

Rayat Shikshan Sanstha's,  
Yashavantrao Chavan Institute of Science, Satara (Autonomous)

## **Department of Biotechnology**

Syllabus under Autonomy B.Sc.II Biotechnology  
(Entire)

## BBTT 301 –Genetics

Credits :02

### Learning Objectives-

- To understand principle of Mendelian genetics.
- To make students aware of Gene interaction and Gene expression.
- To Study the basic concepts of Cytogenetics.
- To study the basic concepts of microbial genetics.

### Unit I.

11

Mendel's laws of Inheritance: – Principles of - segregation, independent assortment and dominance, Variety of gene Expression: – modifiers, suppressors, pleiotropic gene, multiple allele, Interaction of gene:- Epistasis, complimentary gene, duplicate gene.

### Unit II.

11

Linkage: - definition, coupling and repulsion hypothesis, linkage groups , Gene mapping methods - linkage maps and Tetrad analysis, Crossing over –Mechanism and theory , Transposable Genetic elements (Definition, characteristics and types).

### Unit –III.

11

Chromosomal Aberrations:-Structural and numerical changes in chromosomes, Extra chromosomal inheritance-mitochondrial and plastids, Human karyotype.

### Unit IV

12

Plasmid- Types, Structure properties and applications, Genetic recombination in bacteria – Definition, fate of exogenote in recipient cell, transformation, Conjugation, transduction, mechanism of recombination.

### Learning Outcomes-

#### After completing the credit students should gain the -

- The basic knowledge of Inheritance Biology.
- The concepts of Gene interaction and Gene expression.
- The structural and numerical changes in chromosomes.
- The mechanisms of bacterial genetics such as: -transformation, Conjugation, transduction and recombination.

### References:

1. Molecular Genetics of Bacteria 4<sup>th</sup> edition –Larry Snyder, Joseph E.Peters,Tino M .Henkin and Wendy champness.(Unit No. IV).

2. Microbial Genetics 2<sup>nd</sup> edition – Stanley R. Maloy, John E. Cronan, David Freifelder (Unit No. III & IV).
3. Genetics 3<sup>rd</sup> edition – Monroe w. Strickberger.-(Unit No.I,II,III &IV)
4. Cell biology,Genetics,MolecularBiology,Evolution and Ecology 1<sup>st</sup> edition –Dr. P,S.Verma ,Dr.V.K.AgarwalS.Chand publication.-(Unit No.I,II,III &IV)
5. Molecular Biology 2<sup>nd</sup> edition –David Clark, Nanette Pazdernik (Unit- No. III, IV)

## **BBTT-302: Fundamentals in Cell Biology**

**Credits -**

**02**

### **Learning Objectives**

- To study the cell and cellular organelles.
- To study in detail structure of nucleus and it's characteristics.
- To introduce chromosome structure, organization and general features.
- To study cytoskeletal system and membrane transport system of cell.

### **Unit- I**

**11**

Discovery of Cell, Cell theories.

Organization of Prokaryotic cell

Organization of Eukaryotic cell (plant and animal cell), Difference between Prokaryotic and Eukaryotic cell.

Ultrastructure& functions of cell organelles Mitochondria,Chloroplast, E.R., Golgi apparatus, Lysosome, Peroxisome,Ribosomes.

### **Unit- II**

**11**

#### **Nucleus**

Introduction,morphology,occurrence,shape,size,number,position

Ultrastructure of nucleus-Nuclear membrane, nucleoplasm,nucleopore complex, nucleolus.

Ultrastructure of chromosome, General features of Prokaryotic chromosome.

General features of Eukaryotic chromosome-. Chromosome number, size, Chromosomal nomenclature & General structure, banding pattern.

Types of chromosomes.

### **Unit- III**

**12**

#### **Cytoskeletal assembly**

Introduction

Cytoskeletal elements

Microtubules-occurrence, structure, chemical composition,microtubule associated proteins,

Microfilaments- occurrence, structure, chemical composition,functions

Intermediate filaments(IF) - -occurrence, structure, chemical composition, types of IF, functions.

#### **Unit- IV**

##### **Cell membrane & Membrane transport**

**11**

Cell membrane and its components.

Molecular models of cell membrane-Unit membrane model, Protein crystal model, fluid mosaic model.

Types of membrane transport - Passive transport, simple diffusion, facilitated diffusion, osmosis. Active transport-primary and secondary transport, Sodium potassium pump, Calcium pump, ATPase pump

Bulk transport-endocytosis and exocytosis.

#### **Learning Outcomes:**

**The students should have the knowledge about:**

- Knowledge of cell and cellular theories.
- Knowledge about nucleus, features of chromosome
- Study of cytoskeletal assembly and filaments.
- Study membrane transport system.

#### **References:-**

- 1) Molecular biology of cell-Alberts, 5<sup>th</sup> edition. (Unit I,II)
- 2) Molecular biology & cell biology – Lodish et.al, 8<sup>th</sup> edition. (Unit I,II,III and IV)
- 3) Cell biology-Genetics, molecular biology-P.S. Warma& Agarwal. (Unit I,II)
- 4) Gene XI, 11th edition (2012) Benjamin Levin , Publisher- Jones & Barlett Inc. USA (Unit I,II,III and IV)
- 5) Cell biology –Gerald Karp, 7<sup>th</sup> edition. (Unit I,II,III and IV)
- 6) Cell Biology- C.B.Powar 3<sup>rd</sup> edition . Unit I,II)

### **BBTT 303 - Metabolic Pathways**

**Credits: 02**

#### **Learning Objectives:**

- To make students aware of metabolism .
- To study different types of metabolism and its study.
- To understand the concepts of metabolism of Biomolecules.
- To study the Metabolic Pathways with it's Energetics.

