

# **Mahakaushal University, Jabalpur (M.P.)**



## **Scheme & Syllabus**

**For**

**B.Sc. with Research/honors**

**Biotechnology**

**2022-23**

**Duration of Course: 4 Years**

**Examination Mode: Semester**

**Examination System: CBCS**

**Mahakaushal University  
Village-Aithakheda, Mukunwara Road, Post- Tilwara Jabalpur (M.P.) 482003**

## Credit Distribution

SEMESTER SYSTEM			Credits Required								
			Sem	MJ	MI	DSE	GEC/ OEC	AECC	SEC SB/VB	FW	Total Credit
Level 5	Certificate	1 <sup>st</sup> Year Pass (Sem I+Sem II)	I	6	6		4	4			<b>20</b>
			II	6	6		4	4			<b>20</b>
Level 6	Diploma	2 <sup>nd</sup> Year Pass (Sem III+Sem IV)	III	6	6		4		4		<b>20</b>
			IV	6	6		4		4		<b>20</b>
Level 7	Degree	3 <sup>rd</sup> Year Pass (Sem V+Sem VI)	V	6		4			4	6	<b>20</b>
			VI	6		8				6	<b>20</b>
Level 8	Honors/ Research	4 <sup>th</sup> Year Pass (Sem VII+Sem VIII)	VII	6	4	4				6	<b>20</b>
			VIII	6	4					10	<b>20</b>
		<b>Total Credit</b>		<b>48</b>	<b>32</b>	<b>16</b>	<b>16</b>	<b>8</b>	<b>12</b>	<b>28</b>	<b>160</b>

SEMESTER SYSTEM			Credits Required								
			MJ	MI	DSE	GEC/ OEC	AECC	SEC SB/VB	FW	Total Credit	
Level 5	Certificate	1 <sup>st</sup> Year Pass	12	12		8	8			<b>40</b>	
Level 6	Diploma	2 <sup>nd</sup> Year Pass	12	12		8		8		<b>40</b>	
Level 7	Degree	3 <sup>rd</sup> Year Pass	12		12			4	12	<b>40</b>	
Level 8	Honors/ Research	4 <sup>th</sup> Year Pass	12	8	4				16	<b>40</b>	
		<b>Total Credit</b>	<b>48</b>	<b>32</b>	<b>16</b>	<b>16</b>	<b>8</b>	<b>12</b>	<b>28</b>	<b>160</b>	

### For Regular Students Course Duration:

Min. Years for Completing UG Degree	3 Years
Min Years for Completing UG (Hons.) Degree	4 Years
Maximum Years for Completing UG Degree	6 Years
Max Years for Completing UG (Hons.) Degree	8 Years

<b>Faculty of Science</b>									
<b>Major: Biotechnology</b>									
<b>Sem</b>	<b>Major</b>	<b>Minor</b>	<b>DSE</b>	<b>Open Elective/ Generic Elective</b>	<b>AECC</b>	<b>SEC</b>		<b>FW</b>	<b>Total Credits</b>
						<b>Skill Based</b>	<b>Value Based</b>		
1	MJ-I (4+2)	MN-I (4+2)		OEC-I (4)	AECC-I (4)				<b>20</b>
2	MJ-II (4+2)	MN-II (4+2)		OEC-II (4)	AECC-II (4)				<b>20</b>
3	MJ-III (4+2)	MN-III (4+2)		OEC-III (4)		SECSB-I (4)			<b>20</b>
4	MJ-IV (4+2)	MN-IV (4+2)		OEC-IV (4)		SECSB-II (4)			<b>20</b>
5	MJ-V (4+2)		DSE-I (4)				SECVB (4)	Field Work (6)	<b>20</b>
6	MJ-VI (4+2)		DSE-II (4) DSE-III (4)					Internship (6)	<b>20</b>
7	MJ-VII (4+2)	MN-V (4)	DSE-IV (4)					Minor Project (6)	<b>20</b>
8	MJ-VIII (4+2)	MN-VI (4)						Major Research Project (10)	<b>20</b>
<b>Total Credits</b>	<b>48</b>	<b>32</b>	<b>16</b>	<b>16</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>28</b>	<b>160</b>

## Major/Minor

Course Code	Category	Paper	Credits
BBTC101T	MJ/MI	Cell Biology and Genetics	4
BBTC101P	MJ/MI	Cell Biology and Genetics Lab	2
BBTC201T	MJ/MI	Biochemistry	4
BBTC201P	MJ/MI	Biochemistry Lab	2
BBTC301T	MJ/MI	Molecular Biology	4
BBTC301P	MJ/MI	Molecular Biology Lab	2
BBTC401T	MJ/MI	Intermediary Metabolism	4
BBTC401P	MJ/MI	Intermediary Metabolism Lab	2
BBTC501T	MJ/MI	Immunology	4
BBTC501P	MJ	Immunology Lab	2
BBTC601T	MJ/MI	General Microbiology	4
BBTC601P	MJ	General Microbiology Lab	2
BBTC701T	MJ	rDNA Technology	4
BBTC701P	MJ	rDNA Technology Lab	2
BBTC801T	MJ	Applied Microbiology	4
BBTC801P	MJ	Applied Microbiology Lab	2

## Department Specific Elective

BBTC101D-I	DSE	Bioinstrumentation	4
BBTC101D-II	DSE	Bioprocess Technology	4
BBTC102D-I	DSE	Biostatistics and Bioinformatics	4
BBTC102D-II	DSE	Enzyme Technology	4
BBTC103D-I	DSE	Plant Biotechnology	4
BBTC103D-II	DSE	Animal Biotechnology	4
BBTC104D-I	DSE	Environmental Biotechnology	4
BBTC104D-II	DSE	IPR, Biosafety and Bioethics	4

## Skill Enhancement Course (Skill Based) (Any Two)

Course Code	Category	Paper	Credits
BBTC101SB	SEC-SB	Molecular Diagnostics	4
BBTC102SB	SEC-SB	Enzymology	4
BBTC103SB	SEC-SB	Industrial Fermentations	4
BBTC104SB	SEC-SB	Medical Laboratory Technology	4
BBTC105SB	SEC-SB	Basics of Forensic Science	4

### Open Elective Compulsory Course/ Generic Elective Compulsory Course

Course Code	Category	Paper	Credits
OECC101-I	OEC	Fundamental of Computer	4
OECC101-II	OEC	Environmental Studies	4
OECC102-I	OEC	Entrepreneurship	4
OECC102-II	OEC	Principle of Management	4
OECC103-I	OEC	Nutrition and Fitness	4
OECC103-II	OEC	Current Concerns in Public Health Nutrition	4
OECC104-I	OEC	Travel and Tourism	4
OECC104-II	OEC	Tourism Operation Software Skills	4

