



Andhra Pradesh State Council of Higher Education  
CBCS syllabus for Undergraduate courses  
S. K. University, Ananthapuramu, Andhra Pradesh

**B.Sc., Biotechnology: Choice based Credit System**

**FOUNDATION COURSES**

**1<sup>st</sup> 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)

**2<sup>nd</sup> Year:**

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

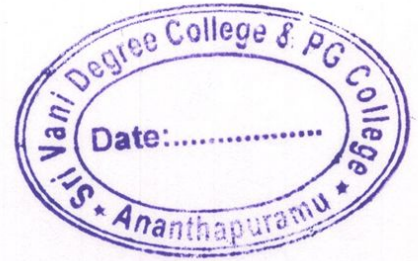
**Semester-IV:** Foundation Course-2C Communication & Soft Skills-3  
Foundation Course- 6 Analytical Skills  
Foundation Course- 7 CE (Citizenship Education)  
Foundation Course- 4 B ICT-2 (Information & Communication Technology)

**3<sup>rd</sup> Year:**

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

  
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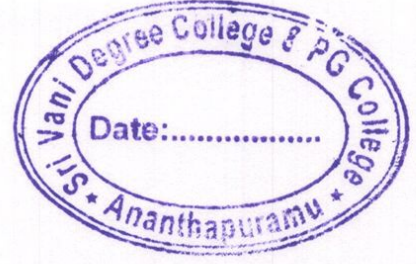
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**SUBJECT EXPERTS**

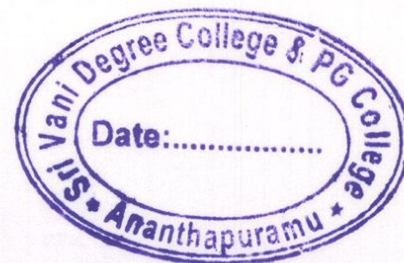
*Dr.M.Ussenaiah*  
Dept of Computer Science,  
Vikrama Simhapuri University

*Dr.A.Kavitha,*  
Govt. Degree College,  
Repalle

**SYLLABUS VETTED BY**

*Dr.Gangadhar,*  
Dept of Computer Science  
Acgharya Nagarjuna University,  
Nagarjuna Nagar

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## B.Sc., SEMESTER I

### BTT- 101 MICROBIOLOGY AND CELL BIOLOGY

#### UNIT I

##### **History, Development and Microscopy**

History and development of microbiology, 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: Gram staining, Acid fast staining, Flagella staining, Endospore staining.

#### UNIT 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, Prokaryotic 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.

**Viruses:** General characteristics of viruses, 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:** Details of growth curve and its various phases. Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat). Physical conditions required for growth: Temperature, pH etc. Pure cultures and cultural characteristics. Preservation of pure culture. Microbial Control: Terminologies/definition - Sterilization, disinfection, antiseptic, sanitization, germicide, microbistasis, preservative and antimicrobial agents. Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), radiation, UV light, electricity, ultrasonic sound waves, filtration. Chemical control: (halogens, alcohol, gaseous sterilization).

#### UNIT V

**Cell Biology:** Brief description about eukaryotic Cell (Plant and animal) - Structure and function of the following: nucleus, nuclear membrane, nucleoplasm, nucleolus, golgi complex, Mitochondria, Chloroplast, endoplasmic reticulum, lysosomes, peroxisomes, glyoxisomes and vacuoles.

  
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### **PRACTICAL:BTP-102 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.**

  
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## B. Sc. SEMESTER II

### BTT- 201 MACROMOLECULES, 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 physical (physical state, taste, solubility, boiling & melting point)-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.

#### UNIT IV

**Enzymes:** Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc. IUB Classification and nomenclature of enzymes. Substrate Specificity (bond specificity, group specificity, absolute specificity, stereospecificity), lock and key and induced fit models. Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of pH 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 monosaccharides and disaccharides, regulation, inhibitors) Gluconeogenesis: Bypass reactions. Structure of mitochondria.