**Unit I** **11**  
**1. Metabolism:-**Introduction to metabolism, anabolism &catabolism ,catabolism& its three stages, types of metabolic reactions, Methods employed to study metabolism (using auxotrophic mutants,radioisotopes) ,High energy compounds.

**Unit II** **12**  
**2. Carbohydrates Metabolism:-**Reactions and energetics of Glycolysis ,TCA cycle Glyoxylate cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis, HMP and its significance.

**Unit III** **11**  
**3. Lipid Metabolism:-**Biosynthesis of fatty acid with respect to Palmitic acid & degradation of fatty acid( $\beta$ -oxidation)with respect to Palmitic acid.

**Unit IV** **11**  
**4. Introduction to Hormones-** Definition , Types as Steroid, Peptide, Amino acid  
**Metabolism of amino acids-** Transamination reactions,Deamination,Urea cycle.

**Learning outcomes:**

After completing the credits students should gain the knowledge about

- Principle & types of metabolism.
- Parameters used to study metabolism
- Biosynthesis of lipid, carbohydrates and hormones.
- Metabolic pathways with regulation.

**References:-**

- 1) Biochemistry- 5<sup>th</sup> edition Lubert Stryer, Jeremy M.Berg,John L. Tymoczko (Unit no.I,II,III&IV)
- 2) Principles of Biochemistry- 4<sup>th</sup> edition Nelson and Cox( Unit no. I,II,III& IV)
- 3) Principles &Techniques of Biochemistry& Molecular Biology- 7<sup>th</sup>KeithWilson and John Walker (Unit no. IV)
- 4) Fundamentals of Biochemistry – Revised edition Dr. J. L. Jain (S. Chand publication) (Unit no.I,II,III&IV)
- 5) Principles of Biochemistry- 3<sup>rd</sup> edition DonaldVoetand JudithVoet (Unit no. IV)
- 6) Biochemistry –4<sup>th</sup> edition - U.Satyanarayanan& U. Chakrapani(Unit no.I,II,III&IV)

**OBJECTIVE:**

- To familiarize the students with basic concept in molecular biology.
- To understanding the DNA structure & Replication.
- To understanding the DNA alterations by Mutation & Repair.
- Understand DNA damage.

**Unit I**

**11**

**Experimental Evidences for DNA as a genetic material:**

Griffith's Exp.

Avery, Macleod, McCarty Exp.

Blender Exp.

RNA As a genetic material. (Gierer and Schram expt.)

**Properties and Function of DNA:-**

T<sub>m</sub>, Cot Curve, Buoyant Density

Unit of Gene (Cistron, Recon, Muton)

One gene One Polypeptide Hypothesis

**Unit II**

**10**

**Nucleic Acid biosynthesis:**

De novo synthesis of Purine and Pyrimidine ring

Salvage Pathway

Synthesis of Deoxyribonucleotide

Feedback inhibition.

**Unit III**

**12**

**DNA Replication:**

Semi conservative model of replication (M.S Expt.)

Direction of replication ( Uni & Bidirectional)

Mechanism of phosphodiester bond formation

Mechanism of DNA replication and regulation in prokaryotes and eukaryotes

Variation in prokaryote and Eukaryote polymerases.

D loop model, Rolling circle model

**Unit IV**

**12**

**DNA damage & Repair:**

DNA damage - Base substitution, Frame shift mutation

Chemical damage SOS repair

Physical breakdown Photo reactivation

DNA repair Recombination repair

Excision repair

Mismatch repair



## **LEARNING OUTCOME:**

### **The students should acquire the knowledge about:**

- Experiment behind the Genetic material.
- Understanding the DNA structure & Replication.
- DNA alterations by Mutation & Repair.
- Functions of DNA.

## **References:**

- 1) Molecular Biology of Gene 6<sup>th</sup> Edition (2008), James D. Watson, Baker et.al. (Unit II)
- 2) Genetics by Monroe W. Strickberger, 3<sup>rd</sup> Edition. (Unit I)
- 3) Molecular biology 8<sup>th</sup>edition Geraladkarp. ( Unit III)
- 4) Gene XI, 11<sup>th</sup> edition (2012) Benjamin Levin, Publisher- Jones & Barlett Inc. USA. (Unit IV)
- 5) Genome 4 by T.A. Brown, 4<sup>th</sup> Edition ( Unit III)

## **BBTT 305 - Ecology and Environmental Biotechnology**

**Credit- 02**

### **Objectives**

- To make students aware of Environmental Biotechnology
- Study of Environmental Impact Assessment.
- Study of Environmental Survey for different approaches.
- Study of environmental toxicology their magnification, effects.
- To study different remediation techniques for environmental pollution

## **UNIT I**

**11**

### **Environmental Toxicology**

Definition, classification and concept.

Pesticide Toxicity –Classification (Organic and Inorganic).

Mode of action of toxicants (Metals, organophosphates, carbamates)

and mutagens)  
Bioconcentration, Bioaccumulation, Biomagnification.  
Potentiation and Synergism.  
Control of Toxic effects- Biotransformation and excretion

**. UNIT II** **12**

**Bioremediation Techniques**

Definition, Principle

*In situ and Ex situ* Bioremediation

Bioremediation of waste waters

Activated Sludge Process

Solid Waste Treatment, Slurry Phase

Treatment

Agricultural Bioremediation- Microbial Composting, Biogas, Land

Farming and waste Control

Bioremediation of Industrial wastes, Xenobiotics

**UNIT III** **11**

**Biogeochemical cycle**

Carbon cycle

Nitrogen cycle

Sulphur cycle

Phosphorus cycle

Bio augmentation and Bio filtration and Environmental Impact Assessment

**UNIT IV** **11**

**Waste water treatment**

Introduction, sources of water pollution

Stages of waste water treatment

    Preliminary

    Primary

    Secondary – Aerobic/anaerobic growth treatment

    Tertiary treatment

Waste water treatment for dairy, tannery, distillery, sugar industry

water recycling process

**Learning Outcomes**

- Knowledge about recycling, and remediation methods of different pollutants.
- Know the technique of remediation method for pollution.