### Ability Enhancement Compulsory Course

Course Code	Category	Paper	Credits
AECC101	AECC	English Language-I	4
AECC102	AECC	English Language-II	4

### Skill Enhancement Course (Value Based) (Any One)

Course Code	Category	Paper	Credits
SECVB101	SEC-VB	Constitution of India	4
SECVB102	SEC-VB	Yoga in Life	4
SECVB103	SEC-VB	National Service Scheme (NSS)	4
SECVB104	SEC-VB	Health & Wellness	4
SECVB105	SEC-VB	Sports	4

### Field Work

Course Code	Category	Paper/Description	Credits
BFWF-501	FW	Field work is the process of observing and collecting data about people, cultures, and natural environments.	6
BFWI-601	FW	The aim of the internship provides a direction to the activities, helps to focus on a result, and to assess the result achieved.	6
BFWP-701	FW	The objective of the minor project is to provide an opportunity for students to undertake short research training outside the classroom to solve real-world issues.	6
BFWR-801	FW	Project objectives describe the desired outcome of a project, which is often a tangible object. It's beneficial to create objectives for your project because creating a specific goal for you helps everyone know what they're supposed to be working toward.	10

## **BBTC101T: Cell Biology and Genetics**

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**4 0 2**

### **Unit-I**

**(12 Lectures)**

Cell as a basic unit: Discovery of the cells, Structure of plant and animal cell. Development of cell theory: Prokaryotic and Eukaryotic cell organization. Membrane Architecture: Unit membrane model, Fluid mosaic model. Cell Cycle Mitosis and Meiosis.

### **Unit-II**

**(12 Lectures)**

Ultra-structure and Function of Organelles: Nucleus, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi, Ribosomes, Lysosomes, Vacuoles, Peroxisomes and Glyoxisomes.

### **Unit-III**

**(14 Lectures)**

Mendelian Genetics: Definitions of common terms in genetics- Phenotype, genotype, heterozygous, homozygous, allele, gene, gene locus, pure line, hybrid, Mendel's laws. Monohybrid cross, Dihybrid cross, Test cross, Back cross and Incomplete dominance.

### **Unit-IV**

**(10 Lectures)**

Interaction of factors: Complementary, lethal and epistatic. Linkage and crossing over in ze mays. Polygenic inheritance.

### **Unit-V**

**(12 Lectures)**

Sex linked and limited inheritance, sex determination in Drosophila, Genic balance theory of determination. Sex determination in human being. Brief outline of allosomal (Klinefelter syndrome), autosomal (Down syndrome) disorders. Population Genetics - Hardy – Weinberg law.

## Reference Books:

- Cell Biology – Gerald Karp, McGraw-Hill, 1979
- De Robertis, E.D.P and De Robertis E.M.F., 2001, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, New York.
- Gardner, E.J. & Snusted, D.P. (1984): Principles of Genetics (7th edition) John Wiley & Sons, N.Y.
- Lewin, B. (1985): Genes IV Wiley Eastern Ltd.,
- Sinnott, E.W., L.C. Dunn & J. Dobshansky (1958): Principles of Genetics (5<sup>th</sup> Edition) McGraw Hill Publishing Co., N.Y. Toronto, London

## **BBTC101P: Cell Biology and Genetics Lab**

### **Practical:**

1. Equipment used in laboratory, general practice and maintenances
2. Identification of various stages of cell division (mitosis and meiosis).
3. Mitosis and Meiosis – onion root tip and grasshopper testis squash methods
4. Isolation of genomic DNA from bacterial culture
5. Isolation of genomic DNA from plant tissue.
6. Quantification of DNA using UV spectrophotometer.
7. Agarose gel electrophoresis of genomic DNA.

### **Reference Books:**

- Molecular Cloning by J. Sambrook and D. W. Russell (2001). Cold Spring Harbour Lab. Press.
- A short course in Bacterial Genetics by J.H. Miller (1992) Cold Spring Harbor Laboratory.
- Methods for Genetics and molecular Bacteriology by Ed. RGF Murray, WA. Wood & NB krieg (1994) American society for Microbiology



## **BBTC201T: Biochemistry**

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**4 0 2**

### **Unit-I**

**(12 Lectures)**

Atoms, molecules, Bonding – types, Water – properties, Acids, Bases and Buffers. Chemistry of Carbohydrates: Atoms, bonding, acid, base and buffer. Definition and Classification of carbohydrates, linear and ring forms (Haworth formula) for monosaccharides for glucose and fructose. Disaccharides - sucrose and lactose. Mutarotation, Oxidation, Reduction. Disaccharide - sucrose and lactose - occurrence, structure; Polysaccharides: starch and cellulose - occurrence, structure. Functions of carbohydrates.

### **Unit-II**

**(12 Lectures)**

Aminoacids - biological role. General structure of amino acids. 3- letter abbreviation. Classification of amino acids based on nature of R group (polar, non-polar, acidic, basic, neutral). Modified amino acids in protein, non-protein amino acids. Levels of organization of protein structure – primary structure – composition, Secondary structure –  $\alpha$  helix (egg albumin),  $\beta$  - pleated sheath (keratin), triple helix (collagen). Tertiary structure –with reference to myoglobin. Quaternary structure with reference to haemoglobin.

### **Unit-III**

**(12 Lectures)**

Lipids- Chemical nature, biological functions and classification of lipids. Fatty acids – definition, classification – saturated, unsaturated, hydroxy and cyclic fatty acids - structure and properties of fatty acids. Simple and mixed triglycerides – structure and general properties. Characterization of fats – iodine value, saponification value, acid number, Reichert-Meissl number.

### **Unit-IV**

**(12 Lectures)**

Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA: A, B, C, Z DNA, structure and biological significance, superhelicity. Isolation, purification, identification and estimation of DNA. Properties of DNA

– hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.

## **Unit-V**

**(12 Lectures)**

Enzymes: Occurrence, cellular localization. Nomenclature, classification, EC Number. Enzyme properties (kinetics), Enzyme preparation and purification. Catalytic activity, Specific activity, Turn over, Mechanism of action, model and theories of enzyme action. Clinical significance-inborn errors (phenyl ketone urea).

### **Reference Books:**

- Donald Voet, Judith G. Voet and Charlotte W. Pratt, “Fundamentals of Biochemistry – Life at the molecular level”. John Wiley and Sons, Inc., Asia, 2006.
- Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, “Harper’s Illustrated Biochemistry”. McGraw Hill Education (Asia), 2006.
- Jeremy M. Berg, John L. Tymozko and Lubert Stryer, “Biochemistry”, Fifth edition, W.H. Freeman and Company, New York, 2002.
- David L. Nelson and Michael M. Cox, “Lehninger Principles of Biochemistry” Fourth Edition, W H Freeman and Company, New York, 2005.

