

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN INSTITUTE OF
SCIENCE, SATARA**

(AN AUTONOMOUS COLLEGE)

Reaccredited by NAAC with 'A+' Grade

Bachelor of Science in Biotechnology

Part - II

Syllabus to be implemented w .e. f. June, 2022

1. Structure of Course: **B. Sc. II BIOTECHNOLOGY (ENTIRE)**

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA						
COURSE STRUCTURE UNDER AUTONOMY						
B. Sc. BIOTECHNOLOGY (ENTIRE)						
B. Sc. II SEMESTER– III (Duration – 6 Months)						
Sr. No .	COURSE CODE	TEACHING SCHEME				
		Theory		Practical		
		No. of Lectures	Credits	COURSE CODE	No. of Lectures	Credits
1	BBTT--301	3	2	BBTP--307	8	4
2	BBTT--302	3	2			
3	BBTT--303	3	2	BBTP--308	8	4
4	BBTT--304	3	2			
5	BBTT--305	3	2	BBTP--309	8	4
6	BBTT--306	3	2			
7	BBTT-AECC 3	3	2			
	Total of SEM III	21	14		24	12
TOTAL NO OF CREDITS FOR SEMESTER III: 26						

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA						
COURSE STRUCTURE UNDER AUTONOMY						
B. Sc. BIOTECHNOLOGY (ENTIRE)						
B. Sc. II SEMESTER– IV (Duration – 6 Months)						
Sr. No .	COURSE CODE	TEACHING SCHEME				
		Theory		Practical		
		No. of lectures	Credit s	COURSE CODE	No. of lectures	Credit s
1	BBTT--401	3	2	BBTP--407	8	4
2	BBTT--402	3	2			
3	BBTT--403	3	2	BBTP--408	8	4
4	BBTT--404	3	2			
5	BBTT--405	3	2	BBTP--409	8	4
6	BBTT--406	3	2			
7	BBTT-AECC 4	3	2			
	Total of SEM IV	21	14		24	12
TOTAL NO OF CREDITS FOR SEMESTER IV: 26						
TOTAL NO OF CREDITS FOR SEMESTER III + IV: 52						

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

Department of Biotechnology

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

Subject	Paper
SEMESTER III	
BBTT 301	Genetics
BBTT 302	Fundamentals in Cell Biology
BBTT 303	Metabolic Pathways
BBTT 304	Molecular Biology- I
BBTT 305	Ecology and Environmental Biotechnology
BBTT 306	Plant Tissue Culture
BBTP 307	Techniques in Genetics and Cell Biology
BBTP 308	Techniques in Metabolic Pathways and Molecular Biology
BBTP 309	Techniques in Plant Tissue Culture and Environmental Biotechnology

Course : BBTT 301 –Genetics

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. Study principles of Mendelian genetics.
2. Understand of Gene interaction and Gene expression.
3. Learn analyze concepts of Cytogenetics.
4. Imbibe basic concepts of microbial genetics.

Credits (Total Credits 04)	SEMESTER-III Genetics	No. of hours per unit/credits
UNIT - I	Mendelian Genetics	11
	<ul style="list-style-type: none"> • Introduction, History and terminologies used in genetics , • 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:- Epitasis, complimentary gene, duplicate gene. 	
UNIT - II	Linkage and Crossing over	11
	<ul style="list-style-type: none"> • Linkage: - Introduction and 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	Cytogenetics	11
	<ul style="list-style-type: none"> • Study of chromosomes –Structure and types of chromosomes , 	

	<ul style="list-style-type: none"> • Chromosomal Aberrations:-Structural and numerical changes in chromosomes, • Extra chromosomal inheritance-mitochondrial and plastids, Human karyotype. 	
UNIT - IV	Microbial genetics	12
	<ul style="list-style-type: none"> • Plasmid- Introduction to plasmid • Genetic recombination in bacteria-Definition, fate of exogenote in recipient cell, • transformation, • transduction -mechanism of recombination. 	

Course outcomes: Students should be able to...

1. Gain knowledge of Inheritance Biology.
2. Understand of Gene interaction and Gene expression.
3. Analyze structural and numerical changes in chromosomes.
4. Understand mechanisms of bacterial genetics such as: -Transformation, Conjugation, transduction and recombination.

References:

1. Molecular Genetics of Bacteria- Snyder Larry, Peters Joseph, Henkin Tino and Champness Wendy, John Wiley & Sons, Washington, DC, USA,4th edition. 2013.
2. Microbial Genetics–Maloy Stanley, Cronan John, Freifelder David, Boston : Jones and Bartlett Publishers 2nd edition, 2008.
3. Genetics–Strickberger Monroe, New Delhi Pearson Publishers, 3rd edition 2015.
4. Cell biology,Genetics,Molecular Biology,Evolution and Ecology- Verma P,S., Agarwal V. K. S.Chand publication 1stedition. 2013.
5. Molecular Biology–David Clark, Nanette Pazdernik, Academic Press-Cell, 2nd edition. 2012.

Course – BBTT: 302: Fundamentals in Cell Biology

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. Understand the basics of cell that is discovery, history, and types of cell and their functions.
2. Differentiate different types of cell organelles.
3. Learn cytoskeletal system and function of nucleus in cell.
4. Understand concept of membrane transport.

Credits (Total Credits 2)	SEMESTER-III BBTT 302 Fundamentals in Cell Biology	No. of hours per unit/credits
UNIT - I	The Cell	11
	<ul style="list-style-type: none"> • Discovery of Cell, Cell theories, • Organization of Prokaryotic cell • Organization of Eukaryotic cell (plant and animal cell), Difference between Prokaryotic and Eukaryotic cell. • Cell Membrane: Cell membrane and its components. • Molecular models of cell: fluid mosaic model. 	
UNIT - II	Cell organelles	11
	Ultra structure& functions of cell organelles- <ul style="list-style-type: none"> • Mitochondria • Chloroplast • Endoplasmic Reticulum (smooth and rough) • Golgi apparatus • Lysosome 	
UNIT - III	Nucleus and cytoskeleton assembly	12
	Ultra-structure of nucleus- <ul style="list-style-type: none"> • Nuclear membrane • Nucleoplasm • nucleopore complex • nucleolus. Cytoskeleton- <ul style="list-style-type: none"> • Microtubule • Microfilament • Intermediate Filament. Ultra-structure and functions of Peroxisome, Ribosomes, Vacuole.	
UNIT - IV	Membrane transport and its types	11

	<ul style="list-style-type: none"> • 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, pinocytosis. 	
--	--	--

Course outcomes: Students should be able to...