- Knowledge about various techniques for Environmental Impact Assessment.
- Knowledge about effluent treatment system.

### References:

1. Applied and environmental Microbiology ; Amann, R.I Stromely, J.Stahl. (Unit I, II)
2. Environmental Biotechnology. , Chattergy. (Unit I,II, III and IV)
3. Environmental Biology,Verma Agerwal (Unit I,II, III and IV)
4. Environmental Chemistry ,B.K Sharma. (Unit I,II, III and IV)
5. Environmental pollution, Peavy and Rowe. (Unit I,II, III and IV)
6. Environmental problems and solution., Asthana and Asthana. (Unit II, III and IV)
7. Environmental Chemistry Manahan. (Unit II and IV)
8. Environmental Science., Saigo, Canninham (Unit I,II, III and IV)
9. Environmental Chemistry.,A.K.Bagi and G.R.Chatwal (Unit II and IV)
10. A textbook of Biotechnology., R.C.Dudey (Unit II and IV)
11. Fundamentals of ecology ; E.P Odum (Unit I)
12. Environmental Biology,Verma Agerwal (Unit I,II, III and IV)
13. General ecology., H.D.Kumar (Unit I)
14. Text book of Biotechnology – U. Satyanarayana (Unit IV)

## **BBTT 306 - Plant Tissue Culture**

**Credit- 02**

### **Learning Objectives:**

- To make students aware of fundamentals of Plant Tissue culture
- Study of laboratory organization for plant tissue culture.
- Study of callus, organ, anther and pollen culture Technique.
- Study of suspension, protoplast culture and micropropagation Technique.
- To study use and application of Plant Tissue culture

### **Unit I**

**11**

**Introduction to plant tissue culture-** Definition, History ,Cellular totipotency, techniques in plant tissue culture.

#### **Infrastructure & Organization of Plant Tissue Culture**

**Laboratory- General and aseptic laboratory-** different work areas, equipments and instruments required, other requirements.

**Aseptic Techniques-** Washing and preparation of glassware's, packing and sterilization, media sterilization, surface sterilization, aseptic workstation, precautions to maintain aseptic conditions.

**Culture Medium-** Nutritional requirements of explants, PGR and their *in vitro* roles, composition of basal M.S. medium and media preparation.

## **Unit II**

**12**

**Callus Culture Techniques-** Introduction, principle, protocol, morphology and internal structure, genetic variations, applications.

**Somatic Embryogenesis-** Introduction, principle, protocol, factors affecting, applications, limitations.

**Organogenesis-** Introduction, principle, protocol, applications.

**Organ Culture Technique-** Introduction, principle, protocol, applications, with respect to root tip culture, leaf culture, ovary and ovule culture.

## **Unit III**

**11**

**Anther & Pollen Culture Technique-** Introduction, principle, protocol, factors affecting, applications.

**Micropropagation-** Introduction, stages of Micropropagation, factors affecting, advantages and applications (with suitable examples)

**Different Pathways of Micropropagation-** Axillary bud proliferation, somatic embryogenesis, organogenesis, meristem culture.

**Somaclonal Variation-** Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism, assessment, applications and limitations.

## **Unit IV**

**11**

**Suspension Culture Technique-** Introduction, principle, protocol, types, growth measurement, viability test, synchronization, applications.

**Production of Secondary Metabolites-** Introduction, types of secondary metabolites, principle, systems of culture, optimization of yield, commercial aspects, applications, limitations.

**Plant Protoplast Culture:-** History, Principle, protocol for isolation-Mechanical and Enzymatic, protoplast culture methods, viability test and applications.

### **Learning Outcomes :**

- Knowledge about laboratory organization for plant tissue culture.
- Know technique of preparation of plant tissue culture media.
- Knowledge about various techniques for plant tissue culture.
- Job oriented skill developments of students to start or work in commercial plant tissue culture laboratory.

### **References:-**

1] Introduction to plant tissue culture- M.K. Razdan, Science Pub Inc; 2 edition (2003) (Unit 1)

- 2] Plant tissue culture-Theory & practice-S.S.Bhojwani& M.K. Razdan, Elsevier Science; 1 edition (1996)(Unit 4)
- 3] Micropropagation Technology and Application- Debergh, P., Zimmerman, R. H. Springer; 1 edition (1991)(Unit 4)
- 4] Plant tissue culture- De K. K.New Central Book Agency (P) Ltd.; 1 edition (2017)(Unit 1 & 3)
- 5]Methods in Plant Tissue Culture -U.Kumar, Agro-Botanica Publishers 1 edition (1999)(Unit 1&3)
- 6] Plant Cell, Tissue and Organ Culture: Fundamental Methods-GamborgO. L. and Phillips G. C., Springer;1 edition (1995)(Unit 1,2 & 4)
- 7] Introduction to Plant Biotechnology- ChawlaH.S. Oxford and IBH Publishing Co. Pvt. Ltd.2 edition (2000)(Unit2 & 3)