  
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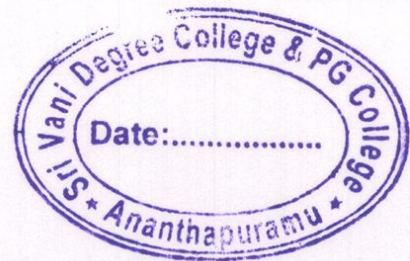
### **PRACTICALS: BTP- 202 MACROMOLECULES & ENZYMOLOGY**

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
12. Effect of temperature/ pH on enzyme activity
13. Assay of protease activity.
14. Assay of alkaline phosphatase
15. Preparation of starch from Potato and its hydrolysis by salivary amylase
16. Isolation of urease and demonstration of its activity

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

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

**UNIT – I:**

**Spectrophotometry:** Spectrum of light, absorption of electromagnetic radiations, Beer's -lambert law - derivation and deviations, extinction coefficient. Instrumentation of UV and visible

Spectrophotometry and applications of UV and visible spectrophotometry. Double beam spectrometer;

**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. Ionexchange 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.

**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), biological and clinical applications of radioisotopes, 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.

**Biostatistics** Basic concepts of mean, median, mode, Standard deviation and Standard error.  
Introduction to ANOVA

  
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**MBP- 301: MICROBIAL BIOCHEMISTRY & METABOLISM**

**TOTAL HOURS: 48**

**CREDITS: 2**

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Aminoacids
3. Colorimetric estimation DNA by diphenylamine method
4. Colorimetric estimation of proteins by Biuret/Lowry method
5. Paper chromatographic separation of sugars and amino acids
6. Preparation of different media- Synthetic and Complex Media
7. Setting and observation of Winogradsky column.
8. Estimation of CFU count by spread plate method/pour plate method.
9. Bacterial growth curve.
10. Factors affecting bacterial growth – pH.
11. Factors affecting bacterial growth – Temperature.
12. Factors affecting bacterial growth –Salts

  
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**B. Sc. SEMESTER IV**  
**BTT-401: IMMUNOLOGY**

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**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  
Antigenicity (factors affecting antigenicity). 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- 402 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. VDRL TEST
9. Determination of RBC count
10. Determination of WBC count
11. Determination of Hb %

  
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Note: - Mandatory to perform atleast 6 practicals

## B. Sc. III –Semester V

BTT- 501: MOLECULAR BIOLOGY

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### Unit I:

**Genome Structure:** Experiments to prove DNA as genetic material (Griffith, Ostwald Avery, Mc Leard & Mc Carthy Experiment and Hershey- Chase experiment), Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size. Gene, Chromosome and Genome. Definition of mutation, types of mutations and brief introduction about physical and chemical mutagens.

### Unit II

**DNA Replication:** Enzymology of prokaryotic 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. DNA damage and repair (Excesion, mismatch repair and SOS repair). Inhibitors of DNA replication.

### 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, 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 t-RNA, the adaptor hypothesis, attachment of amino acids to t-RNA. Codon-anticodon interaction – the wobble hypothesis. Initiation, elongation, termination of protein and few examples of inhibitors.


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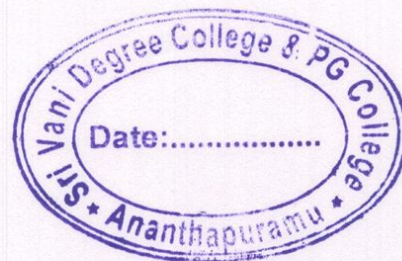


**PRACTICALS BTP: 502-MOLECULAR BIOLOGY**

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
11. Comic test

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## B. Sc. III – Semester V

### BTT- 503: RECOMBINENT DNA TECHNOLOGY (r-DNA)

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#### 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 Southern, Northern and Western blotting.

#### 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, antibiotic resistance and blue white screening)

#### Unit III:

**Cloning vehicles** – Plasmid (pBR 322, pUC), Bacteriophage, Construction of genomic and cDNA libraries. Advantages of cDNA libraries.