## **BBTC201P: Biochemistry Lab**

### **Practical:**

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

### **Reference Books:**

- An Introduction to Practical Biochemistry by Rodney Boyer (2003). Pearson Education.
- Laboratory Manual of Biochemistry by J.Jayaraman (1988) Wiley Eastern
- Practical Biochemistry by Wilson and Walker (1994). Cambridge University Press
- Handbook of Laboratory culture media, Reagents, Stains and Buffers by N. Kannan (2003), Panima Publishers, New Delhi

## **BBTC301T: Molecular Biology**

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### **Unit-I**

**(10 Lectures)**

Experiments on genetic material (Griffith, Hershey and Chase; Avery and McCarty experiments); Watson and Crick model; Chargaff's rule. Genome Organization: Prokaryotic and Eukaryotic; Chromosome: structure and function, Chromatin (Hetero and Euchromatin); Chloroplast and Mitochondrial DNA; Gene families and Clusters.

### **Unit-II**

**(14 Lectures)**

Replication: Prokaryotic and Eukaryotic DNA replication; Transcription: Mechanism (Prokaryotic and Eukaryotic); Post transcriptional modification (Polyadenylation and capping) and splicing mechanism; Translation: Genetic code; mechanism of translation; Post translational modifications (Phosphorylation, methylation, glycosylation, Acetylation, ubiquitination and lipidation).

### **Unit-III**

**(12 Lectures)**

DNA repair mechanisms; Mutations: Mutagenesis, Types of Mutations, Biochemical basis of mutants, Mutational Hot Spots, Reversion; Transposable elements (Insertion Sequence and transposons, Integrons and Antibiotic Resistance Cassettes).

### **Unit-IV**

**(12 Lectures)**

Gene Regulation mechanisms: General aspects of Regulation, The lactose system and the operon model, The Galactose operon, The Tryptophan operon, Concept of Feedback Inhibition.

### **Unit-V**

**(12 Lectures)**

Chromosomal Variations and Mapping: Chromosomal aberrations (in Number & Structure) – Ploidy and structural aberrations; Position Effect; Chromosome Mapping. Oncogenesis: Development, causes and types of cancer; Oncogenes: proto and tumor suppressor gene.

## **Reference Books:**

- Lodish H., 2016, Molecular Cell Biology, 8th edition, W. H Freeman and company, New York.
- De Robertis, E.D.P and De Robertis E.M.F., 2001, Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, New York.
- Friefelder D., 2009, Molecular Biology, 2nd Edition, Narosa Publishing House, New Delhi.
- Lewin B., 2008, Genes IX, Jones and Bartlett, Burlington.
- Rastogi, S.C., 2004, Cell Biology, 2nd Edition, New Age International Publishers, New Delhi.

## **BBTC301P: Molecular Biology Lab**

### **Practical:**

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity.

### **Reference Books:**

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

## **BBTC401T: Intermediary Metabolism**

**L T P**  
**4 0 2**

### **Unit-I**

**(14 Lectures)**

Bioenergetics: Molecular basis for evolution. Principles of thermodynamics - free energy functions - ATP as main carrier of free energy. Carbohydrates – Glycolysis, citric acid cycle, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma amino butyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Hormonal regulation of carbohydrate metabolism.

### **Unit-II**

**(12 Lectures)**

Amino Acids – General reactions of amino acid breakdown and synthesis, scheme - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids. Urea cycle and its regulation.

### **Unit-III**

**(10 Lectures)**

Lipids –Introduction, hydrolysis of tri-acylglycerols, oxidation of fatty acids. Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, Lipid biosynthesis, Metabolism of cholesterol and its regulation.

### **Unit-IV**

**(12 Lectures)**

Nucleotides – Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway. Biosynthesis of deoxyribonucleotides and polynucleotides including inhibitors of nucleic acid biosynthesis. Porphyrins – Biosynthesis and degradation of porphyrins. Production of bile pigments.

### **Unit-V**

**(12 Lectures)**

Coenzymes and Cofactors–Role and mechanism of action of NAD<sup>+</sup>/NADP<sup>+</sup>, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B12 coenzymes and metal ions with specific examples.

## Reference Books:

- Donald Voet, Judith G. Voet and Charlotte W. Pratt, “Fundamentals of Biochemistry – Life at the molecular level”. John Wiley and Sons, Inc., Asia, 2006.
- Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, “Harper’s Illustrated Biochemistry”. McGraw Hill Education (Asia), 2006.
- Jeremy M. Berg, John L. Tymozko and Lubert Stryer, “Biochemistry”, Fifth edition, W.H. Freeman and Company, New York, 2002.
- David L. Nelson and Michael M. Cox, “Lehninger Principles of Biochemistry” Fourth Edition, W H Freeman and Company, New York, 2005..



## **BBTC401P: Intermediary Metabolism Lab**

### **Practical:**

1. Isolation of genomic DNA from bacterial culture
2. Isolation of genomic DNA from plant tissue.
3. Quantification of DNA using UV spectrophotometer.
4. Agarose gel electrophoresis of genomic DNA.

### **Reference Books:**

- Donald Voet, Judith G. Voet and Charlotte W. Pratt, “Fundamentals of Biochemistry – Life at the molecular level”. John Wiley and Sons, Inc., Asia, 2006.
- Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, “Harper’s Illustrated Biochemistry”. McGraw Hill Education (Asia), 2006.
- Jeremy M. Berg, John L. Tymozko and Lubert Stryer, “Biochemistry”, Fifth edition, W.H. Freeman and Company, New York, 2002.
- David L. Nelson and Michael M. Cox, “Lehninger Principles of Biochemistry” Fourth Edition, W H Freeman and Company, New York, 2005.

# **BBTC501T: Immunology**

**L T P**  
**4 0 2**

## **Unit-I**

**(12 Lectures)**

Basics of Immune System: Historical perspectives and overview of immune system – Immunity – Classification: Innate, Acquired (Natural, Artificial - Active and Passive) – Innate: Anatomic, Physiological, Phagocytic and Inflammatory barriers – Acquired: Two arms (Humoral and Cellular), Haematopoiesis – Cells, tissues and organs of the immune system – their structure and functions – Interrelationship between innate and adaptive immunity.

## **Unit-II**

**(12 Lectures)**

Antigens Definition and types – Antigenicity – immunogen and immunogenicity – properties - epitope – hapten – adjuvants – Immune response and its types – Antibodies - structure – types – function – Clonal selection theory – Monoclonal Antibodies and its applications - Hybridoma Technology for MAb production- Complement – structure -properties – functions of complement components and pathways.

## **Unit-III**

**(12 Lectures)**

Antigen-Antibody Interactions: Definition, different levels of interactions - types – in vitro methods – agglutination – precipitation – ABO Blood grouping and Rh typing - ELISA – RIA – IF – Flowcytometry – HA & HI – CFT – in vivo methods – Skin tests - immune complex tissue demonstrations..

