunological tolerance; **General aspects and mechanism:** Hypersensitivity and autoimmunity.

Unit. IV **Applied Immunology :**

Transplantation: immunity to infectious agents like intracelluar parasites, helminthes and viruses; **Tumor immunology**; AIDS and other immune deficiencies: Hybridoma technology and monoclonal antibodies.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
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SEMESTER – III
CC-302: Bioprocess Engineering and Technology.

Unit. I **Introduction :**

Bioreactor: General Features; Isolation, preservation and maintenance of industrial microorganisms; **Kinetics of microbial growth and death**; Media and industrial fermentation; Air and media sterilization. **Types of fermentation processes**: Analysis of batch, fed-batch and continuous Bioreactors; Stability of microbial reactors; Mixed microbial populations; **Specialized Bioreactors**: pulsed, fluidize, photo bioreactors etc; **Bioprocess parameters:** Measurement and control and scale up.

Unit. II **Downstream Processing :**

Introduction: General idea on downstream processing, **Processing procedure**: Removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, **Chromatography:** Role of Chromatography in downstream processing, **Purification of the Product:** Membrane process (Dialysis); Drying and crystallization.

Unit. III **Industrial Production of Chemicals :**

Whole cell immobilization: Methods of whole cell immobilization and its applications in industries, **Industrial production of chemicals:** Alcohol (ethanol), Acids (citric acid and gluconic acid) solvents (glycerol, acetone, butanol), Antibiotics(penicillin, streptomycin, tetracycline), Amino acids (Lysine, glutamic acid), **Single cell protein(SCP)**: Production of single cell protein.

Unit. IV **Food Technology :**

Canning and packing: Elementary idea of canning and packing; **Sterilization and pasteurization:** Procedures employed for Sterilization and pasteurization of food products; **Technology:** Production of typical food/ food products (bread, Cheese, Idli), **Food preservation**: Techniques of food preservation.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR

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SEMESTER – III

CC-303: Environmental Biotechnology

Unit. I : Environment :

Introduction: Definition and basic concepts, Environmental components; Global environmental problems; Environmental priorities; **Man and environment:** Interrelationship and man made environment destruction, **Environmental management:** Methodology, problem solving approach and its limitations.

Unit. II : Environmental Pollution: Air Pollution:

Air Pollution: Methods of measurement; Sources of air pollution, Effects on men, vegetation and materials; Monitoring techniques, control through Biotechnology; **Air pollution and Ozone depletion**: Role of air pollution in ozone depletion and Biotechnological remedial measures, **UV-B, Green house effect and Acid rain**: their impact and Biotechnological approaches for management.

Unit. III : Environmental Pollution: Water Pollution:

Water Pollution: Water as a scarce natural resource; Need for water management; Sources of water pollution; Waste water collection; Measurement of water pollution; **Effluent:** General idea on Industrial effluents and water pollution, **Treatment:** D.O.C. and C.O.D. methods and disposal of effluents, **Degradation of**: hydrocarbons, Oil pollutants, surfactants, pesticides; **Bio pesticides:** Role of Bio pesticides in integrated pest management.

Unit. IV: Waste Treatment:

Methods of waste water treatment: Aerobic process: Oxidation pond, activate sludge, trickling filter, towers rotating disc and drums; **Anaerobic process:** Anaerobic digestion, filters, up flow, anaerobic sludge, blanket reactors; **Treatment schemes for waste waters:** dairy, distillery, tannery, sugar, antibiotic industries; **Methods of Solid wastes Treatment:** Sources and management (composting, worm culture and methane production), **Microbial degradation**: Microbiology of degradation of xenobiotic in the environment, ecological considerations, decay and behavior of degradative plasmids.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – III

CC-304: Information Technology & Bioinformatics

Unit. I Anatomy of a digital Computer:

Working principle of different peripheral devices, low level and high level languages, language translators,, difference between compiler and translators, binary number system & conversion to decimal number system, Flow charting & writing of algorithm.

Unit. II Structure of c program:

Operators, Data types, if else statement, nested if, SWITCH, FOR, DO, WHILE statements, concept of arrays (ID 2D) library functions, user defined functions.
Data structure memory representations, insertion and deletion operation on STACK & QUEUE simple query using SQL, DDL, DML &DCL.

Unit. III Introduction to Bioinformatics:

Genome project, life science discovery process, data source in life science, developing and biological data integration system challenges in biological information integration.
Data base management system in bioinformatics: Data base management concept, & definition, data life cycle, steps of data life cycle.

Unit. IV DBMS, Modeling and Simulation:

Data mining: concept & methods, pattern matching, Pair wise sequence alignment, local vs. global alignment, multiple sequence alignment, Dot matrix analysis, substitution matrices.

Modeling and Simulation: Fundamental concepts, continues simulation, discrete simulation, hybrid simulation, Monte Carlo methods, metropolis algorithm. Protein structure: Ab inito method, heuristic method, template selection, alignment, model building & evaluation.