#### Unit IV.

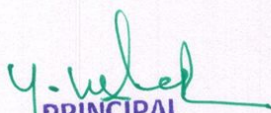
**Methods of gene sequencing** – Maxam - Gilberts and Sanger's dideoxy chain termination methods; Polymerase chain reaction technique (Components in PCR and PCR conditions)

#### 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 e.g., Bt- cotton) Medicine (production of Insulin, Growth hormone, Tissue plasminogen activator and HBsAg vaccine)


  
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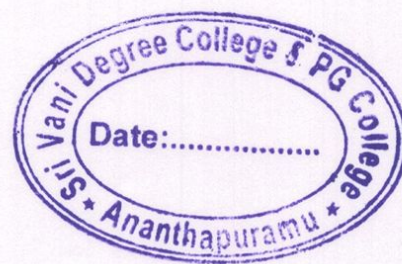


### PRACTICALS BTP 504: rDNA TECHNOLOGY

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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
8. Determination of DNA molecular weight by agarose gel electrophoresis
9. Recovery of DNA fragments from agarose gel

  
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**B.Sc MICROBIOLOGY (CBCS) SYLLABUS  
THIRD YEAR – SEMESTER- VI**

**MBT- 601A MICROBIAL BIOTECHNOLOGY**

**TOTAL HOURS: 36**

**CREDITS: 3**

**UNIT- I**

**No. of Hours: 8**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.  
Genetically engineered microbes for industrial application: Bacteria and yeast

**UNIT- II**

**No. of Hours: 7**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine).  
Microbial polysaccharides, polyesters and bioplastics.  
Microbial production of bio-pesticides  
Microbial biosensors

**UNIT- III**

**No. of Hours: 10**

Microbial based transformation of steroids and sterols.  
Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.  
Immobilization methods and their application: Whole cell immobilization

**UNIT- IV**

**Hours: 7**

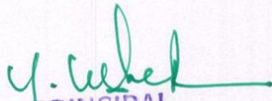
**No. of**

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass.  
Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics.  
Mineral recovery, removal of heavy metals from aqueous effluents.

**UNIT- V**

**No. of Hours: 4**

Outlines of Intellectual Property Rights: Patents, Copyrights, Trademarks

  
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**MBP- 601A MICROBIAL BIOTECHNOLOGY**

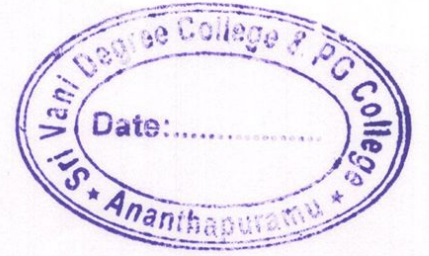
**TOTAL HOURS: 36**

**CREDITS: 2**

1. Yeast cell immobilization in calcium alginate gels
2. Enzyme immobilization by sodium alginate method
3. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

  
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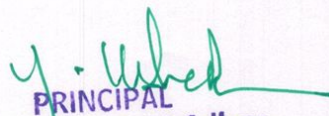




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B.Sc., Biotechnology Course Structure for the Academic year 2020-21

Semester	Title of the paper
I	Bio-molecules & Analytical Techniques
II	Microbiology, Cell & Molecular Biology
III	Immunology & r-DNA technology
IV	i Plant & Animal Biotechnology
	ii Environmental & Industrial Biotechnology

  
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**B.Sc., Biotechnology: Choice based credit system**

**B.Sc., I Semester W.E.F. 2020-21**



### **BT-101: Bio-molecules & Analytical Techniques**

**Course Objectives:** To ensure students gain knowledge about the structure, properties and functions of biomolecules and characterization of biomolecules using analytical techniques.