## **Unit-IV**

**(12 Lectures)**

Cell Mediated Immunity: T-cells and types - Antigen processing and presentation – Major histocompatibility complex – Class 1 & 2. Cytokines: Interleukins and interferons - Cytokine receptors – Hypersensitivity – Definition - Gell and Coombs classification – Antibody mediated: Anaphylaxis (IgE mediated), Cytotoxic (antibody-dependent), immune complex mediated - Delayed type hypersensitivity - Autoimmune diseases - Immune tolerance.

## Unit-V

(12 Lectures)

Transplantation immunology – Blood Transfusion reactions – Tissue and Organ transplantation - Graft rejection – Graft vs Host reaction – Tumor immunology – tumor associated antigens. Immune response to tumor - Vaccines – Immunization types – Vaccine types – live attenuated vaccines, killed vaccines, purified polysaccharide vaccines – toxoid vaccines – recombinant vaccines and DNA vaccines..

### Reference Books:

- Punt J, Sharon Stranford, Patricia Jones and Judith A Owen. J. Kuby Immunology (2018) 8th ed. WH Freeman.
- Roitt, I.M., M.David Roth, Jonathan Brostoff and David Male (Editors). Immunology (2012) 8th Edn, Elsevier Saunders, London, UK.
- Richard Coico and Geoffrey Sunshine. Immunology: A Short Course, (2015) 7th Edn, Wiley Blackwell, NY,
- Gabriel Virella (Editor) Medical Immunology (2001) 5th Edition, Marcel Dekkar, NY.
- Weir M. D. and J. Stewart, Immunology (1997), 8th Ed., Churchill Livingston, USA.
- Roitt, I.M., Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Roitt's Essential Immunology (2017) 13th Edition, Wiley-Blackwell Publishers, UK
- Hyde R. M., Microbiology and Immunology (2012), 3rd Edition. Springer Science & Business Media.
- Ananthanarayanan R and C.K.Jayaram Paniker, Textbook of Microbiology, (2005) 7th ed., Orient Longman Publishers.
- Pelczar M.J., E.C.S. Chan and N. R. Krieg, Microbiology, (2001), 5th ed., McGraw Hill Publications

## **BBTC501P: Immunology Lab**

### **Practical:**

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

### **Reference Books:**

- Punt J, Sharon Stranford, Patricia Jones and Judith A Owen. J. Kuby Immunology (2018) 8th ed. WH Freeman.
- Roitt, I.M., M.David Roth, Jonathan Brostoff and David Male (Editors). Immunology (2012) 8th Edn, Elsevier Saunders, London, UK.
- Richard Coico and Geoffrey Sunshine. Immunology: A Short Course, (2015) 7th Edn, Wiley Blackwell, NY,
- Gabriel Virella (Editor) Medical Immunology (2001) 5th Edition, Marcel Dekkar, NY.
- Weir M. D. and J. Stewart, Immunology (1997), 8th Ed., Churchill Livingstone, USA.
- Roitt, I.M., Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Roitt's Essential Immunology (2017) 13th Edition, Wiley-Blackwell Publishers, UK
- Hyde R. M., Microbiology and Immunology (2012), 3rd Edition. Springer Science & Business Media.
- Ananthanarayanan R and C.K.Jayaram Paniker, Textbook of Microbiology, (2005) 7th ed., Orient Longman Publishers.
- Pelczar M.J., E.C.S. Chan and N. R. Krieg, Microbiology, (2001), 5th ed., McGraw Hill Publications

## **BBTC601T: General Microbiology**

**L T P**  
**4 0 2**

### **Unit-I**

**(12 Lectures)**

Introduction – Definition, scope and history of microbiology. Classification of microorganisms – general principles and nomenclature – Haeckel’s three kingdom concept, Whittaker’s five kingdom concept. Classification and characterization of bacteria according to Bergey’s Manual of Systematic Bacteriology (9th edition). Basic understanding of classification of viruses, algae, fungi and protozoa.

### **Unit-II**

**(16 Lectures)**

Microscopy: Principles and applications of simple, compound, bright field, dark field, phase contrast, fluorescent and electron microscopy. Principles of staining: types of staining – simple, differential, negative and spore staining, Sterilization : Principles and methods – physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorites).

### **Unit-III**

**(10 Lectures)**

General structure and characteristics and nature of Archaeobacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

### **Unit-IV**

**(10 Lectures)**

Types of media: simple, defined, differential, selective, enriched, enrichment and transport media with specific examples for each type. Isolation and purification of cultures from different samples. Growth curve: Diauxy - continuous culture – chemostat – turbidostat - synchronized growth. Measurement of microbial growth – Total cell count method - viable cell count method and biomass determination.

## Unit-V

(12 Lectures)

Nutritional types of Microorganisms. Effect of environment on microbial growth: - Temperature, pH, water activity, oxygen concentration, salt concentration, pressure and radiation. Determination of levels of antimicrobial activity. Methods of maintenance and preservation of microbes. Methods of bacterial identification.

### Reference Books:

- Kochhar, I. Bernard D. Davis. Renato Dulbecco. Herman N. Eisen. and Harold, S. Ginsberg. (1990). Microbiology (4th edition). J.B. Lippincott company, New York.
- Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore.
- Prescott L.M. Harley J.P. and Klein D.A. (2003). Microbiology (5th edition) McGraw Hill, New York.
- Madigan, M.T. Martinko. J.M and Parker J Brock T.D. (2017) Biology of Microorganisms. (15<sup>th</sup> edition). Prentice Hall International Inc, London.
- Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (2006). Microbiology, Mc. Graw Hill. Inc, New York.
- Salle, A.J. (1996). Fundamental principles of Bacteriology. (7th edition). Tata McGraw-Hill publishing company Ltd, New Delhi.
- James G. Cappuccina, Natalie Sherman. (1996). Microbiology – A laboratory manual, The Benjamin (Cummings Publishing Company, Inc.)
- Mackie and McCartney. (1989). Practical Medical Microbiology, Churchill Livingstone.
- Stainer, Ingham, Wheelis and Painter. 1987. General Microbiology. 5th Edition. Macmillan Education, London.
- Powar and Dagainawala. 2010. General Microbiology. Volume I & II. Himalaya Publishing House.
- A Text book of Microbiology. Dubey, RC and Maheswari DK (2005). S. Chand & Company Ltd., New Delhi.
- Tortora, G.J., Funke, B.R. and Case, C.L. 2012. Microbiology - An Introduction. 11th Edition. Pearson Education.

## **BBTC601P: General Microbiology Lab**

### **Practical:**

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

### **Reference Books:**

- Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4<sup>th</sup> edition. John and Sons, Inc.
- Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7<sup>th</sup> edition, CBS Publishers and Distributors, Delhi, India.
- Kumar HD. (1990). *Introductory Phycology*. 2<sup>nd</sup> edition. Affiliated East Western Press.
- Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12<sup>th</sup> edition. Pearson/Benjamin Cummings.
- Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5<sup>th</sup> edition. McGraw Hill Book Company.
- Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5<sup>th</sup> edition. McMillan.
- Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9<sup>th</sup> edition. Pearson Education.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7<sup>th</sup> edition. McGraw Hill Higher Education.