## **BTE 307 - Techniques in Genetics and Cell Biology**

**Credits - 04**

### **SECTION A - Techniques in Genetics (Semester I)**

#### **Learning objectives:**

- **The objective of the course is to study the techniques of mutant isolations and meiosis, mitosis.**
- |  |   |
|--|---|
| 1. Isolation of Lac negative mutants of <i>E. coli</i> by visual detection | 1 |
| 2. Isolation of streptomycin resistant mutants by gradient plate technique | 1 |
| 3. Conjugation in <i>E. coli</i> .   | 1 |
| 4. U.V survival curve  | 2 |
| 5. Problems based on Mendelian Inheritance, linkage and crossing over      | 1 |
| 6. Study of meiotic abnormality in <i>Rhoeo</i>                            | 1 |
| 7. Study of karyotype by using photograph                                  | 1 |

#### **Learning outcomes:**

At the end of course, students will acquire the knowledge of techniques like mitosis, meiosis, karyotyping, Bacterial genetics, mutations etc.

#### **References:**

1. Immunology Lab Biology 477 Lab Manual

2. A Laboratory manual of Genetics- Sunita Joshi – I K International publishing house.
3. Genetics Laboratory manual – Ray Dennis and shotwell mark.- Kendall Hunt Publishing

### **SECTION B - Techniques in Cell Biology**

#### **Learning objective:**

**The objective of the course is to familiarize the students with the cells organelles, Chromosomes.**

8.Measurement of size of cell structure/cell organelle/spore by micrometry	01
9. Isolation of nucleus.	01
10.Isolation of chloroplast.	01
11. Isolation of giant chromosomes using Drosophila / Chironomous larvae.	01
12. Use of dialysis to separate smaller molecules than larger molecules.	02

#### **Learning outcome:**

At the end of the course, the students will have sufficient scientific understanding of the isolation of cellular organelles , Chromosome , Stages involved in mitosis meiosis, protein purification method & plasmolysis

#### **References:**

1. William H. Heidcamp ; Cell Biology Laboratory Manual
2. SRM university; cell biology practical manual
3. Jerry D. Berlin ; Cell biology Laboratory Manual

### **BBTP- 308: Techniques in Metabolic Pathways and Molecular Biology**

**Credits - 04**

#### **Learning Objectives:**

- To learn Techniques in Metabolic Pathways and Molecular Biology.
- To understand isolation of genetic material.

- To study the different methods of estimation of macromolecules.
- Acquire knowledge about DNA, Plasmid, RNA, protein electrophoresis techniques.

#### **Section: A**

Estimation of fructose by Resorcinol method	01
Estimation of DNA by Diphenylamine method	01
Estimation of RNA by Orcinol Method	01
Cellulose acetate paper electrophoresis of Amino Acid	01
Adsorption chromatography of amino acid	01
Isolation of Amylase from germinating seed	02

#### **Section: B**

Eukaryotic DNA Isolation from - Plant Material/ Animal Material	01
Quantification of DNA and RNA.	01
Genomic DNA isolation from bacteria.	02
Purification of DNA by silica membrane.	01
Plasmid isolation from <i>E.coli</i> .	01
Agarose gel electrophoresis to separate DNA.	01

#### **Learning Outcomes:**

- The basic knowledge about electrophoresis.
- Knowledge about laboratory equipment.
- Known techniques of DNA, RNA, Plasmid isolation.

#### **References:**

- HiMedia teaching kit manual.
- Experiments in Molecular Biology by Slater, Robert J.
- Wilson & Walker's principles & techniques of Molecular biology.
- Molecular Biology of Gene 6<sup>th</sup> Edition (2008), James D. Watson, Baker et.al. (Unit II)
- Genetics by Monroe W. Strickberger, 3<sup>rd</sup> Edition. (Unit I)

## **BBTTP 309 - Techniques in Plant Tissue Culture and Environmental Biotechnology**

**Credits - 04**

### **Section A**

#### **Techniques in Plant Tissue Culture**

##### **Learning Objectives :**

- To make students aware of fundamentals of Plant Tissue culture
- Study of laboratory organization for plant tissue culture.
- Study of callus and various micropropagation culture Techniques.
- To study use and application of Plant Tissue culture

Visit : Compulsory Visit to commercial Plant Tissue Culture Laboratory and ETP plant

##### Techniques in Plant Tissue Culture

1 Preparation of M.S. stock solutions & medium	2
2 Aseptic seed germination	1
3 Embryo culture technique.	1
4 Micropropagation stage I-Initiation of micropropagation–Shoot tip or axillary bud culture technique tissue culture	2
5 Micropropagation stage II-Subculture & multiplication of culture.	1
6 Micropropagation stage III-Rooting- in vitro & ex vitro	1
7 Micropropagation stage IV-Acclimatization & hardening	1
8 Callus culture technique- Initiation of culture, callus morphology	2
9 Isolation of Protoplast	1

### **Learning Outcomes :**

- Knowledge about laboratory organization for plant tissue culture.
- Know technique of preparation of plant tissue culture media.
- Knowledge about various techniques for plant tissue culture.
- Job oriented skill developments of students to start or work in commercial plant tissue culture laboratory.

### **References:-**

- 1] Plant tissue culture-Theory & practice-S.S.Bhojwani& M.K. Razdan, Elsevier Science; 1 edition (1996)
- 2] Plant Cell, Tissue and Organ Culture: Fundamental Methods-GamborgO. L. and Phillips G. C., Springer; 1 edition (1995)

## **Section B**

### **Techniques in Environmental Biotechnology**

#### **Learning Objectives:**

- To understand the basic concepts of Hardness of water sample.
- To study the Biological oxygen Demand test is an important water quality parameter.
- Study the physico-chemical properties of water samples – pH, TDS, Total hardness,BOD,COD.
- To study the water analysis techniques.