#### **Unit-I-Carbohydrates, Protein and Lipids**

Classification, structure, properties of carbohydrates. Classification, structure and properties of amino acids, peptide bond and peptides. Classification, structure (primary, secondary, tertiary, quaternary) and functions of proteins. Denaturation and renaturation of proteins. Classification structure and properties of saturated and unsaturated fatty acids. Structure and functions of glycolipids, phospholipids, and cholesterol.

#### **Unit-II- Nucleic acid, Vitamins and Bioenergetics**

Structure and functions of DNA and RNA. Source, structure, biological role and deficiency manifestation of vitamin A, B, C, D, E and K. Free energy, entropy, enthalpy and redox potential. High energy compounds, Glycolysis, TCA cycle, Electron-Transport System and Oxidative Phosphorylation.

#### **Unit-III-Centrifugation, Chromatography and Electrophoresis**

Basic principles of sedimentation and types of centrifugations. Principle, instrumentation and application of partition, absorption, paper, TLC, ion exchange, gel permeation, affinity chromatography. Introduction to HPLC, GCMS and LCMS. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

#### **Unit - IV-Spectroscopy, Microscopy and Laser Techniques**

Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric calorimeter and UV-visible spectrophotometer. Introduction to crystallography and application. Types and design of microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM). Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography).

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## Unit –V- Biostatistics

Mean, median, mode, standard deviation, One-way Anova, Two-way Anova, t-test, F-test and chi-square.

### List of Practicals:-

1. Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2. Calculation of molarity, normality and molecular weight of compounds.
3. Qualitative analysis of carbohydrates (sugars)
4. Quantitative analysis of carbohydrates
5. Quantitative estimation of protein - Lowery method
6. Estimation of DNA by diphenylamine reagent
7. Estimation of RNA by orcinol reagent
8. Assay of protease activity
9. Preparation of starch from potato and its hydrolyze by salivary amylase
10. Preparation of standard buffer and pH determination
11. Separation of amino acids by paper chromatography
12. Separation of lipids of TLC
13. Agarose gel electrophoresis
14. Calculation of mean, median and mode

### Textbooks for Biomolecules and Analytical Techniques

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffery Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H. Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA
5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H. Freeman and Company, NY
6. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu. Pvt.Ltd. New Delhi, India
7. Biochemical Methods, 1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
8. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
9. Proteins: biotechnology and biochemistry, 1<sup>st</sup> edition, (2001), Gary Walsch; Wiley, USA
10. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
11. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath

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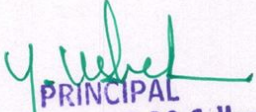
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12. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
13. Analytical Biochemistry, 3<sup>rd</sup> edition, (1998), David Holmes, H. Peck, Prentice-Hall, UK
14. Introductory Biostatistics, 1<sup>st</sup> edition, (2003), Chap T. Le; John Wiley, USA.
15. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
16. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press

  
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**B.Sc., -II Semester W.E.F. 2020-21**



### **BT-201: Microbiology, Cell and Molecular Biology**

**Course Objectives:** To acquaint students with concepts of microbiology, cell and molecular biology. This course is aimed to give an understanding of the basics of microbiology, dealing types of microbes, classification and their characterization, structure and function of prokaryotic and eukaryotic cell organelles, cell division and basics of molecular biology including DNA replication, transcription, translation and regulation of gene expression.

#### **Unit-I- Scope and Techniques of Microbiology**

History and contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming. Ultrastructure of bacteria and growth curve. Pure culture techniques. Sterilization techniques, principles and application of physical methods (autoclave, hot air oven, incineration), chemical methods and radiation methods. Simple, gram and acid-fast staining.

#### **Unit-II-Microbial Taxonomy and Metabolism**

Concepts of microbial species and strains. Classification of bacteria based on morphology, nutrition and environment. General characteristics, transmission and cultivation of viruses. Structure and properties of plant (tobacco mosaic virus, TMV), animal (Newcastle disease virus, NDV), human (Human immunodeficiency virus, HIV) and bacterial viruses (T4 phage). Emerging and reemerging viruses (dengue virus), zoonotic viruses (rabies, SARS-CoV-2). Microbial production of penicillin. Bacterial toxins, tuberculosis, typhoid. Introduction to fungi, algae and mycoplasma.