1. Differentiate of Prokaryotic and Eukaryotic Cell.
2. Compare structures and functions of Cell Organelles.
3. Get the knowledge about Nucleus and Cytoskeletal assembly.
4. Learn membrane transport system.

References-

1. Molecular biology of cell- Bruce Alberts, Alexander Johnson and Julian Lewis. Garland Science, 5th edition 2022.
2. Molecular biology & cell biology- Lodish Harvey, W H Freeman & Co; 9th edition 2021.
3. Cell And Molecular Biology- De Robertis Eduardo. Publisher CCH, a Wolters Kluwer Business; Genre · Technology & Engineering, 8th edition, 2017.
4. Cell biology, Genetics, molecular biology- Verma P,S., Agarwal V. K. , S Chand; 8th edition 2006.
5. Gene XI- Levin Benjamin, Publisher- Jones & Barlett Inc. USA , Genes 7th, 8th , 9th, 10th 11th edition, by Jones & Bartlett. 2012.
6. Cell biology- Karp Gerald, Wiley; 7th edition. 2013.
7. Cell Biology- Powar C. B., Himalaya Publishing House, 3rd edition, 2010.

BBTT 303 - Metabolic Pathways

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. Study different types of biosynthetic pathways of biomolecules.
2. Understand the metabolic reaction occurred in cells.
3. Know various energy yielding pathways .
4. Study types of hormones and their role.

Credits (Total Credits 2)	SEMESTER-III BBTT 303 METABOLIC PATHWAYS	No. of hours per unit/credits
UNIT - I	Metabolism	10
	<ul style="list-style-type: none"> • 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	Carbohydrates Metabolism	12
	<ul style="list-style-type: none"> • Reactions and energetics of Glycolysis • TCA cycle • Glyoxylate cycle, • Gluconeogenesis, • Glycogenesis and Glycogenolysis, • HMP and its significance. 	
UNIT - III	Lipid Metabolism	12
	<ul style="list-style-type: none"> • Biosynthesis of fatty acid with respect to Palmitic acid & degradation of fatty acid (β-oxidation)with respect to Palmitic acid. 	
UNIT - IV	Introduction to Hormones	11
	<ul style="list-style-type: none"> • Introduction to Hormones-Definition , Types as Steriod, Peptide, Amino acid • Metabolism of amino acids- Transamination reactions, Deamination, Urea cycle. 	

Course outcomes: Students should be able to...

1. Differentiate different methods of studying metabolism.

2. Understand biosynthetic pathways of biomolecules with their energetics.
3. Apply the concept of free energy concept.
4. Understand the pathways of sugar degradation and bioenergetics of these pathways.

References-

- 1) Biochemistry- Berg Jeremy, Stryer Lubert, W.H. Freeman Publisher, 9th edition. 2003.
- 2) Principles of Biochemistry- Nelson David and Cox Michael, W.H. Freeman publisher, 6th edition, 2013.
- 3) Principles And Techniques Of Biochemistry And Molecular Biology- Wilson Keith and Walker John, Cambridge University Press, 8th edition, 2018.
- 4) Fundamentals of Biochemistry- Jain J. L., Jain Sanjay, Jain Nitin, , S. Chand Publisher, Revised edition 2016.
- 5) Principles of Biochemistry- Voet Donald, Voet Charlotte, Voet Judith, Wiley Publiser 4th Edition, 2012.
- 6) Fundamentals of Plant Physiology- Jain V. K., S. Chand Publishing 2017.
- 7) Biochemistry- Satyanarayan U., Elesvier publication 4th Edition, 2013.

BBTT 304 - Molecular Biology- I

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. Know about various basic concept in molecular biology.
2. Understand DNA structure & replication.
3. Study DNA alterations by mutation & repair.
4. Understand causes of DNA damage.

Credits (Total Credits 2)	SEMESTER-III BBTT 304 - Molecular Biology- I	No. of hours per unit/credits
UNIT - I		11
	<ul style="list-style-type: none">• 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_m, Cot Curve,• Buoyant Density Unit of Gene (Cistron, Recon, Muton)• One gene One Polypeptide Hypothesis	
UNIT - II		10
	<ul style="list-style-type: none">• Nucleic Acid biosynthesis: De novo synthesis of Purine and Pyrimidine ring Salvage Pathway• Synthesis of Deoxyribonucleotiden• Feedback inhibition.	
UNIT - III		12
	<ul style="list-style-type: none">• 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
	<ul style="list-style-type: none">• DNA damage & Repair: DNA damage –Base substitution, Frameshift mutation, Chemical damage, Physical breakdown• DNA repair, Excision repair, Mismatch repair, SOS repair, Photo reactivation, Recombination repair	

Course outcomes: Student should be able to...

1. Analyze the experiments behind the genetic material.
2. Understand the DNA structure & replication
3. Know the DNA alterations by mutation & repair.
4. Understand the functions of DNA

References-

- 1) Molecular Biology Of The Gene James D. Watson, A. Baker Tania, P. Bell Stephen Paperback – Pearson Education; 7th edition 2017.
- 2) Genetics–Strickberger Monroe, New Delhi Pearson Publishers, 3rd edition 2015.
- 3) Cell and Molecular Biology: Concepts and Experiments Loose Leaf - Karp Gerald, Iwasa Janet, Marshall Wallace, Wiley; 8th edition 2015
- 4) Gene XI- Levin Benjamin, Publisher- Jones & Barlett Inc. USA , Genes 7th, 8th , 9th, 10th 11th edition, by Jones & Bartlett. 2012.
- 5) Cell And Molecular Biology- De Robertis Eduardo. Publisher CCH, a Wolters Kluwer Business; Genre Technology & Engineering, 8th edition, 2017.
- 6) Genomes 4- Brown T.A., Garland Science; 4th Edition 2017.

BBTT 305 - Ecology and Environmental Biotechnology

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. Understand concept of Environmental Biotechnology
2. Study of Environmental Impact Assessment.
3. Imbibe strategies for Environmental Survey for different approaches.
4. Know various effluent treatment system.