## **BBTC701T: rDNA Technology**

**L T P**  
**4 0 2**

### **Unit-I**

**(12 Lectures)**

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, exonuclease & endonuclease, Concept of restriction and modification - Restriction endonucleases, DNA modifying enzymes, Ligases.

### **Unit-II**

**(12 Lectures)**

Different Kinds of Vectors - Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors- YAC, BAC- *S. cerevisiae* system as a model. Methods of Transformation, Recombinant Selection and Screening, Molecular cloning.

### **Unit-III**

**(12 Lectures)**

Sequencing (chemical degradation; chain termination and automated sequence). Mutagenesis, altered expression and engineering genes. Site-directed mutagenesis. DNA amplification using polymerase chain reaction (PCR): Key Concepts, Analysis of Amplified Products. Applications of PCR: RFLP, RAPD, DNA Finger printing. Blotting techniques.

### **Unit-IV**

**(12 Lectures)**

Strategies for the production of recombinant proteins - insulin- human growth hormone- industrially important proteins. Construction of genomic library- cDNA library.

### **Unit-V**

**(12 Lectures)**

Application of rDNA Technology in plants: Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); Bio-pharmaceuticals and secondary metabolite production.



## Reference Books:

- Bernard R, Glick and Jack J. Pasternak. (2002). Molecular Biotechnology, Panima Publishing House, New Delhi.
- Brown T. A. (2001). Gene Cloning, Blackwell Science Publishers.
- Ernst L and Winnacker. (2003). Genes to Clones, Panima Publishing House, New Delhi.
- Glover D.M and Hames B.D. (1995). DNA cloning I & II, IRL Press.
- Innis M. A, Gelfand D.H and Sninsky D. J. J. (1995). PCR strategies, Academic Press.
- Primrose S. B. (2001). Molecular Biotechnology, Panima Publishing House, New Delhi.
- Watson J.D, Gilman M, Witkowski and Zoller M. (1992). Recombinant DNA, Scientific American books.

## **BBTC701P: rDNA Technology Lab**

### **Practical:**

1. Blood Grouping
2. Total WBC and RBC
3. Estimation of Haemoglobin
4. Preparation of Serum components
5. Radial Immunodiffusion test
6. Double Immunodiffusion test
7. Restriction Digestion of plasmid DNA
8. Ligation of restricted fragments

### **Reference Books:**

- Bernard R, Glick and Jack J. Pasternak. (2002). Molecular Biotechnology, Panima Publishing House, New Delhi.
- Brown T. A. (2001). Gene Cloning, Blackwell Science Publishers.
- Ernst L and Winnacker. (2003). Genes to Clones, Panima Publishing House, New Delhi.
- Glover D.M and Hames B.D. (1995). DNA cloning, I & II, IRL Press.
- Innis M. A, Gelfand D.H and Sninsky D. J. J. (1995). PCR strategies, Academic Press.
- Primrose S. B. (2001). Molecular Biotechnology, Panima Publishing House, New Delhi.
- Watson J.D, Gilman M, Witkowski and Zoller M. (1992). Recombinant DNA, Scientific American books.

## **BBTC801T: Applied Microbiology**

**L T P**  
**4 0 2**

### **Unit-I**

**(14 Lectures)**

Food as a substrate for microorganisms – Principles of Food Preservation. General principles and application methods – asepsis, removal of microorganisms, anaerobic conditions, high temperature, low temperature, drying and food additives. Factors affecting the growth of microorganisms in food, feed and fodder. Extrinsic and Intrinsic factors, chemical preservatives and food additives. Heat processing; D, Z, and F values and working out treatment parameters for canned foods; Canning Spoilage of food: milk and milk products, meat and meat products, fish, seafoods and canned foods.

### **Unit-II**

**(12 Lectures)**

Soil as a habitat for microorganisms; Microbial balance in soil. Factors affecting microbial community in soil-soil moisture, organic and inorganic chemicals. Microbial interactions; negative interactions. Ammensalism, competition, parasitism and predation (mycoparasitism, mycophagy, nematophagy – predaceous fungi), commensalism positive interactions – mutualism, synergism, associative symbiosis, cyanobacterial bacterial (Rhizobium legume symbiosis).

### **Unit-III**

**(12 Lectures)**

Water ecosystem and its type, marine microorganisms and their importance, Eutrophication, brief account of major water borne diseases and their control measures. Water treatment – wastes types, solid and liquid wastes characterization, Primary secondary, tertiary solid waste treatment, Bioaccumulation, Bioremediation, Bioleaching of copper and uranium.

### **Unit-IV**

**(10 Lectures)**

Microbiology of xenobiotics - novel pollutants, persistence and biomagnifications. Petroleum hydrocarbons - their microbial degradation. Bio remediation of soil and water. Corrosion of metals due to microbial growth and biofilms.

## **Unit-V**

**(12 Lectures)**

Beneficial Microbial Interactions with Human: Normal microbial population of healthy human body -Entry of pathogens into the host, types of bacterial pathogens, Mechanism of bacterial pathogenicity, colonization and growth, Virulence, Virulence factors – exotoxins, enterotoxins, endotoxins, neurotoxins. – avoidance of host defense mechanisms, damage to host cell, Host factors for infection and innate resistance to infection. Collection, transport and culturing of clinical samples.

### **Reference Books:**

- Davis B. D, Dulbecco R, Eisen H.N and Ginsberg H.S. (1980). Microbiology, Harper Intl. Edition.
- Pelczar M.J, Jr. Chan E.C.S and Krieg N.R. (2001). Microbiology, Tata McGraw Hill Publishing Co.
- Paul E.A. (Ed.) (2015) Soil Microbiology, Ecology and Biochemistry, 4th Edn Academic Press.
- Tortora, Funke and Case. (1995). Microbiology – An Introduction, Benjamin-Cummings Publications.
- Jay,J.M. (2000). Modern Food Microbiology. CRC Press. London.

## **BBTC801P: Applied Microbiology Lab**

### **Practical:**

1. Microbiology laboratory: general practices and maintenances.
2. Microscopes – Basic Parts and Handling
3. Sterilization Principles and Techniques
4. Hanging Drop Experiment
5. Staining Techniques: Simple, Gram, Acid Fast, Spore
6. Media preparation: liquid, solid and agar slants, basal, enriched, enrichment, differential and selective
7. Inoculation techniques – pour plate – spread plate –dilution techniques
8. Pure culture and subculture techniques.