#### **Unit-III- Cell Structure and Functions**

Structure, properties and functions of cellular organelles (E.R, Golgibodies, Mitochondria, Ribosomes and Vacuoles) of eukaryotic cells. Cell cycle and cell division (mitosis and meiosis). Chemical composition and dynamic nature of the membrane, cell signaling and communication, endocytic pathways.

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#### **Unit-IV- DNA Replication, Repair and Regulation of Gene Expression**

DNA replication in prokaryotes and eukaryotes (semiconservative, dispersive, conservative, uni and bi-direction, rolling circle). Mechanism of DNA replication, enzymes and protein involved in DNA replication. DNA damage and repair. Regulation of gene expression in prokaryotes Lac and Trip operon concept.

#### **Unit – V - Central Dogma of Molecular Biology**

Genome organization of prokaryotic and eukaryotic organisms. Genetic code, prokaryotic and eukaryotic transcription, enzymes involved in transcription. Post-transcriptional modification (Capping Poly adenylation) and splicing.


Translation: mechanism of translation in prokaryotic and eukaryotic cells (initiation, elongation, termination). Post-translational modification (glycosylation and phosphorylation).

#### **List of Practicals:-**

1. Cleaning and preparation of glassware
2. Preparation of nutrient agar medium for bacteria
3. Preparation of PDA medium for fungi
4. Sterilization techniques (autoclave, hot air oven, filter)
5. Isolation of bacteria from soil
6. Simple staining technique
7. Differential staining technique
8. Microbial counting by Haemocytometer
9. Identification of different bacteria
10. Motility test by hanging drop
11. Biochemical identification of bacteria
12. Preparation of pure culture by slab, slant, streak culture
13. Study of stages of mitotic cell division
14. Study of stages of meiotic cell division
15. Isolation of chloroplast
16. Extraction and isolation of DNA from bacteria.

#### **Textbooks for Microbiology, Cell and Molecular Biology**

1. Microbiology–6th Edition, (2006), Pelczar M.J., Chan E.C.S., Krieg N.R.; The McGrawHill Companies Inc. NY
2. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton; McGrawHill Science Engineering, USA
3. Textbook of Microbiology, Anantnarayan and Paniker (2017)

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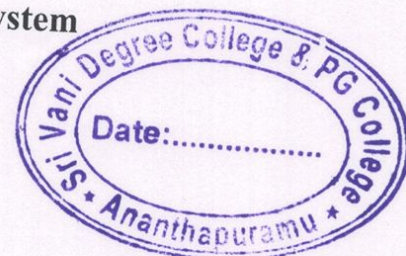
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5. Genes XI, 11th edition, (2012), Benjamin Lewin; Publisher - Jones and Barlett Inc. USA
6. Molecular Biology of the Gene, 6th Edition, (2008), James D. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.; Cold Spring Harbour Lab. Press, Pearson Pub.
7. Molecular Biology, 5th Edition, (2011), Weaver R.; McGraw Hill Science. USA
8. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi; Oxford University Press.
9. Molecular Biology: Genes to Proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA.
10. Cell and Molecular Biology: Concepts and Experiments, 6th Edition, Karp, G. 2010.; John Wiley & Sons. Inc.
11. Cell and Molecular Biology, 8th edition. De Robertis, E.D.P. and De Robertis, E.M.F. 2006; Lippincott Williams and Wilkins, Philadelphia.
12. Cell Biology, (2017), De Robertis & De Robertis, Blaze Publishers & Distributors Pvt. Ltd.
13. The Cell: A Molecular Approach. 5th edition. Cooper, G.M. and Hausman, R.E. 2009. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
14. The World of the Cell, 7<sup>th</sup> edition, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 Pearson Benjamin Cummings Publishing, San Francisco.
15. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
16. P. Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
17. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
18. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by Ron Jon Publishing. Incorporated.
19. Gunasekaran, P. 2009. Laboratory Manual in Microbiology. 1st Edition. New Age International Publishers.
20. Dr. T. Sundararaj. Microbiology Laboratory Manual. 2005. Dr.A.L. MPGIBMS, University of Madras, Taramani, Chennai - 600 113.
21. James G. Cappuccino and Natalie Sherman. 2013. Microbiology: A Laboratory Manual. 10th Edition. Benjamin Cummings.
22. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
23. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Narosa Publishing House.