Credits (Total Credits 4)	SEMESTER-III BBTT 305 Ecology and Environmental Biotechnology	No. of hours per unit/credits
UNIT - I	Environmental Toxicology	11
	<ul style="list-style-type: none"> • 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, Toxicants removal techniques with examples 	
UNIT - II	Bioremediation Techniques	12
	<ul style="list-style-type: none"> • Introduction of bioremediation, Definition, Principle, <i>In situ and Ex situ</i> Bioremediation, Bioremediation of waste waters • Activated Sludge Process, Solid Waste Treatment, Slurry Phase Treatment • Agricultural Bioremediation- Microbial Composting, Biogas, Land Farming and Pest Control • Bioremediation of Industrial wastes, Xenobiotics 	
UNIT - III	Biogeochemical cycle	11
	<ul style="list-style-type: none"> • Carbon cycle (Types of Carbon cycle -Marine carbon cycle, terrestrial carbon cycle), • Nitrogen cycle, Sulphur cycle, Phosphorus cycle- Significance and importance of cycles • Bio augmentation and Bio filtration, • Environmental Impact Assessment (EIA) 	
UNIT - IV	Waste water treatment	11
	<ul style="list-style-type: none"> • Introduction, sources of water pollution, Stages of waste water treatment- Preliminary, Primary, Secondary – Aerobic and anaerobic treatment, Tertiary treatment. • Waste water treatment for industry water recycling process (dairy, distillery, sugar industry) 	

	<ul style="list-style-type: none">• Waste water treatment for industry water recycling process in dairy distillery, sugar industry (raw process, differences in processing between all bio remedial techniques)	
--	---	--

Course outcomes: Student should be able to...

1. Understand about recycling, and remediation methods of different pollutants.
2. Apply the technique of remediation method for pollution control.
3. Analyze various techniques for Environmental Impact Assessment
4. Evaluate about effluent treatment system.

References-

1. Environmental Biotechnology. , Chattergy A. K., Prentice Hall India Learning Private Limited; 3rd edition, 2011.
2. Environmental Chemistry , Sharma B. K., Krishna Prakashan Media (P) Ltd. 2nd Edition 2014.
3. Environmental problems and solution., Asthana D. K. and Asthana M.S., S. Chand Publishing, 2001.
4. Fundamentals of ecology ; Odum E.P, Cengage Learning India, 5th Edition 2005
5. Environmental Biology, Verma P. S. and Agerwal V. K., S. Chand publishing 2nd Edition. 2015.
6. Biochemistry- Satyanarayan U., Elsevier publication 4th Edition, 2013.

BBTT 306 - Plant Tissue Culture

Lectures:45

Credits:02

Course Objectives: Students will be able to...

1. To make students aware of fundamentals of Plant Tissue culture
2. Study of laboratory organization for plant tissue culture.
3. Understand callus, organ, anther and pollen culture Technique.
4. Study of suspension, protoplast culture and micropropagation Technique.
5. To imbibe use and application of Plant Tissue culture

Credits (Total Credits 04)	SEMESTER-III BBTT 306 Plant Tissue Culture	No. of hours per unit/credits
UNIT - I	Overview of Plant Tissue Culture-	11
	<ul style="list-style-type: none"> • Introduction to plant tissue culture- Definition, History ,Cellular totipotency, techniques in planttissue 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 work station, precautions to maintain aseptic conditions. • Culture Medium- Nutritional requirements of explants, Plant Growth Regulator and their <i>invitro</i> • roles, composition of basal Murashige and Skoog medium and media preparation. 	
UNIT - II	Different Culture Techniques	11
	<ul style="list-style-type: none"> • Callus Culture Techniques- Introduction, principle, protocol, morphology and internal structure, genetic variations, applications. • Anther & Pollen Culture Technique- Introduction, principle, protocol, factors affecting,applications. • Organ Culture Technique- Introduction, principle, protocol, applications, with respect to root tipculture, leaf culture, ovary and ovule culture. 	
UNIT - III	Micropropagation introduction and various stages	11
	<ul style="list-style-type: none"> • Micropropagation- Introduction, stages of Micropropagation, factors affecting, advantages and applications (with suitable examples) • Different Pathways of Micropropagation- Axillary bud proliferation, somatic embryogenesis, organogenesis, meristem 	

	<p>culture (Introduction, principle, protocol, factors affecting, applications, limitations).</p> <ul style="list-style-type: none"> • Somaclonal Variation- Introduction, terminology, origin, selection at plant level, selection at cell level, mechanism, assessment, applications and limitations. 	
UNIT - IV	Applications of Plant Tissue Culture	12
	<ul style="list-style-type: none"> • 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, use of Cell suspension, hairy root and immobilized cells for production of secondary metabolites, 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. 	

Course outcomes: Student should be able to...

1. Understand about laboratory organization for plant tissue culture.
2. Know technique of preparation of plant tissue culture media.
3. Know the various techniques for plant tissue culture.
4. Apply for Job oriented skill developments of students to start or work in commercial plant tissue culture laboratory.

References:-

- 1) Introduction to plant tissue culture- Razdan M.K., Science Pub Inc; 2 edition. 2003.
- 2) Plant tissue culture-Theory & practice- Bhojwani S.S. & Razdan M. K., Elsevier Science; 1st edition. 1996.
- 3) Plant tissue culture- De K. K. New Central Book Agency (P) Ltd.; 1st edition. 2017.
- 4) Methods in Plant Tissue Culture -U.Kumar, Agro-Botanica Publishers 2nd edition. 2002.
- 5) Plant Cell, Tissue and Organ Culture: Fundamental Methods-Gamborg O. L. and Phillips G. C., Springer;1st edition 1995.
- 6) Introduction to Plant Biotechnology- Chawla H.S. Oxford and IBH Publishing Co. Pvt. Ltd. 2nd edition, 2000.

BBTP 307 - Techniques in Genetics and Cell Biology

SECTION A - Techniques in Genetics

Course objectives: Students will able to:-

1. Carry out isolation of lac negative mutants of *E.coli*
2. Carry out U.V survival curve.
3. Understand mendelian genetics concept with numerical examples.
4. Study of karyotype by using photograph rearranging.

Credits (Total Credit 02)	SEMESTER-III BBTP 307 Techniques in Genetics	No. of hours per unit/credits
1	Isolation of Lac negative mutants of <i>E. coli</i> by visual detection method	2
2	Isolation of streptomycin resistant mutants by gradient plate technique	2
3	U.V survival curve	2
4	Problems based on Mendelian Inheritance	1
5	Problems based on linkage and crossing over.	1
6	Study of karyotype by using photograph (Rearrangement of the chromosomes)	1
7	To study the chromosomal abberation with Effects of Cytotoxicity of (Any industrial effluent, dye etc.)	1

Course outcomes- Students should be able to...

1. Understand the technique of isolation of lac negative mutants of *E.coli*.
2. Perform U.V survival curve.
3. Perform the karyotyping experiments.
4. To understand the concept of mendelian inheritance with numerical.