### **Reference Books:**

- Davis B. D, Dulbecco R, Eisen H.N and Ginsberg H.S. (1980). Microbiology, Harper Intl. Edition.
- Pelczar M.J, Jr. Chan E.C.S and Krieg N.R. (2001). Microbiology, Tata McGraw Hill Publishing Co.
- Paul E.A. (Ed.) (2015) Soil Microbiology, Ecology and Biochemistry, 4th Edn Academic Press.
- Tortora, Funke and Case. (1995). Microbiology – An Introduction, Benjamin-Cummings Publications.
- Jay,J.M. (2000). Modern Food Microbiology. CRC Press. London.

# **Department Specific Elective**

## **BBTC101D-I: Bioinstrumentation**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Basics of Instrumental analysis: Selection of analytical methods, Accuracy, Precision, Detection Limit, Sensitivity and Analytical Range – Types of errors: Random and Systematic – Calibration methods: Standard curve and internal standard addition.

### **Unit-II**

**(12 Lectures)**

Spectroscopic and Imaging Analysis: Principles, Instrumentations and Applications of UV-Visible and IR spectrophotometry, Fluorescence, Electron Microscopy (Scanning Electron Microscopy and Transmission Electron Microscopy) and Flow Cytometry.

### **Unit-III**

**(12 Lectures)**

Structure Elucidation Techniques: NMR, MS–Ionization (MALDI, ESI), Analyzer (TOF and Quadrupole) and Detector. Separation Techniques: Centrifugation – Principle and applications; Types (Differential, Ultra and industrial centrifugation).

### **Unit-IV**

**(12 Lectures)**

Chromatographic Techniques: Theories on chromatography: Rate and Plate theory and Van Deemter equation – Resolution of chromatography – Principle, Instrumentation and Applications of Thin Layer, Adsorption, Gel Exclusion, Ion exchange, Affinity, Gas and Liquid chromatography (HPLC).

### **Unit-V**

**(12 Lectures)**

Electrophoretic Techniques: Concepts of influential factors and troubleshooting – Principle, Instrumentation and Applications of Gel (Agarose, PAGE and SDS-PAGE), Capillary, Pulse field and Native. Isoelectric focusing: Theory, Instrumentation and Applications.

## Reference Books:

- Skoog, D. A., Holler, F. J., and S. R. Crouch. "Instrumental Analysis, 6th." (2007). Brooks Cole Publishing Company. USA.
- Wilson, K., and J. Walker. "Principles and Techniques of Practical Biochemistry and Molecular Biology, 7th." (2010). Cambridge University Press, U.K.
- R., and S.K. Anand. "Instrumental Methods of Chemical Analysis, 5th," 2012. Himalaya Publishing House, India.
- Sharma, B.K. "Instrumental Methods of Chemical Analysis, 24th." (2014). GOEL Publishing House, India.



## **BBTC101D-II: Bioprocess Technology**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Introduction to White Biotechnology: Isolation and screening of industrially important microbes. Strain improvement - mutation and recombination. Media/substrates for industrial fermentation/process - typical media, media formulation. Media formulation/optimization. Preservation of industrially important microorganisms.

### **Unit-II**

**(12 Lectures)**

Fermentation and its types: History and Concepts of basic modes of fermentation – Batch, Fed batch and Continuous fermentation. Phases of cell growth in batch cultures Fermentor/Bioreactor design and operations - basic function, design, components and body construction. Sterilization of Fermentor/Bioreactor - air and media sterilization. Bioprocess control and monitoring - online measurement - on / off control - PID control.

### **Unit-III**

**(12 Lectures)**

Types of Fermentors / Bioreactors: Mechanical - Stirred tank bioreactors, pneumatic - Airlift fermentors, photo bioreactors, solid state fermentors, anaerobic solid stage silage fermentors, bed fermentors, tower fermentors, bubble cap fermentor, animal cell culture reactors and plant cell culture reactors.

### **Unit-IV**

**(12 Lectures)**

Downstream Processing: Objectives and criteria – Intra and extra cellular products. Primary separation- Cell disruption; foam separation; flocculation; precipitation methods; filtration; Centrifugation. Secondary separation- Liquid - liquid extraction, two-phase aqueous extraction solvent recovery. Membrane based separation (micro & ultra-filtration). Purification Chromatography. Drying devices, crystallization and whole broth processing.

## Unit-V

(12 Lectures)

Bioprocess Economics and Industrial Production: Bioprocess economics. Production of enzymes amylases. Acetone – Butanol - Ethanol (ABE) fermentation. Antibiotic production - penicillin. Amino acid - proline and glutamic acid. Vitamin production - vitamin B12. Organic acid production – acetic and citric acid. Cell and enzyme immobilization.

### Reference Books:

- Arnold L. Demain and Julian E. Davis. (2004). Industrial Microbiology and Biotechnology, ASM Press.
- Casida L.E. (1968). Industrial Microbiology, John Wiley & Sons.
- Emt.el-Mansi and Bryce C.F.A. (2004). Fermentation Microbiology and Biotechnology, Taylor and Francis Ltd.
- Prescott L. M, Harley J. P and Klein D. A. (1999). Microbiology, 4th edition, Mc Graw Hill.
- Stainer R.Y, Ingrtham J.L, Wheels M.L and Painter P.R. (1987). General Microbiology, MacMillan.
- Stanbury P.F, Whitaker A and Hall S.J. (1997). Principles of fermentation technology, Oxford University Press.
- Belter P.A, Cussler E and Wei Shan Hu, Bioseparation – Downstream Processing for Biotechnology, Wiley Interscience, 1988.

## **BBTC102D-I: Biostatistics and Bioinformatics**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Bio-Statistics: Concepts of statistics-types of data, methods of collection of data. Sampling design – essentials of sampling – sampling methods – statistical laws and errors. Experimental designs. Data representation: Tabulation, Diagrammatic and graphical representation of data.

### **Unit-II**

**(12 Lectures)**

Measures of central tendency – mean, median and mode. Measures of dispersion: Mean deviations, standard deviation. Correlation analysis (Karl Pearson's and Spearman's Rank). Regression analysis – simple linear.

### **Unit-III**

**(10 Lectures)**

Tests of significance - 't'-test, Chi-square and goodness of fit, 'F' test - Analysis of variance (ANOVA): One-way.& Two-way.

### **Unit-IV**

**(12 Lectures)**

Biological Databases: Sequence databases – Nucleic Acid sequence Databases: Genbank ;Protein Sequence Databases: UniProt; Searching Sequence Databases – Non-redundant Databases – Low Annotation Databases – Specialized sequence Databases – Structural Databases – Motif Databases – Genome Databases – Proteome Databases.