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**B.Sc., -III- Semester W.E.F. 2020-21**



**BT-301: Immunology and rDNA technology**

**Course Objectives:** To acquaint students with concepts of immunology and recombinant DNA technology. This course is aimed to give an understanding of the basics of immunology dealing cells and organs of the immune system, types of immune responses, antigen-antibody interactions, vaccines and tools, techniques and strategies and applications of genetic engineering.

**Unit- I –Concepts, Cells and Organs of the Immune System**

Terminology, antigen, hapten, antibody (types), antigenicity, immunogenicity and types of immunity. Innate and adaptive immunity. Hematopoiesis, organs, tissues, cells and mediators of the immune system (primary and secondary lymphoid organs, lymphocytes and cytokines). Introduction to complement components, MHC. Basic concepts of humoral and cell-mediated immune response.

**Unit-II-Vaccinology and Clinical Immunology**

Live, killed, attenuated, subunit and recombinant vaccines. Role and properties of adjuvants. Hybridoma technology, monoclonal antibodies and their application in immunodiagnosis. Antigen and antibody interactions - precipitation, agglutination, immune diffusion and ELISA. Introduction to hypersensitivity and autoimmunity.

**Unit-III –Introduction, Tools and Techniques of rDNA Technology**

Introduction to rDNA technology, steps involved in cloning, tools of genetic engineering (Genes, Cloning vectors - plasmids and cosmids, Enzymes – restriction endonucleases and DNA Ligase, Hosts – bacteria and yeast). Principles and application of PCR. Southern, Northern and Western Blotting. Introduction to DNA sequencing (Sanger Sequencing) and Site-directed Mutagenesis.

**Unit-IV-Cloning Strategies and Application of rDNA Technology**

cDNA library, construction, methods of transformation, recombinant selection and screening methods. Applications of rDNA technology in agriculture (transgenic plants, edible vaccines and antibodies) and medicine (disease diagnosis and DNA fingerprinting).

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## Unit-V-Bioinformatics

Databases (PubMed, NCBI, EMBL and ExPASy), nucleotide and protein BLAST analysis, CLustal W and phylogenetic tree construction. Introduction to omics (proteomics, genomics and transcriptomics). Introduction to nanotechnology.

### List of Practicals:-

1. Determination of Blood Groups
2. Pregnancy test
3. Widal test
4. Ocuteroloney immunodiffusion
5. Radial immune diffusion
6. ELISA
7. Production of antibodies (theory exercise)
8. Bleeding, separation of serum and storage
9. Lymphoid organs (theory exercise)
10. Isolation of plasmid DNA (alkaline lysis method)
11. Analysis of plasmid DNA by Agarose gel electrophoresis
12. Southern blotting (theory exercise)
13. PCR Amplification (theory exercise)

### Textbooks for Immunology and rDNA technology

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House
6. Textbook of Biotechnology - 2007, By H.K. Das (Wiley Publications)
7. Principles of Gene Manipulation - 7<sup>th</sup> edition, 2006, By R.W. Old & S.B. Primrose, Publ: Blackwell
8. Molecular Biology & Biotechnology- 1996, By H.D. Kumar, Publ: Vikas
9. Molecular Biotechnology - 4<sup>th</sup> edition, 2010, G.R. Click and J.J. Pasternak, Publ: Panima