Practical references:

1. Bacteriological techniques F. J. Baker, Butterworth & Co Publishers Ltd; 2nd Revised edition (1967)
2. Laboratory Fundamentals of Microbiology – Jeffrey C. Pommerville , Jones and Bartlett Publishers, Inc; 9th edition (29 jully 2010)
3. A Laboratory manual of Genetics- Sunita Joshi – I K International publishing house.(2016)

4. Genetics Laboratory manual – Ray Dennis and Shotwell Mark.- Kendall Hunt Publishing, 3rd edition
6. Basic and Practical Microbiology – Atlas, Macmillan Pub Co (January 1, 1986)

SECTION B - Techniques in Cell Biology

Course Objectives: The students should be able to...

1. Understand the different techniques of isolation of organelles.
2. Understand the micrometry
3. Study the dialysis technique.
4. Perform the estimation of chlorophyll.

Credits (Total Credit 02)	SEMESTER-III BBTP 307 Techniques in Cell Biology	No. of hours per unit/credits
1	Measurement of size of cell structure/cell organelle/spore by micrometry	01
2	Isolation of nucleus.	01
3	Isolation of chloroplast.	01
4	Isolation of Mitochondria.	01
5	Isolation of giant chromosomes using Drosophila / Chironomous larvae	01
6	Use of dialysis to separate smaller molecules than larger molecules.	02
7	Estimation of amount of chlorophyll present in the leaf tissue	01

Course outcomes- Students should be able to...

1. Learn the technique of micrometry for measurement of size of cell
2. Acquire the knowledge of isolation techniques for various organelles.
3. Demonstrate Dialysis technique.
4. Evaluate the estimation of chlorophyll.

Practical references-

1. Cell Biology Laboratory Manual, William H. Heidcamp ;
2. Cell biology practical manual, SRM university
3. Cell biology Laboratory Manual: Jerry D. Berlin, Kendall Hunt Pub Co., 1987.

SECTION A - Techniques in Metabolic Pathways

Course Objectives: Student will able to...

1. Learn Techniques in Metabolic Pathways and Molecular Biology.
2. Understand isolation of genetic material.
3. Study the different methods of estimation of macromolecules.
4. Acquire knowledge about DNA, Plasmid, RNA, protein electrophoresis techniques.

Credits (Total Credit 02)	SEMESTER-III BBTP 308 Techniques in Metabolic Pathways	No. of hours per unit/credits
1.	Estimation of fructose by Resorcinol method.	01
2.	Estimation of DNA by Diphenylamine method.	01
3.	Estimation of RNA by Orcinol Method.	01
4.	Cellulose acetate paper electrophoresis of Amino Acid.	01
5.	Adsorption chromatography of amino acid.	01
6.	Isolation of Amylase from germinating seed.	02
7.	Isolation of Amylase from saliva	02

Course outcomes-Students should be able to...

1. Perform electrophoresis technique.
2. Understand knowledge of laboratory equipments used in molecular biology.
3. Demonstrate isolation Purification and Quantification of DNA, RNA and Plasmid.

References:

1. HiMedia teaching kit manual.
2. Experiments in Molecular Biology ,Slater, Robert J, 2009.
3. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology, Andreas Hofmann , Samuel Clokie, Cambridge publishing house, 8th edition, 2018.
4. Molecular Biology of Gene, James D. Watson, Baker et.al., 6th Edition, 2008.
5. Genetics, Monroe W. Strickberger, 3rd Edition,2010.

SECTION B- Techniques in Molecular Biology

Course Objectives: Student will able to...

1. Understand the Techniques in Molecular Biology.
2. Understand the isolation of genetic material
3. Understand the different methods of estimation of macromolecules
4. Understand the about DNA, Plasmid, RNA, protein electrophoresis techniques.

Credits (Total Credit 02)	SEMESTER-III BBTP- 308: Techniques in Molecular Biology	No. of hours per unit/credits-02
	1. Preparation of solution for molecular biology	01
	2. Isolation of DNA from - Plant Material	01
	3. Isolation of DNA from- Animal Material	01
	4. Quantification of Genetic material	01
	5. Isolation of Genomic DNA from bacteria.	01
	6. Purification of DNA by silica membrane.	01
	7. Isolation of Plasmid from E.coli.	01
	8. Analysis of isolated DNA by agarose gel electrophoresis	01

Course outcomes-Students should be able to...

1. Understand the Preparation of solution for molecular biology
2. Understand the basic knowledge of electrophoresis technique
3. Understand the knowledge of laboratory equipments used in molecular biology.
4. Understand the techniques of isolation Purification and Quantification of DNA, RNA and Plasmid

Practical references-

1. HiMedia teaching kit manual.
2. Experiments in Molecular Biology (Springer Protocols Handbooks), Robert J. Slater, Humana; 6th edition, 2008.
3. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology ,Andreas Hofmann, Samuel Clokie,,Cambridge University Press; 8th edition, 2018.

4. Molecular Biology Of The Gene Paperback ,James D. Watson, A. Baker Tania, P. Bell Stephen, Pearson Education; 7th edition, 2017.
5. Genetics,Strickberger, Pearson Education India 3rd Edition, 2015.

BBTTP 309 - Techniques in Plant Tissue Culture and Environmental Biotechnology

Section A-Techniques in Plant Tissue Culture

Course Objectives: Student will able to...

1. Understand fundamentals of Plant Tissue culture
2. Perform Plant Tissue culture media preparation.
3. Study of callus and various micropropagation culture Techniques.
4. Understand use and application of Plant Tissue culture

Credits (Total Credit 02)	SEMESTER-III BBTP 309 - Techniques in Plant Tissue Culture	No. of hours per unit/credits
1.	Preparation of M.S. stock solutions & medium.	02
2.	Aseptic seed germination.	01
3.	Embryo culture technique.	01
4.	Micropropagation stage I-Initiation of micropropagation– Shoot axillary bud culture	01
5.	Micropropagation stage II-Subculture & multiplication of culture.	01
6.	Micropropagation stage III-Rooting- in vitro & ex vitro.	01
7.	Micropropagation stage IV-Acclimatization & hardening	01
8.	Callus culture technique- Initiation of culture, callus morphology	01
9.	Isolation of Protoplast	01

Course outcomes-Students should be able to...

1. Understand laboratory organization for plant tissue culture.
2. Perform technique of preparation of plant tissue culture media.
3. Demonstrate about various techniques for plant tissue culture.
4. Apply for 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; 1st

edition 1996.