### **Unit-V**

**(14 Lectures)**

Pairwise Sequence Analysis Tools: BLAST– Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores -Multiple Alignment — ClustalW – Phylogenetic Tree – Sequence Analysis using EMBOSS. Protein Structure Prediction: Secondary structure Prediction –PDB-FSSPSCOP-CATH- Chou-Fasman – Jpred – Q3 – Transmembrane protein

prediction – Tertiary structure prediction – Comparative Modelling – Fold recognition – Ab initio prediction – modeler – RASMOL – Emerging areas of bioinformatics.

### **Reference Books:**

- Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
- Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi.
- Harshawardhan, P. (2005) Bioinformatics principles and application. Tata Mc Graw Hill Publishers. New Delhi.
- Manikand Vijayaraj, 2002. Bioinformatics for beginners, Kalaikathir Achchagam, Coimbatore
- Mount, D.W. 2005. Bioinformatics Sequence and genome analysis ( II edition) CBS Publishers. New Delhi

## **BBTC102D-II: Enzyme Technology**

**L T P**  
**4 0 0**

### **Unit-I**

**(10 Lectures)**

Definition, Nomenclature, Classification of Enzymes – Properties, Enzymes as biological Catalyst.

### **Unit-II**

**(12 Lectures)**

Enzyme activity – Specificity of Enzymes – Units of Enzyme Activity, Turnover number, Factors influencing Enzyme activity, Michaelis Menten Equation.

### **Unit-III**

**(12 Lectures)**

Mechanism of Enzyme action, active side, Lock and Key Hypothesis, Induced fit Hypothesis, Enzyme – Substrate Complex.

### **Unit-IV**

**(14 Lectures)**

Coenzymes – NAD, NADP, FAD, PLP, TPP. Allosteric Enzyme – Phosphofructokinase – Multi Enzyme Complex – Pyruvate dehydrogenase complex, Isoenzymes – Lactate dehydrogenase.

### **Unit-V**

**(12 Lectures)**

Immobilized Enzymes – Methods, Principle and application. Industrial applications of Enzymes – Amylase, Lipase. Clinical importance of Enzymes – LDH, Creatine kinase, Aspartate transaminase, Alanine transaminase, Alkaline and acid phosphatase.

### **Reference Books:**

- Biophysical Chemistry – Principles and Techniques – Upadhyay, Upadhyay and Nath.
- Principles and techniques of Practical Biochemistry – Wilson & Walker
- Principles and techniques of Practical Biochemistry – Williams and Wilson.

## **BBTC103D-I: Plant Biotechnology**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Outline of Plant breeding Techniques-Conventional and Non-conventional breeding methods. History of plant cell tissue and organ culture. Plant Tissue Culture – Introduction, laboratory organization – Sterilization, composition of media (Whites, MS), Media Preparation – Callus culture, Organogenesis, meristem culture and Micropropagation, hardening and Green House Technology.

### **Unit-II**

**(12 Lectures)**

Techniques of overcoming incompatibility barriers – Anther culture, embryo culture, Somatic embryogenesis, embryoids, Synthetic Seeds, Protoplast isolation and fusion, Cybrid Production. Cell Culture – Production of Secondary Metabolites. Conservation of plant materials- Cryopreservation. Applications of plant tissue culture.

### **Unit-III**

**(12 Lectures)**

Genetic Engineering in Plants - Molecular biology of Agrobacterium mediated DNA transfer- Ti plasmid Vectors- Binary and co-integrated vectors- Transformation strategies in plants – Agrobacterium tumefaciens. Physical methods of gene transfer- Electroporation and gene gun methods.

### **Unit-IV**

**(8 Lectures)**

Molecular Markers- Selectable markers, reporter genes and promoters used in plant vectors. Plant DNA finger printing, PCR based markers (RFLP, RAPD, and SSR's). Plant Genome Mapping- Physical and molecular maps, gene tagging. Seed production techniques, release of new varieties and plant breeder's right: UPOV and PPVFR.

## Unit-V

(12 Lectures)

Molecular biology of plant pathogen interactions and application of gene transfer techniques in pest resistance (Bt genes, edible vaccines and Delayed fruit ripening). Management aspect of plant genetic engineering. Transgene escape – tagging - mapping and cloning of plant genes.

### Reference Books:

- Bernard R. Glick and Jack J. Pasternak. (2001). Molecular Biotechnology- Principles and applications of recombinant DNA technology. ASM Press, Washington DC.
- Bhojwani S.S. and Razdan M.K. (2004). Plant Tissue culture: theory and practice, Elsevier science.
- Chrispeels M.J and Sadava D.F. (1994). Plants, Genes and Agriculture. Jones and Bartlett Publishers.
- Dixon R.A and Gonzales R.A. (2004). Plant cell culture, IRL press.
- Erbisch F.H and Maredia K.M. (2000). Intellectual property in agricultural Biotechnology, University Press.
- Glick and Paster Mark (2002). Molecular Biotechnology, Panima Publishers.
- Hammond J, McGarvey P and Yusibov V. (Eds). (1999). Plant Biotechnology – New products and Applications, Springer Publication.
- Kalyankumar De. (2007). An Introduction to Plant Tissue Culture Techniques. New Central Book Agency, Kolkata.
- Lycett G.W. and Grierson D. (1990). Genetic Engineering of crop plants.

## **BBTC103D-II: Animal Biotechnology**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Embryology: Gametogenesis and fertilization in animals, Molecular events during fertilization, genetic regulations in embryonic development - In vitro fertilizations and embryo transfer, Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

### **Unit-II**

**(12 Lectures)**

Animal cell culture: Fundamentals. Facilities and Applications. Media for Animal cells. Types of cell culture: Primary cell culture, secondary culture, cell transformation, cell lines, Insect cell lines, stem cell cultures, cell viability and cytotoxicity. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis Organ culture. Cryopreservation.

### **Unit-III**

**(10 Lectures)**

Genetic engineering in animals: methods of DNA transfer into animal cells- calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production.

### **Unit-IV**

**(12 Lectures)**

Gene therapy, mapping of human genome. RFLP and applications. DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

### **Unit-V**

**(14 Lectures)**

Transgenics: Transgenic animals. Production and recovery of products from animal tissue cultures: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones. Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.



## Reference Books:

- Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub., New York.
- Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. VOL. 57). Academic Press, London.
- Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology- A Practical Approach. Oxford Univ. Press, Oxford.
- Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausalito, CA, USA.
- E.J. Murray (Ed) .1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press, Totowa, NJ.
- Watson, J.D., N.H.Hopkins, T.W.Roberts, J.A.Steitz and A.M. Weiner.1987. Molecular Biology of Gene. Benjamin Cummins, San Francisco.

## **BBTC104D-I: Environmental Biotechnology**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Basic Ecological Concepts and Principles Our Environment: Geological Consideration, and Homeostasis; Biological control of chemical environment; Energy transfer in an ecosystem; Food chain, food web; Energy budget; Production and decomposition in a system; Ecological efficiencies; Trophic structure and energy pyramids; Ecological energetics; Principles pertaining to limiting factors; Biogeochemical cycles (N, C, P cycles). Over view of Freshwater Ecology; Marine Ecology; Estuarine Ecosystem; and Terrestrial Ecosystem.