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – I

CC- 105: Biochemistry & Biostatistics Laboratary-01

1. Determination of absorption maxima of dyes.
2. Verification of Beer-Lambert's Law
3. Titration Curves of amino acids and organic acids.
4. Quantitative Estimation of sugar and preparation of standard graph by using Anthrone method.
5. Extraction & Estimation of quantity of sugar by using Nelson Somogyi method.
6. Extraction and estimation of amino acid
7. Extraction and estimation of soluble protein
8. Extraction and estimation of RNA
9. Extraction and estimation of DNA
10. Enzymatic hydrolysis of polysaccharides
11. Extraction assay of Catalase
12. Extraction assay of Peroxidase
13. Co-relation and regression analysis
14. Measurement of Central tendency, and dispersion

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – I

CC-106: Cell Biology, Microbiology & Instrumentation, Laboratary-02

A. Cell Biology

1. Karyotype : Analysis – I
2. Karyotype : Analysis-II
3. Mitotic index
4. Micro metry & Measurement of cell size

B. Microbiology

1. Sterilization of glass-wares & culture media
2. Preparation of Media
3. Serial dilution technique.
4. Isolation of pure culture: Streak plate technique, Spread plate technique, Pour plate technique.
5. Staining of bacteria
6. Test for antibiotic sensitivity by Kirby-Bauer method
7. Determination of minimum inhibitory concentration of antibiotic

C. **Instrumentation :**

1. PH meter
2. Spectro photometry
3. Centrifugation

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – II

CC-205 Molecular Biology, Genetic Engineering, Chromatography Laboratary-03

1. Isolation of DNA from bacteria
2. Isolation of DNA from plants
3. Agarose Gel Electrophoresis of protein
4. Electrophoresis of DNA
5. Cellulose acetate Electrophoresis
6. SDS PAGE
7. PCR Techniques
8. RFLP
9. Ligation of DNA
10. Southern Blotting
11. Western Blotting
12. Paper Chromatography
13. Thin Layer Chromatography
14. Column Chromatography
15. Ion- exchange Chromatography

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – II

CC-206: Plant Biotechnology and Animal Biotechnology Laboratary-04

1. Maintenance of Lab
2. Media preparation
3. Sterilization of Explant and Inoculation
4. Callus Culture
5. Maintenance of culture
6. Culture of sterile plants and buds
7. Culture medium for animal cell culture
8. Adherent and floating cell culture
9. Isolation of lymphocytes
10. Culture of stem cell

KHALLIKOTE AUTONOMOUS COLLEGE, BRAHMAPUR
M.SC. BIOTECHNOLOGY
SEMESTER – III

CC-305: Immunology & Bioprocess Engg. & Environmental Biotechnology Laboratory-05

A) Immunology

1. Radial immunodiffusion
2. Ouchterlony Double diffusion method
3. Redial immunoassay
4. Immuno- electrophoresis
5. Rocket immuno electrophoresis
6. Counter current electrophoresis
7. E LISA test.
8. Blood group Testing

B) Bio-processing

1. Instrumentation and operation of fermentor
2. Media preparation and inoculation

C) Environmental Biotechnology

1. Physical analysis of water
2. Chemical analysis of water (Salinity, Chlorinity, Hardness, N-content)
3. Determination of dissolved oxygen in polluted water
4. Determination of BOD of polluted water

KHALLIKOTE AUTONOMOUS COLLEGE, BRAHMAPUR
M.SC. BIOTECHNOLOGY
SEMESTER – III

CC-306: Information Technology and Bioinformatics
Laboratory-06

INFORMATION TECHNOLOGY

1. C-Programming on variables & Expression of assignments

2. Loops, If else. Case Statement, for, while, do-while

3. Break, Continue go to statement

4. 1-D and 2-D array

5. Simle quary using SQL,DDL, DML,&DCL statement in SQL, data manipulation in SQL

BIOINFORMATICS

1. Retrieval of Nucleotide sequence from data base

2. Pair wise sequence alignment of nucleotide sequence using BLAST n algorithm

3. Dot matrix analysis of two nucleotide sequence

4. Retrieval of protein sequence from data base

5. Pair wise sequence alignment of amino acid sequence using BLAST n algorithm

6. Dot matrix analysis of wo protein sequence

7. Multiple sequence alignment by Clustal W2 in EBI

8. Phylogenetic Analysis using Phylip Software

9. Selection of template, homology modeling using modeler

KHALLIKOTE AUTONOMOUS COLLEGE, BERHAMPUR
M.SC. BIOTECHNOLOGY
SEMESTER – IV

CE-401 PROJECT:

Student has to undertake a Research project in area of Biotechnology in a laboratory With in the state/out side the state as possible for a minimum period of three months and has to submit project thesis after completion with certificate from research guide. It should not involve mere collection of data from any source or training of a technique.

CE- 402 STUDENTS SEMINAR:

Regular week end Seminar presentation and presentation of Seminar related to the topics of Biotechnology/project work will be taken into consideration. Presentation will on MS-ppt.