2] Plant Cell, Tissue and Organ Culture: Fundamental Methods-Gamborg O. L. and Phillips G. C., Springer; 1st edition 1995.

Section B- Techniques in Environmental Biotechnology

Course Objectives: Student will be able to...

1. Understand the basic concepts of Hardness of water sample.
2. Study the Biological oxygen Demand test is an important water quality parameter.
3. Perform the physico-chemical properties of water samples – pH, TDS, Total hardness, BOD, COD.
4. Study the water analysis techniques.

Credits (Total Credit 02)	SEMESTER-III BBTP 309 Techniques in Environmental Biotechnology	No. of hours per unit/credits
	Effect of environmental factors on microorganisms	
	1. Determination of total and permanent hardness of water sample.	01
	2. Estimation of BOD of water sample.	02
	3. Determination of TDS of water	01
	4. Study of effect of heavy metal on growth of organisms.	01
	5. Estimation of COD of water sample.	01
	6. Routine bacteriological analysis of water Presumptive, Confirmatory, Completed and	01
	7. MPN	01
	8. IMVIC Test	01
	9. Isolation of Micro organisms from waste water resources	01
	Visit : Compulsory Visit to commercial ETP plant	

Course outcomes: Students should be able to...

1. Analyze physico-chemical properties of water samples such as pH, TDS, Total hardness, BOD, COD.
2. Perform techniques for water analysis and water quality parameters.
3. Skill developments of students to work in commercial Environmental Biotechnology laboratory.

4. Demonstrate the evaluation of hardness of water.

Practical references-

1. Practical Biochemistry (Principle and protocols) – 2nd edition – HrudayanathThatoi , Supriya Dash, Dreamtech Press - 2021
2. Environmental Science - A practical Manual –G. Swarajya Lakshmi, BS Publications; St ed.-2011
3. Practical microbiology- 5th edition – D.K.Maheshwari, S. Chand Publications - 2013
4. Laboratory manual of Microbiology and Biotechnology-2nd edition-K.R.Aneja, medtech scientific pub. -2018

SEMESTER IV	
BBTT 401	Immunology
BBTT 402	Advances in Cell Biology
BBTT403	Plant Physiology & Biochemistry
BBTT 404	Molecular Biology II
BBTT 405	Developmental Biology
BBTT 406	Animal Tissue Culture
BBTP 407	Techniques in Immunology and Cell Biology
BBTP 408	Techniques in Metabolic Pathways and Molecular Biology
BBTP 409	Laboratory exercise in Developmental Biology and Animal Tissue Culture

BBTT 401 – Immunology

Lectures: 45

Credits:02

Course Objectives: Students will be able to...

1. Study the overview of vertebrates Immune System. To understand the Types and mechanism of Defense.
2. Illustrate the Cells and Organs of immune system.
3. Understand Antigen and antibody reactions.
4. Study immune response and parasitic immunology.

Credits (Total Credits 04)	SEMESTER-III Immunology	No. of hours per unit/credits
UNIT - I	Overview of Immune system-	11
	<p>Introduction:-</p> <ul style="list-style-type: none"> • Introduction and history of vertebrates immune system • Classification of immune system • Innate (Specific and non-specific) • Acquired (Active and Passive) 	
UNIT - II	Introduction to Cells and organs of immune system	11
	<ul style="list-style-type: none"> • Cells of immune system • Broad categories of leucocytes -their role and properties • B-lymphocytes • C) T-Cells –subsets • 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	Antigen and Antibody	11
	<ul style="list-style-type: none"> • Antigen- Defination, Nature, types of antigens, factors affecting Antigencity • Antibody-Defination ,Nature, Basic structure of immunoglobulin • major human immunonoglobulin classes (Their properties and functions). 	
UNIT - IV	Immune response	12

	<ul style="list-style-type: none"> • Immune response- Primary and secondary immune response. • Antigen Antibody reactions –Principle and applications of agglutination, b)precipitation c)complement fixation d) ELISA e) neutralization • Parasitic immunology:-Immune response against Bacterial infection with reference to suitable example. 	
--	---	--

Learning Outcomes -

Course outcomes: Students should be able to...

1. Understand vertebrates ImmuneSystem.
2. Derive knowledge about Types and mechanism ofdefence.
3. Know Cells and Organs of immune system.
4. Understand Antigen and antibody reaction.

References:-

1. Kuby's Immunology- Thomas J. Kindt, W.H.Freeman & Co Ltd, 8th edition, 2006
2. General Microbiology– Roger Y.Stanier, Edward A. Adelberg, John L. Ingraham, 5th edition 1999
3. Molecular Genetics of Bacteria–Larry Snyder, Joseph E.Peters, Tino M .Henkin and Wendy champness, ASM Press 5th edition 2020
4. Textbook of Microbiology– R. Ananthanarayan and C K J Paniker, Universities Press (India) Pvt. Ltd. 9th edition 2018
5. Immunology– Dulsy Fatima, N. Arumugam, Saras publication, 2014
6. Essential Immunology, 13th edition 2017 – Peter J. Delves, Dennis, Ivan M. Roitt.

BBTT 402- Advances in Cell Biology

Lectures: 45

Credits:02

Course Objectives: Student will able to...

1. Understand the concept of cell signaling.
2. Differentiate how proteins are transported to the various organelles.
3. Study cell cycle and their control.
4. Know recite cell division.

Credits (Total Credits 2)	SEMESTER-IV BBTT 402 Advances in Cell Biology	No. of hours per unit/credits
UNIT - I	Cell Signaling	11
	<ul style="list-style-type: none"> • 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, and enzyme linked receptors. • Signaling through G-protein linked receptors - IP3 and DAG Pathway. 	
UNIT - II	Secretary pathway and protein trafficking	11
	<ul style="list-style-type: none"> • Secretary pathway • ER associated ribosomal translation • Co-translational transport of nascent polypeptide chain to ER lumen. • Transport of proteins to- mitochondria, chloroplast, peroxisomes, nucleus, Golgi apparatus. 	
UNIT - III	Cell division cycle	11
	<ul style="list-style-type: none"> • 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. 	

	<ul style="list-style-type: none"> • Programmed cell death • Necrosis 	
UNIT - IV	Mechanism of cell division	12
	<ul style="list-style-type: none"> • Introduction Types of cell division- mitosis and meiosis. • Mitosis- history, phases in mitosis, unique features of M-phase, significance. • Meiosis -history, phases in meiosis, significance. • Cancer -types, characteristics of cancer cells, causes of cancer, tumor suppressor genes, p 53. 	