#### Techniques inEnvironmental Biotechnology

1. Determination of total and permanent hardness of water sample.	1
2. Estimation of BOD of water sample.	1
3. Determination of TDS of water	1
4. Study of effect of heavy metal on growth of organisms.1	
5. Estimation of COD of water sample.	1
6. Routine bacteriological analysis of water Presumptive, Confirmatory ,Completed and MPN	2
7. IMVIC Test	1

#### **Learning Outcomes:**

- Student should gain the Knowledge of physico-chemical properties of water samples such as pH, TDS, Total hardness, BOD, COD.
- Knowledge about various techniques for water analysis and water quality parameters.
- Skill developments of students to work in commercial Environmental Biotechnology laboratory.

- Student should gain the basic concept of hardness of water.

**References:-**

1. Practical Biochemistry (Principle and protocols) – 2<sup>nd</sup> edition – Hrudayanath Thatoi ,  
Supriya Dash
2. Environmental Science - A practical Manual –G. Swarajya Lakshmi
3. Practical microbiology- 5<sup>th</sup> edition – D.K.Maheshwari
4. Laboratory manual of Microbiology and Biotechnology-2<sup>nd</sup> edition-K.R.Aneja.

**BBTT 401 – Immunology**

**Credits- 2**

**Learning Objectives–**

- To study the overview of vertebrates Immune System.
- To study the Types and mechanism of Defence.
- To study the Cells and Organs of immune system.
- Students should aware of Antigen and antibody reactions.
- Students should aware of immune response and parasitic immunology.

**Unit I**

**11**

**Overview of Immune system-**

**Introduction:-**

Types of immunity- i) Innate (Specific and non-specific) ii) Acquired (Active and Passive)

Types of Defence- a) first line of defence (barriers at the portal of entry, physical and chemical barriers) b) Second line of defence c) Third line of defence – specific defence mechanism.

## **Unit II**

**11**

### **Introduction to Cells and organs of immune system**

Cells of immune system a) Broad categories of leucocytes - their role and properties

b) B-lymphocytes c) T-Cells – subsets d) Other cells (Antigen presenting cell, Null cell, Natural killer cell.)

Organs of immune system – primary and secondary lymphoid organs – structure and their role.

## **Unit III**

**11**

### **Antigen and Antibody**

Antigen- Definition, Nature, types of antigens, factors affecting Antigenicity.

Antibody- Definition, Nature, Basic structure of immunoglobulin, major human immunoglobulin classes (Their properties and functions).

## **Unit IV**

**12**

### **Immune response**

Immune response- Primary and secondary immune response.

Antigen Antibody reactions – Principle and applications of – a) agglutination, b) precipitation c) complement fixation d) ELISA e) neutralization

Parasitic immunology :- Immune response against Bacterial infection with reference to suitable examples.

### **Learning Outcomes -**

**After completing the credit students should gain the –**

- The basic knowledge of vertebrates Immune System.
- The knowledge of about Types and mechanism of defence.
- The knowledge of Cells and Organs of immune system.
- The concept of Antigen and antibody reaction.

## References:-

1. Immunology – Kuby 7<sup>th</sup> edition (Unit No. I,II,III&IV)
2. General Microbiology 4<sup>th</sup> edition – Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham (Unit –No.IV)
3. Molecular Genetics of Bacteria 4<sup>th</sup> edition – Larry Snyder, Joseph E. Peters, Tino M. Henkin and Wendy Champness (Unit No. III,IV)
4. Textbook of Microbiology 7<sup>th</sup> edition – Ananthanarayan and C K J Paniker (Unit No. I,II,III&IV)
5. Immunology 1<sup>st</sup> edition – Dulsy Fatima, N. Arumugamsaras publication. (Unit No. I,II,III&IV)
6. Essential Immunology 13<sup>th</sup> edition – Peter J. Delves, Dennis, Ivan M. Roitt. (Unit No. I,II,III&IV)

## BBTT 402- Advances in Cell Biology

Credits - 02

### Learning Objectives:

- To study secretory pathways and trafficking.
- To study cell signaling and Cell surface receptor proteins.
- To gain knowledge of cell cycle, molecular events in cell cycle.
- To gain knowledge of programmed cell death.
- To study cancer cells, causes of cancer and tumour suppressor genes.

### Unit I

#### Cell Signaling

##### 11

#### Introduction

Types of cell signaling-contact dependent signaling, autocrine, paracrine, synaptic, endocrine, gap junctions, combinatorial signaling, Secondary Messengers

Cell surface receptor proteins, Ion channel linked receptors, G-protein linked receptors, enzyme linked receptors.

Signaling through G-protein linked receptors- IP<sub>3</sub> and DAG Pathway.

## **Unit II**

### **Secretory pathway and protein trafficking**

**12**

Secretory pathway-ER associated ribosomal translation, co-translational transport of nascent polypeptide chain to ER lumen

Transport to Golgi apparatus

Transport of proteins to- mitochondria, chloroplast, peroxisomes, nucleus.

## **Unit III**

### **Cell division cycle**

**11**

Introduction, definition, phases of cell cycle.

Control of cell cycle and its checkpoints.

Molecular events of cell cycle-CDK and cyclins, s-phase, CDK cyclins Complex, M-phase CDK cyclins complex, anaphase promoting complex.

Programmed cell death, Necrosis.

Cancer -types, characteristics of cancer cells, causes of cancer, tumour suppressor genes, p 53.