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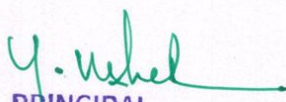
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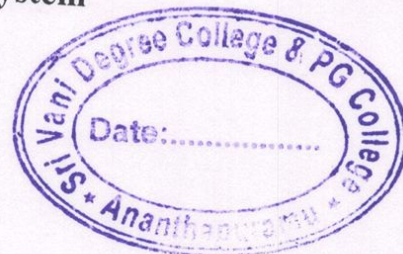
10. Genes and Genomes – 1991, By Maxine Singer and Paul Berg
11. Genes VII- 2000, By B. Lewin - Oxford Univ. Press
12. Molecular Biology - 4<sup>th</sup> Edition, 2008, By D. Freifelder, Publ: Narosa Publishing house New York, Delhi
13. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
14. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
15. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
16. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
17. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
18. Introduction to Bioinformatics – 2007, By V. Kotheekar
19. Introduction to Bioinformatics – 2013, By Arthur M. Lesk
20. Bioinformatics: 2001, Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press
21. Biological Sequence Analysis: 1<sup>st</sup> Edition, 1998, Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press
22. Bioinformatics: 2004, A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxeavanis, B. F. Francis Ouellette, Wiley-Interscience
23. Bioinformatics tools and Resources – free online tools, software packages, Bioinformatics books and Journals, Bioinformatics web-portals

  
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**B.Sc., -IV Semester W.E.F. 2020-21**



**BT-401 (i) Plant and Animal Biotechnology**

**Course Objectives**

The objectives of this course are to introduce students to the principles, practices and application of animal biotechnology, plant tissue culture, plant and animal genomics, genetic transformation.

**Unit – I**

**Plant tissue culture techniques & secondary metabolites production**

Plant tissue culture: totipotency , media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture ,applications of tissue culture-micro propagation; Somatic embryogenesis; synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation, Plant secondary metabolites- concept and their importance

**Unit – II**

**Transgenesis and Molecular markers**

Plant transformation technology-- Agrobacterium mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid, Transgenic plants as bioreactors. Herbicide resistance – glyphosphate, Insect resistance- Bt cotton,, **Molecular markers - RAPD, RFLP and DNA fingerprinting-principles and applications.**

**Unit – III**

**Animal tissue culture techniques**

Animal cell culture: cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines, stem cell cultures; Tests: cell viability and cytotoxicity, Cryopreservation. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

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#### Unit – IV

#### Transgenic animals & Gene Therapy

Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin, somatostatin, vaccines), IVF, Concept of Gene therapy, Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology

#### Unit V

#### Bioethics, Biosafety and IPR


Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP, GMP, Introduction to IP-Types of IP: patents, trademarks & copyright

#### Student Learning Outcomes

Students should be able to gain fundamental knowledge in animal and plant biotechnology and their applications.

#### PLANT AND ANIMAL BIOTECHNOLOGY-PRACTICALS

- plant culture media and composition of MS media
  - Raising of aseptic seedlings
  - Induction of callus from different explants
  - Plant propagation through Tissue culture (shoot tip and Nodal culture)
- Establishing a plant cell culture (both in solid and liquid media)
- suspension cell culture
- Cell count by hemocytometer.
- Establishing primary cell culture of chicken embryo fibroblasts.
- Animal tissue culture – maintenance of established cell lines.
- Animal tissue culture – virus cultivation.
- Estimation of cell viability by dye exclusion (Trypan blue).
- ELISA – Demonstration


  
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**List of reference books;**

1. K. Vijaya Ramesh, Environmental Microbiology, 2004, MJP Publishers, Chennai.
2. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory & Techniques, 2005, MJP Publishers
3. Environmental microbiology by Raina M. Maier Ian L. Pepper & Charles P. Gerba, 2000, Academic press
4. Environmental Chemistry, A.K. De. Wiley Eastern Ltd., 2001, New Delhi
5. Introduction of Biodeterioration, D. Allsopp and K.J. Seal, ELBS/Edward Arnold, 2008
6. Power un seen: How microbes rule the world. By Dixon, B. Freeman/ Spectrum, 1994, Oxford.
7. Environmental Microbiology. By. Mitchell. R. Wiley, 1992, New York
8. Introduction to Environmental Sciences, Y. Anjaneyulu, 2004, BS Publications
9. Industrial Microbiology by A.H. Patel, 2009
10. Prescott & Dum (2002) Industrial Microbiology, Agrabios (India), 2005, Publishers
11. Creueger W. & Crueger A.A Text of Industrial Microbiology, 2000, 2nd Edition, Panima Publishers corp.