Course outcomes: Students should be able to...

1. Understand the Principles and transduction pathways of cell signaling and cell surface receptor proteins.
2. Derive Secretory pathways and transport of proteins into various organelles.
3. Know Cell cycle, cell division and cellular events.
4. Understand Phases of cell division, Cancer cells, tumor suppressor genes.

References

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Molecular biology of cell, Garland Science, 5th edition. (March 21st 2002)
2. Harvey Lodish, Molecular biology & cell biology, W H Freeman & Co; 9th edition, (27 January 2021)
3. De Robertis E.D.P. ; Cell And Molecular Biology– 8th edition
4. Cell biology-Genetics, molecular biology, P.S. Varma & Agarwal, S Chand; Reprint Edn. 2006 edition (1 September 2004)
5. Benjamin Levin Gene XI, Publisher- Jones &Barlett Inc. USA , Genes 7th, 8th , 9th, 10th 11th edition, by Jones & Bartlett (November 27th 2012)
6. Gerald Karp, Cell biology, Wiley publication; 7th edition (10 May 2013)
7. Cell Biology, Dr. C. B. Powar, Himalaya Publishing House, 3rd edition (1 January 2010)

BBTT403 - Plant Physiology & Biochemistry

Lectures: 45

Credits:02

Course Objectives: Student will able to...

1. Understand basics of physiology of plants.
2. Study biochemistry in growth and development of plant.
3. Understand biosynthesis and role of plant hormones in plant.
4. Imbibe the concept of Photosynthesis and oxidative photophosphorylation.

Credits (Total Credits 2)	SEMESTER-III BBTT 403 Plant Physiology & Biochemistry	No. of hours per unit/credits
UNIT - I	Plant Water Relationship	(11)
	<ul style="list-style-type: none"> • Introduction, Absorption of water- Mechanism, Theories (Active and Passive), Translocation of water- Mechanism, Ascent of Sap, Root pressure theory, Vital theory, Bohem's theory, Transpiration- Types, Mechanism of Transpiration and factors affecting transpiration. 	
UNIT - II	Photosynthesis	(12)
	<ul style="list-style-type: none"> • Ultra structure of chloroplast, • Photosynthetic pigments, red drop and Emerson's enhancement effect, • mechanism of photosynthesis- Cyclic and non-cyclic flow of electron transfer, light reaction, dark reaction, • C-3 pathway, C-4 pathway, CAM, photorespiration. 	
UNIT - III	Respiration	(11)
	<ul style="list-style-type: none"> • 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. • Anaerobic Respiration: - Alcoholic and Lactic acid 	

	fermentation.	
UNIT - IV	Introduction to Plant Hormones	(11)
	<ul style="list-style-type: none"> • Chemistry, Biosynthesis, Distribution, mode of action and physiological effects of - Auxin, • Cytokinin, Gibberellins, Absisic acid, Ethylene • Secondary Metabolites: Biosynthesis of plant secondary metabolites (Shikimate pathway, • Mevalonate pathway, MEP pathway) 	

Course outcomes-Students should be able to...

1. Understand mechanism of plant growth and development.
2. Know about photosynthesis, respiration and biosynthesis.
3. Understand synthesis and applications of secondary metabolites
4. Apply basic concept of plant -water relation and related theories.

References

- 1) Biochemistry, Lubert Stryer, Jeremy M.Berg, John L. Tymoczko- 9th edition, 2019.
- 2) Principles of Biochemistry, Nelson and Cox, Macmilan publisher, 4th edition,2013.
- 3) Principles &Techniques of Biochemistry& Molecular Biology, Keith Wilson and John Walker Paperback publication7th edition, 2018.
- 4) Fundamentals of Biochemistry, Dr. J. L. Jain S. Chand publication,Revised edition.
- 5) Principles of Biochemistry, Donald Voet and Judith Voet, 3rd edition,2010.
- 6) Biochemistry, U. Satyanarayanan & U. Chakrapani, Book and allied pvt.ltd, 4 th edition,2009.

BBTT 404: Molecular Biology- II

Lectures: 45

Credits:02

Course Objectives: Student will able to....

1. Study the basic concepts Transcription, Translation, operon.
2. Understand the importance about molecular biology.
3. Understand the central dogma of life.
4. Study basic concept of gene expression and regulation.

Credits (Total Credits 2)	SEMESTER-IV BBTT 404: Molecular Biology- II	No. of hours per unit/credits
UNIT - I		12
	<ul style="list-style-type: none">• Transcription in prokaryote and Eukaryote.• RNA polymerase, RNA synthesis and processing (Initiation, Elongation, termination)• Regulation of mRNA stability: Capping, RNA processing, RNA editing, splicing, and polyadenylation, structure and function	
UNIT - II		11
	<ul style="list-style-type: none">• Genetic Code Triplet nature, Salient feature of genetic code, Decipheration of genetic code• Assignment of codons with Unknown sequences: i) Polyuridylic ii) Acid Method iii) Copolymers method• Assignment of codons with known sequences: i) Binding technique ii) Repetitive seq.• Technique Wobble Hypothesis, Variation in genetic code	
UNIT - III		11
	<ul style="list-style-type: none">• Translation in prokaryote and Eukaryote Structure and role of ribosome in translation,• Amino acid t-RNA complex formation, Initiation,	

	Elongation, termination of translation,	
UNIT - IV		11
	<ul style="list-style-type: none"> • Regulation of gene expression in prokaryote and eukaryote Regulation of gene expression: i) Promoter ii) Enhancers ii) Activators iii) Repressor iv) Co repressors, • Developmental and environmental regulation of gene expression: i) Lac operon ii) Tryptophan operon, iii) Galactose metabolism in yeast. 	

Course outcomes-Students should be able to...

1. Understand the scientific understanding of DNA Transcription, Translation and Gene Expression.
2. Discuss the mechanisms associated with Gene Expression at the level of Transcription and Translation
3. Understand the mechanisms associated with Regulation of Gene Expression in Prokaryotes And Eukaryotes

References

- 1) Molecular Biology Of The Gene Paperback ,James D. Watson, A. Baker Tania, P. Bell Stephen, Pearson Education; Seventh edition (26 April 2017)
- 2) Genetics 3ed Paperback, Strickberger, Pearson Education India – 1 January 2015
- 3) Karp's Cell and Molecular Biology: Concepts and Experiments Loose Leaf Gerald Karp Janet Iwasa, Wallace Marshall – Wiley; 8th edition (29 December 2015)
- 4) Lewin's GENES XI, Jocelyn Krebs, Jones& Bartlett Learning; 11th edition (December 31, 2012)
- 5) Genomes 4, T.A. Brown, Garland Science; 4th edition (21 June 2017).