## **Unit IV**

### **Mechanism of cell division**

**11**

Introduction

Types of cell division-amitosis, mitosis and meiosis.

Mitosis- history, phases in mitosis, unique features of M-phase, significance.

Meiosis -history, phases in meiosis, significance.

### **Learning Outcomes:-**

#### **The students should know about:**

- Transport systems through membrane.
- Cell cycle cycle, cell division and cellular events.
- Cell signaling and cell surface receptor proteins.
- Cancer cells, tumour suppressor genes.

### **References:-**

1. Bruce Albert ; Molecular biology of cell- 4<sup>th</sup> Edition, March 21st 2002 by Garland Science. ( Unit I,II,III and IV)

2. Harvey Lodish et al; Molecular biology & cell biology – 5th Edition. ( Unit I,II,III and IV)
3. De Robertis ; Cell biology – 8<sup>th</sup> edition ( Unit I,II)
4. P. S. Verma& Agarwal; Cell biology, Genetics, Molecular Biology September 1st 2004 by Chand( Unit II and III )
5. Lewin's ; Essential Genes 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup> edition, November 27th 2009 by Jones & Bartlett ( Unit III and IV)
6. Gerald Karp; Cell biology ( Unit I,II,III and IV)

## **BBTT403 - Plant Physiology & Biochemistry**

**Credits-02**

### **Learning Objectives:**

- To make students aware of physiology of plants.
- To study and use of biochemistry in growth and development of plant.
- To study biosynthesis and role of plant hormones in plant.
- To study concept of Photosynthesis and oxidative photophosphoylation.

### **Unit I**

**11**

**1. Plant Water Relation:-**Introduction, Absorption of water- Mechanism, Theories (Active and Passive), Translocation of water- Mechanism, Ascent of Sap, Root pressure theory , Transpiration- Types, Mechanism of Transpiration and factors affecting transpiration.

### **Unit II**

**12**

**2. Photosynthesis:-**Ultra structure of chloroplast, Photosynthetic pigments, red drop and Emerson's enhancement effect, mechanism of photosynthesis- Cyclic and noncyclic flow of electron transfer, light reaction, dark reaction, C-3 pathway, C-4 pathway, CAM, photorespiration

### **Unit III**

**11**

#### **3. Respiration:-**

- a) Aerobic-Flow of electrons through reducing power in ETC, Complexes of electron transport, Redox potential components of ETC, Mechanism of ATP generation- Chemiosmotic hypothesis ATP synthase complex.
- b) Anaerobic Respiration:- Alcoholic and Lactic acid fermentation.

## Unit IV

11

### 4. Introduction to Plant Hormones

Chemistry, Biosynthesis, Distribution, mode of action and physiological effects of - Auxin, Cytokinin, Gibberellin, Absisic acid, Ethylene

Secondary Metabolites: Biosynthesis of plant secondary metabolites (Shikimate pathway, Mevalonate pathway, MEP pathway)

### Learning outcomes:

Students should be able to understand

- Mechanism of plant growth and development.
- The basic knowledge about photosynthesis, respiration and biosynthesis.
- Synthesis and applications of secondary metabolites
- The basic concept of plant -water relation and related theories.

### References:-

- 1) Biochemistry- 5<sup>th</sup> edition Lubert Stryer, Jeremy M. Berg, John L. Tymoczko ( Unit no. II ,III& IV )
- 2) Principles of Biochemistry- 4<sup>th</sup> edition Nelson and Cox ( Unit no. II,III& IV )
- 3) Principles & Techniques of Biochemistry & Molecular Biology- 7<sup>th</sup> Keith Wilson and John Walker( Unit no. IV)
- 4) Fundamentals of Biochemistry – Revised edition Dr. J. L. Jain (S. Chand publication) (Unit no. II, III & IV)
- 5) Principles of Biochemistry- 3<sup>rd</sup> edition Donald Voet and Judith Voet (Unit no. II, III, IV)
- 6) Plant Physiology – New edition D.A. Kadam .(Unit no. I, II, III & IV)
- 6) Biochemistry – 4<sup>th</sup> edition U. Satyanarayanan..(Unit no. I, II, III & IV)

## BBTT-405 Developmental Biology

Credits: 02

### Objectives:

- To learn concept of plant embryology
- To understand different developmental stages in plants and animals
- To learn concept of animal embryology

- To understand concept of Differentiation and Regeneration

## **UNIT I**

**11**

### **Plant Embryology Gametogenesis and Fertilization in plants**

Gametogenesis in Plants, Development of male and female Gametophyte, Process of fertilization in Angiosperm.

#### **Development of Embryo and Endosperm**

Development of embryo and endosperm, Types of endosperm in Angiosperm.

**Apomixis**- Introduction , Definition, Types.

**Polyembryony**- Introduction, Definition, Types

## **UNIT II**

**11**

### **Pollen germination and Meristem organization**

Pollen germination Pollen germination, factors affecting.

Self incompatibility Definition, types and its genetic control. Plant meristem

Plant meristem, organization and differentiation

Organization of shoot apical meristem

Organization of root apical meristem.

## **UNIT III**

**12**

### **Animal embryology**

#### **Gametogenesis, gametes and fertilization in Animals**

Gametogenesis in animals, Types of eggs and sperms in animals, Fertilization in animals.

#### **Early development in animals**

Types and patterns of cleavages in animals, Blastulation , gastrulation in chick up-to the formation of three germ layers, Embryonic induction, Foetal membranes, Types and significance of placenta.