  
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**B.Sc., -IV Semester W.E.F. 2020-21**

**BT-401 (ii) Environmental & Industrial Biotechnology**



**Learning Objective**

This course aims to introduce fundamentals of Environmental Biotechnology. The course will also give an insight in introducing major groups of microorganisms and their industrial applications

**Unit – I**

**Pollution Types and Control**

Environmental Biotechnology-Environmental Pollution : Types of pollution, air pollution & its control through Biotechnology, Biofilters, Bioscrubbers, Biotrickling filter. Water pollution and its management: Measurement of water, pollution, sources of water pollution. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors. Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors.

**UNIT-II**

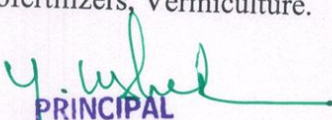
**Bioremediation**

Biodegradation and Bioremediation – Concepts & principles of Bioremediation, Bioremediation of Hydrocarbons and its applications Degradation of pesticides and other toxic chemicals by microorganism. Role of genetically Engineered microbes, Concept of Phytoremediation, , environmental safety guidelines.

**UNIT III**

**Biofuels**

Bio fuels-biogas, microbial groups involved in biogas production & interactions, factors affecting biogas production, Biofertilizers, Vermiculture.

  
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#### Unit IV

##### Basic principles of Microbial technology

Industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Strain Improvement, Basic concepts of fermentation; Design of fermenter and applications

#### Unit V

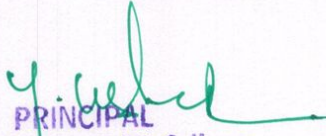
##### Commercial Production of Microbial products

Microbial technology products and applications; Microbial production of Organic acids (Lactic acid, citric acid), Amino acids (Glutamic acid, Aspartic acid and Lysine). Fermentation by microbes for food additives: dairy products (Cheese, Yogurt), beverages (Beer, Wine) and antibiotics (Streptomycin, Pencillin)

**Student Learning Outcomes** Students should be able to gain fundamental knowledge in animal and plant biotechnology and their applications.

#### ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY -PRACTICALS

- Detection of coliforms for determination of the purity of potable water.
- Determination of total dissolved solids of water
- Determination of Hardness and alkalinity of water sample.
- Determination of dissolved oxygen concentration of water sample
- Determination of biological oxygen demand of sewage sample
- Determination of chemical oxygen demand (COD) of sewage sample.
- Isolation of industrially important microorganisms from soil.
- Isolation of amylase producing organisms from soil.
- Production of  $\alpha$  - amylase from Bacillus Spp. by shake flask culture.
- Production of alcohol or wine using different substrates.
- Estimation of citric acid by titrimetry.

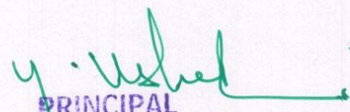
  
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1. Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers
2. Plant Tissue Culture, kalyan Kumar De,199 M7,New Central Book Agency
3. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998
4. Biotechnology – By U. Satyanarayana ;1997
5. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001
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7. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing
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9. R. Ian Freshney, “Culture of animal cells – A manual of basic techniques” 4<sup>th</sup> edition, John Wiley & Sons, 2000 ,Inc, publication, New York
10. Daniel R. Marshak, Richard L. Gardner, David Gottlieb “Stem cell Biology” edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York
11. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.

  
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