BBTT-405 Developmental Biology

Lectures: 45

Credits:02

Course Objectives: Student will able to...

1. Study concept of plant embryology
2. Understand different developmental stages in plants and animals
3. Imbibe the concept of animal embryology
4. Understand concept of Differentiation and Regeneration

Credits (Total Credits 2)	SEMESTER-IV BBTT 405 Developmental Biology	No. of hours per unit/credits
UNIT - I	Plant Embryology	11
	<ul style="list-style-type: none"> • Gametogenesis and Fertilization in plants Introduction of Development of male and female Gametophyte, 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	Pollen germination and Meristem organization	11
	<ul style="list-style-type: none"> • Introduction of pollen germination(structure) , 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	Animal embryology	12

	<ul style="list-style-type: none"> • 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	Differentiation and Regeneration	12
	<ul style="list-style-type: none"> • Differentiation, Dedifferentiation, Redifferentiation, Commitment, Transdifferentiation, Developmental Plasticity • Regeneration: Definition, mechanism, factors affecting regeneration. 	

Course outcomes: Students should be able to...

1. Understand concept of plant embryology.
2. Demonstrate different developmental stages in plants and animals.
3. Understand concept of animal embryology with reference to Chick.
4. Study the Differentiation and Regeneration in plants and animals.

References

1. Developmental biology – Scoott Gilbert- 6th edition , 2001
2. Developmental biology – N. Arumugam. –Saras publications, first edition2019.
3. Developmental biology – P.S. Verma and V K. agarwal .-S.Chand publications,2000.
4. Instant notes of developmental biology - Dr Richard Twyman, Taylor & Francis publications; 1st edition (15 June 2000)
5. Foundations of Embryology – Patten by Carlson, McGraw Hill publication; 6th edition (16 January 2003)
6. Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany-Subramurti, I K International Publishing House Pvt. Ltd (30 December 2013)
7. Plant Anatomy and Embryology- S.N. Pandey, A. Chadha, S Chand; First edition) 1 may 1997)
8. Plant Anatomy – E.Cutter, Published by Edward Arnold, 1970.
9. The Embryology of Angiosperm – Bhojawani S.S. and Bhatnagar.S.P, Vikas publications (9 July 2018)
10. An Introduction to the Embryology of Angiosperm. – P.Maheswari, Nabu Press 2011.

BBTT 406 - Animal Tissue Culture

Credits – 02

45

Course Objectives: Student will able to...

1. Study the organization of animal tissue culture laboratory.
2. Know the basic concepts in animal tissue culture with understanding of different physicochemical requirements, variations in techniques.
3. Understanding different types of cell cultures.
4. Imbibe the applications of animal tissue culture.

Credits (Total Credits 2)	SEMESTER-III BBTT 406 Animal Tissue Culture	No. of hours per unit/credits
UNIT - I	Introduction to Animal Tissue Culture	11
	<ul style="list-style-type: none"> • History and Introduction of Animal Cell culture. • Requirements of Animal cell culture- substrate for cell growth, Equipment's required for animal cell culture (Laminar air flow, CO₂ 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	Biology, Characterization and growth cultured cells	12
	<ul style="list-style-type: none"> • 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 	

	<p>cell lines.</p> <ul style="list-style-type: none"> • 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. 	
UNIT - III	Respiration	11
	<ul style="list-style-type: none"> • 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, multi surface culture, multiarray disks, and tubes, Micro carrier culture, Immobilized cell culture. 	
UNIT - IV	Introduction to Plant Hormones	11
	<ul style="list-style-type: none"> • Organ and Histotypic culture-Types and maintenance of organ culture, Histotypic culture, Stemcell cultures. • Cell storage and distribution: a. Cryopreservation b. Cell repositories • Applications of cell culture-In transplantation, and tissue engineering, monoclonal antibodiesproduction, ethics and morality, production of vaccine via animal cell culture e.g. COVID-19. 	

Course outcomes: Students should be able to...

1. Understand basic knowledge of animal tissue culture.
2. Derive knowledge about laboratory organization and safety.
3. Known techniques of preparation of ATC media.
4. Apply the ethics of animal tissue culture techniques.

References:

1. Freshney, I.; Culture of Animal Cells, 7thEdition, Wiley & Sons, Inc., USA.
2. Animal Cell Culture- Practical Approach, Masters, J., Oxford University Press,USA; 3rd Edition, 2000
3. Principles and Practice of Animal Tissue Culture, Gangal, S.; 2nd Edition, University Press,India
4. Animal cell culture- 3rd edition , August 24th 2000 by Oxford University Press,USA
5. Animal biotechnology, M.M.Ranga; CBS Publishers PVT. LTD., 1st edition 2007
6. Animal biotechnology, R. Sasidhara ; MJP Publishers,1st edition March 15th 2015
7. Animal cell culture technique, Martin Clynes; , 2nd edition, by Springer, June 16th 1998

BBTP 407 - Techniques in Immunology and Cell Biology

SECTION B - Techniques in Immunology

Course Objectives: Student will able to...

1. Understand antigen antibody reactions.
2. Study serological tests.
3. Know cells Organelles, Chromosomes.
4. Understand the disease epidemiology.

Credits (Total Credit 02)	BBTP 307 - Techniques in Immunology	No. of hours per unit/credits
1	Widal test– Quantitative	2
2	Radial immuno diffusion Assay	2
3	Immuno electrophoresis-Qualitative	2
4	Double Immuno diffusion Technique	2
5	Enzyme linked immune sorbent assay ELISA-dot ELISA	1
6	Rapid Plasma Reagin (RPR) card test	1
7	Case study: Any bacterial(T.B/Pnemonia) /Viral (Covid -19) disease – Introduction, Mode of Infection, Epidemiology and preventive measures etc.	-----

Course Objectives: Student Should be able to...

1. Analyze antigen antibody reactions.
2. Demonstrate serological tests.
3. Know cells Organelles, Chromosomes.
4. Understand the disease epidemiology.

References:

1. Lab manual of immunology –Dr. Julie Jameson.
2. Practical immunology A Laboratory Manual- Senthilkumar Balkrishnan, Lap Lambert Academic Publishing, 1st edition, 2017
3. Immunology: A laboratory Manual –Richard L. Myers. William C Brown Pub; 1st edition (June 1,

1989)

4. Experimental Cell Biology Laboratory Manual, William H. Heidcamp, William H. Heidcamp publication, 1992
5. Cell biology practical manual - SRM university
6. Cell biology Laboratory Manual - Jerry D. Berlin ; Kendall Hunt Pub Co (1 Dec 1987)

SECTION B - Techniques in Cell Biology

Course Objectives: The students should be able to...