## **UNIT IV**

**11**

### **Differentiation and Regeneration**

Differentiation, Didifferentiation, Redifferentiation, Commitment, Transdifferentiation, Developmental Plasticity

**Regeneration:** Definition, mechanism, factors affecting regeneration.

### **Learning Outcomes:**

#### **Students should acquire the basic knowledge of**

- The concept of plant embryology.
- The different developmental stages in plants and animals.
- The concept of animal embryology with reference to Chick.
- The Differentiation and Regeneration.

#### **Reference books:-**

1. Developmental biology – Scoott Gilbert- 6<sup>th</sup> edition (Unit No.I,II,III&IV)
2. Developmental biology – N.Arumugam. –Saras publications.(Unit No.III ,IV)
3. Developmental biology – verma and agarwal .-S.Chand publications..(Unit No.III ,IV)
4. Instant notes of developmental biology .(Unit No.I,II,III&IV)
5. Foundations of Embryology – Patten(Unit No.I,II,III&IV)
6. Cell and Developmental Biotechnology – Raj Narian Desikar.(Unit No.III ,IV)
7. Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany- Subramurti(Unit I,II)
8. Plant Anatomy and Embryology- S.N. Pandey, A. Chadha (Unit No.I ,II)
9. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics (Unit No.I ,II)
10. Plant Anatomy – E.Cutter.(Unit No.I ,II)
11. The Embryology of Angiosperm – Bhojawani .S.S and Bhatnagar.S.P (Unit No.I ,II)
12. An Introduction to the Embryology of Angiosperm. – P.Maheswari.(Unit No.I ,II)

## **BBTT 406 - Animal Tissue Culture**

**Credits – 02**

### **Learning Objectives:**

#### **The students should acquire the knowledge about:**

1. The organization of animal tissue culture laboratory
2. Basic concepts in animal tissue culture with understanding of different physicochemical requirements, variations in techniques
3. To understanding different types of cell cultures.
4. Applications of animal tissue culture.

### **Unit I**

#### **History and Introduction of Animal Cell culture.**

**11**

**Requirements of Animal cell culture-** substrate for cell growth, Equipment's required for animal cell culture (Laminar air flow, CO<sub>2</sub> incubator, Centrifuge, Inverted microscope),

**Sterilization of Glassware's, Equipment's & culture media -** Glassware sterilization, reagent and media sterilization, sterility testing.

**Culture media-** Natural media, synthetic media (serum containing media, serum free media, balanced salt solution, media constituent, complete culture media, physicochemical properties of Media).

### **Unit II**

**11**

**Cultured cells-** Biology and Characterization- Characteristics of cultured cells, cell adhesion, cell proliferation, cell differentiation,

**Characterization of cultured cells-** Morphology of cells, species of origin of cells, Identification of tissue of origin, transformed cells, Identification of specific cell lines.

**Measurement of growth parameters of cultured cells-** Growth cycle of cultured cells, plating efficiency of cultured cells

**Cell synchronization-** Cell separation by physical means, cell separation by chemical blockade

**Senescence and apoptosis-** Cellular senescence, Measurement of senescence. Apoptosis, Measurement of apoptosis

### **Unit III**

**11**

**Basic technique of mammalian cell culture-** Isolation of tissue, disaggregation of tissue, measurement of viability, primary cell culture, Cell lines, Maintenance of cell culture, Subculture.  
**Scale up of Animal cell culture-** Scale up in suspension-stirrer culture, continuous flow culture, Airlift fermenter culture Scale up in monolayer- Roller bottle culture, multisurface culture, multiarray disks, and tubes, Micro carrier culture, Immobilized cell culture.

#### **Unit IV**

**12**

**Organ and Histotypic culture-** Types and maintenance of organ culture, Histotypic culture, Stem cell cultures.

**Cell storage and distribution:** a. Cryopreservation b. Cell repositories

**Applications of cell culture-** In transplantation, and tissue engineering, monoclonal antibodies production, ethics and morality.

#### **Learning Outcomes:**

- The basic knowledge of animal tissue culture.
- Knowledge about laboratory organization and safety.
- Known techniques of preparation of ATC media.
- To understand the ethics of animal tissue culture techniques.

#### **References:**

1. Freshney, I.; Culture of Animal Cells, 7<sup>th</sup> Edition, Wiley & Sons, Inc., USA. (Unit I, II, III, IV)
2. Masters, J.; Animal Cell Culture- Practical Approach, 3<sup>rd</sup> Edition, 2000, Oxford University Press, USA (Unit II)
3. Gangal, S.; Principles and Practice of Animal Tissue Culture, 2<sup>nd</sup> Edition, University Press, India (Unit III)
4. R.W. Masters; Animal cell culture- 3<sup>rd</sup> edition, August 24<sup>th</sup> 2000 by Oxford University Press, USA (Unit IV)
5. M.M. Ranga; Animal biotechnology, 2007 (Unit II)
6. R. Sasidhara; Animal biotechnology, March 15<sup>th</sup> 2015, 1<sup>st</sup> edition (Unit IV)
7. Martin Clynes; Animal cell culture technique, June 16<sup>th</sup> 1998 by Springer, 2<sup>nd</sup> edition (Unit III)
8. Cell growth & division a practical approach- Ed. R. B. Se (Unit I)

## SECTION A - Techniques in Immunology

### Learning objective-

**The objective of this course is to get hands on training of antigen antibody reactions.**

- |                                      |   |
|--------------------------------------|---|
| 1) Widal test – Quantitative         | 1 |
| 2) Radial immunodiffusion Assay      | 1 |
| 3) Immunoelectrophoresis-Qualitative | 1 |
| 4) Double Immunodiffusion Technique  | 1 |
| 5) ELISA-dot ELISA                   | 1 |
| 6) RPR card test                     | 1 |

### Learning outcome:

Students will acquire the scientific knowledge of medical immunology /serological practicals for detection of Antigen or Antibody.