1. Understand the different techniques of Membrane permeability.
2. Study different methods of cell lysis.
3. Understand Mitosis and Meiosis stages.
4. Study separation of chromosomes.

Credits (Total Credit 02)	SEMESTER-III BBTP 407 Techniques in Cell Biology	No. of hours per unit/credits
1	Effect of temperature and organic solvent on membrane permeability of cells.	02
2	Study of mitosis and preparation of slides and identification of different stages.	01
3	Study of Meiosis and preparation of slides and identification of different stages.	02
4	Study of plasmolysis and Deplasmolysis.	01
5	Study of separation of chromosome by paradichlorobenzene (PDB).	01
6	Study of methodology of cell lyses.	01
7	Karyotype analysis by Rheo.	01

Course Objectives: The students should be able to...

1. Demonstrate the different techniques of Membrane permeability.
2. Perform different methods of cell lysis.
3. Differentiate Mitosis and Meiosis stages.
4. Perform experiment for separation of chromosomes.

Practical references-

1. Experimental Cell Biology Laboratory Manual, William H. Heidcamp, William H. Heidcamp publication, 1992
2. Cell biology practical manual, SRM university
3. Cell biology Laboratory Manual - Jerry D. Berlin ; Kendall Hunt Pub Co (1 Dec 1987)

BBTP 408: Techniques in Metabolic Pathways and Molecular Biology

SECTION A - Techniques in Metabolic Pathways

Course objectives: Student will able to...

1. Understand Techniques in Metabolic Pathways and Molecular Biology.
2. Perform Gel Filtration Chromatography.
3. Study the Ion exchange chromatography.
4. Understand activity of nitrate reductase.

Credits (Total Credit 04)	SEMESTER-IV BBTP 408: Techniques in Metabolic Pathways	No. of hours per unit/credits
1	Gel Filtration Chromatography	02
2	Ion exchange chromatography using DEAE Cellulose	02
3	Study of lipase activity.	01
4	Study of activity of nitrate reductase	01
5	Industrial visit to Demonstrate GLC, HPLC, LCMS, GCMS	01

Course outcomes: Students should be able to...

1. Know the Techniques in Metabolic Pathways and Molecular Biology.
2. Demonstrate Gel Filtration Chromatography.
3. Study the Ion exchange chromatography.
4. Analyze activity of nitrate reductase.

References:

1. Experiments in Molecular Biology, Slater, Robert J, 2009.
2. Principles & techniques of Molecular biology, Wilson & Walker's, Paperback publication, 5th edition, 2013.
3. Molecular Biology of Gene, James D. Watson, Baker et.al., 6th Edition, 2008
4. Genetics, Monroe W. Strickberger, 3rd Edition, 2010.

SECTION B - Techniques in Molecular Biology

Course objectives: Student will able to...

1. Carry out isolation of genetic material.
2. Perform the different methods of estimation of macromolecules
3. Understand the techniques in Molecular Biology.
4. Understand the knowledge about DNA, Plasmid, RNA, protein electrophoresis techniques.

Credits (Total Credit 04)	SEMESTER-IV BTP 408: Techniques in Molecular Biology	No. of hours per unit/credits-04
	1. Determination of T _m of DNA. 2. Restriction digestion of DNA. 3. Isolation of RNA from animal tissue. 4. Agarose gel electrophoresis to separate RNA. 5. SDS-PAGE for separation of protein CBB staining.	

Course outcomes: Students should be able to...

1. Understand the basic knowledge about electrophoresis
2. Able to perform technique of DNA, RNA, and Plasmid isolation
3. Understand the SDS-PAGE method
4. Determination of T_m of DNA.

Practical references:

1. Experiments in Molecular Biology (Springer Protocols Handbooks), Robert J. Slater, Humana; 1986th edition (7 February 2008)
2. Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology, Andreas Hofmann, Samuel Clokie, Cambridge University Press; 8th edition (19 April 2018)
3. Lewin's GENES XI, Jocelyn Krebs, Jones & Bartlett Learning; 11th edition (December 31, 2012)
4. Genetics 3ed Paperback, Strickberger, Pearson Education India – 1 January 2015

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

SECTION A - Laboratory exercise in Developmental Biology

Course Objectives: student will able to...

1. Study concept of plant and animal embryology.
2. Understand different developmental stages in plants and animals
3. Study the different methods of Dissection, staining, Mounting etc.
4. Perform Pollen germination incompatibility.

Credits (Total Credit 04)	SEMESTER-IV BBTP 409- Laboratory exercise in Developmental Biology	No. of hours per unit/credits
	1. Methods of studying plant development a. Dissection b. Sectioning c. Maceration d. Staining e. Mounting	02
	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)	01
	7. Pollen germination incompatibility	01

Course outcomes: Students should be able to...

1. Understand different developmental stages in plants and animals.

2. Understand plant and animal embryology.
3. Demonstrate different developmental stages in plants and animals
4. Perform different methods of Dissection, staining, Mounting etc.
5. Demonstrate Pollen germination incompatibility.

Practical references:

1. Animal cell and tissue culture manual; SRM university 2002
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).

SECTION B - Laboratory exercise in Animal Tissue Culture

Course Objectives: Student will able to...

1. Understand animal tissue culture.
2. Knowledge about laboratory organization and safety.
3. Study techniques of preparation of ATC media.
4. Understand the ethics of animal tissue culture techniques.

Credits (Total Credit 04)	SEMESTER-IV BBTP 409 Laboratory exercise in Animal Tissue Culture	No. of hours per unit/credits
1	Laboratory organization for Animal tissue culture	01
2	Sterilization procedures and media preparation for Animal Cell cultures	01
3	Preparation of Serum.	01
4	Growth studies by viable cell count analysis.	01
5	Estimation of Hemoglobin	01
6	Validation of Autoclave by gamma radiation strips.	01`
7	Compulsory Visit to commercial Tissue Culture Lab	01

Course outcomes: Students should be able to...

1. Understand the organization of animal tissue culture Laboratory.
2. Knowledge about laboratory organization and safety.
3. Perform techniques of preparation of ATC media.
4. Understand the ethics of animal tissue culture techniques.
5. Apply to work in animal tissue culture Laboratory.

Practical references:

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.