### References:

- 1) Lab manual of immunology –Dr.Julie Jameson.
- 2) Practical immunology A Laboratory Manual- Senthilkumar Balkrishnan, Lap Lambert Academic Publishing.
- 3) Immunology :A laboratory Manual –R.L. Myers, Richard L.Myers.

## SECTION B - Techniques in Cell Biology

### Objective of the course:

**The objective of the course is to familiarize the students with the cells Organelles, Chromosomes and mechanisms of Mitosis, Meiosis**

- |   |    |
|---|----|
| 7) Effect of temperature and organic solvent on membrane permeability of cells.       | 02 |
| 8) Study of mitosis and preparation of slides and identification of different stages. | 01 |
| 9) Study of Meiosis and preparation of slides and identification of different stages. | 02 |
| 10) Study of plasmolysis.   | 01 |
| 11) Study of separation of chromosome by paradichlorobenzene (PDB).                   | 01 |
| 12) Study of methodology of cell lyses.   | 01 |

### Learning outcome:

At the end of the course, the students will have sufficient scientific understanding of the isolation of cellular organelles , Chromosome , Stages involved in mitosis meiosis, protein purification method & plasmolysis

**References:**

- 1) William H. Heidcamp ; Cell Biology Laboratory Manual
- 2) SRM university; cell biology practical manual
- 3) Jerry D. Berlin ; Cell biology Laboratory Manual

**BBTP 408: Techniques in Metabolic Pathways and Molecular Biology Credits - 04**

**Learning Objectives:**

- To learn Techniques in Metabolic Pathways and Molecular Biology.
- To understand isolation of genetic material.
- To study the different methods of estimation of macromolecules.
- Acquire knowledge about DNA, Plasmid, RNA, protein electrophoresis techniques.

**SECTION : A**

Gel Filtration Chromatography	02
Ion exchange chromatography using DEAE Cellulose	02
Study of lipase activity	01
Study of activity of nitrate reductase	01
Industrial visit to Demonstrate GLC, HPLC, LCMS, GCMS	01

**SECTION : B**

Determination of T <sub>m</sub> of DNA.	01
Restriction digestion of lambda DNA.	01
Isolation of RNA from animal tissue.	02
Agarose gel electrophoresis to separate RNA.	01
SDS-PAGE for separation of protein CBB staining.	02

**Learning Outcomes:**

- The basic knowledge about electrophoresis.

- Knowledge about laboratory equipment.
- Known techniques of DNA, RNA, Plasmid isolation.
- To understand SDS-PAGE.

**References:**

- HiMedia teaching kit manual.
- Experiments in Molecular Biology by Slater, Robert J.
- Wilson & Walker's principles & techniques of Molecular biology.
- Molecular Biology of Gene 6<sup>th</sup> Edition (2008), James D. Watson, Baker et.al.
- Genetics by Monroe W. Strickberger, 3<sup>rd</sup> Edition.

**BBTP- 409 :-Laboratory exercise in Developmental Biology and Animal Tissue Culture** **Credit: 04**

**Learning Objectives:**

- To learn concept of plant and animal embryology.
- To understand different developmental stages in plants and animals
- To study the different methods of Dissection, staining, Mounting etc.
- Acquire knowledge about animal tissue culture lab organization, media preparation , cell analysis, Cytotoxicity

**SECTION A**

- |  |    |
|--|----|
| 1. Methods of studying plant development   | 01 |
| a) Dissection b) Sectioning c) Maceration d) Staining e) Mounting  |    |
| 2. Study of apices and meristem Root apical meristem, Shoot apical meristem.   | 01 |
| 3. Microsporogenesis- anther squash technique Development of male and female gametophytes. Developmental stages during plant embryogenesis in dicots and monocots. | 02 |
| 4. Dissection of seed and excision of young embryo and endosperm (one dicotyledon and one monocotyledon).  | 01 |
| 5. Study of different types of eggs.   | 01 |
| 6. Study of staging & staining of Chick embryos(18h, 24 h, 48h, 72 h)  | 04 |

**SECTION B**

- |  |    |
|--|----|
| 7. Laboratory organization for Animal tissue culture | 01 |
|--|----|

8. Sterilization procedures and media preparation for Animal Cell cultures	01
9. Preparation of Serum	01
10. Growth studies by viable cell count analysis.	01
11. Cytotoxicity.	01
12. Estimation of HB	01
13. Validation of Autoclave by gamma radiation strips.	01

**Learning Outcomes:**

- The different developmental stages in plants and animals.
- To concept of plant and animal embryology with reference to Chick embryo.
- The basic knowledge of animal tissue culture.
- Knowledge about laboratory organization and safety.
- Known techniques of preparation of ATC media.
- To understand the ethics of animal tissue culture techniques.

**Reference Books and Manuals:**

1. Animal cell and tissue culture manual; SRM university
2. Readings in Mammalian cell culture. R. Pollack., Cold Spring Harbour Laboratory (1981).
3. Animal Cell Culture. R. Pollack and S. Pfeiffer, Cold Spring Harbour Laboratory (1971).
4. Experiments with Normal and Transformed cells. R. Crowe., H. Ozer and Dr. Rifkin. Cold Spring Harbour Laboratory (1978).
5. Hand Book of cell and organ culture. D. J. Merchant., R.H. Kahn and W. H. Murphy., Burgess Publishing Company (1969).
6. Culture of Animal Cells. R. Ian Freshney and R. Alan., Liss. Inc. (1987).