### **Unit-II**

**(12 Lectures)**

Concept of Environmental Pollution: Origin of pollution; Classification and nature of Environmental Pollutants; Industrial pollutions. Overview of Noise pollution. Radiation Pollution Types and possible hazards of radioactive substances; Soil Pollution - Waste land formation - Deforestation, Shifting cultivation. Impact of Dams, Loss of soil fertility. Global environmental changes; Greenhouse effect. Over view of Water pollution - oil spills.

### **Unit-III**

**(12 Lectures)**

Microbiology of waste water treatment, aerobic process – activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process: Anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Biotechnology in tannery, dairy, distillery, textile, pulp, paper and Antibiotic industries effluent treatment.

### **Unit-IV**

**(12 Lectures)**

Remote sensing and its applications in resource management and pollution monitoring - IRS satellites & their sensors. Biosensors, Bioremediation (Mycorrhizae - in restoration of soil fertility) and pollution abatement: Biotechnological applications for Xenobiotics degradation,

hydrocarbons, oil pollutants, surfactants and pesticides. Biobleaching. Phytoremediation. Recycling of metallic waste; a brief note on panchakavya.

## **Unit-V**

**(12 Lectures)**

Quality of environment for life on earth and man - Deterioration of environmental quality with reference to anthropogenic impact. Methods of assessment of environmental quality; Short term studies/surveys. Environmental Impact Assessment (EIA) - The Environmental Protection Act, 1986. Green peace friendly concept.

### **Reference Books:**

- Harvinder Sohal & A K Srivastava (1982) - Environment and Biotechnology, Black Well publishers. New Delhi.
- Kumar H D (1982) - Modern Concepts of Ecology - Vikas Publishing House Pvt. Ltd.
- Environmental Chemistry A.K. De, Wiley Eastern Ltd.
- Environmental Biotechnology and Clean air Bioprocess by E.J. Olguin, G. Sanchez and E. Hernandez (2003) Taylor& Francis.
- Kumaraswamy.K. Algappa Moses A, Vasanthi M: Environmental Studies-Bharathidasan University Publication, Trichy.
- Agarwal. K.C, 2001. Environmental Pollution: Causes, Effects and Control-Nidhi Publishers (India) Bikaner.
- Environmental Biotechnology 1995, S.N.Jogdand Himalaya Publishing House.
- Waste water engineering – treatment, disposal and reuse. Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.

## **BBTC104D-II: IPR, Biosafety and Bioethics**

**L T P**  
**4 0 0**

### **Unit-I**

**(12 Lectures)**

Intellectual Property Rights: Significance of IPR - Types of IP: Patents, Trademarks, Copyright, Industrial Designs, Trade Mark, Trade secret and Geographical Indications – Treaties on IPR, GATT, WTO, WIPO and TRIPS - Farmers rights.

### **Unit-II**

**(12 Lectures)**

Patents and Patenting System: Patent law: Principles – Need for patent law in biotechnology – Types of patents – Role of a Country Patent office – Patent applications: Forms and guidelines – Types of patent application – Patent specification: provisional and complete specification – Patent databases: India, USPTO, and EPO – Patent infringement: Case studies on Turmeric and Neem.

### **Unit-III**

**(12 Lectures)**

Biosafety: Definition – Causes: classification, identification of hazards – Issues. Handling – Types of accidents, first aid and precautionary measures – Clean room procedures: Classification specification – Basic methods for safe handling, transport, and storage of biological and chemical materials – Equipment related hazards.

### **Unit-IV**

**(12 Lectures)**

Levels of Biosafety: Biological safety cabinets: Horizontal and Vertical Laminar Air Flow Cabinet, Fume hood – Primary and secondary containments – Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens) – Material Safety Data Sheet. Guidelines: Biosafety Guidelines and regulations (National and International including Cartagena Protocol) of Government of India – GMOs and LMOs – Roles of Institutional Biosafety Committee.

## Unit-V

(12 Lectures)

Bioethics: Introduction to ethics and bioethics and its framework – Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research - Ethical implications of GM crops, GMOs, human genome project and cloning, designer babies, biopiracy and biowarfare – Eugenics –Animal right activities and Ethical limits– Green peace - Human Rights and Responsibilities.

### Reference Books:

- Erbisch, F.H, Maredia, K.M, Intellectual property rights in agricultural biotechnology, Universities Press (India) Ltd, 2000., ISBN 9788173712555.
- Deepa Goel and Shomini Parashar, IPR, Biosafety and Bioethics, Pearson Education publisher, (2013), ISBN 9789332514010.
- Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.
- Singh. K.K, Intellectual Property Rights in Biotechnology, Springer India, 2015. ISBN 9788132220589.
- Sasson A. Biotechnologies and Development, UNESCO Publications.
- Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.

# **Skill Based: Skill Enhancement Courses**

## **BBTC101SB: Molecular Diagnostics**

**L T P**  
**4 0 0**

**Enzyme Immunoassays:** Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

**Molecular methods in clinical microbiology:** Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno fluorescence. Radioimmunoassay.

GLC, HPLC, Electron microscopy, flow cytometry and cell sorting. Transgenic animals.

### **Practical:**

*(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)*

1. Perform/demonstrate RFLP and its analysis.
2. Kirby-Bauer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture.
3. A kit-based detection of a microbial infection (Widal test).
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test ( Typhoid, Malaria, Dengue).

## Reference Books:

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
- Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
- Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton Century-Crofts publication.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
- Microscopic Techniques in Biotechnology, Michael Hoppert



## **BBTC102SB: Enzymology**

**L T P**  
**4 0 0**

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of  $K_m$  and  $V_{max}$  and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of  $K_i$ , suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples:- chymotrypsin, Lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme

engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding invitro & invivo.

### **Practical:**

1. Purification of an enzyme from any natural resource.
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as  $K_m$ ,  $V_{max}$ ,  $K_{cat}$

### **Reference Books:**

- Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
- Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
- Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.
- Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
- Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
- Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
- Practical Enzymology Hans Bisswanger Wiley–VCH 2004
- The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

## **BBTC103SB: Industrial Fermentations**

**L T P**  
**4 0 0**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

Microbial products of pharmacological interest, steroid fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra-centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient ( $K_a$ ) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

### **Practical:**

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

## **Reference Books:**

- Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
- Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
- Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
- Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2<sup>nd</sup> edition, Elsevier Science Ltd.
- Salisbury, Whitaker and Hall. Principles of fermentation Technology,

## **BBTC104SB: Medical Laboratory Technology**

**L T P**  
**4 0 0**

Basic laboratory principles -Organization of clinical laboratory and Safety measures -personnel hygiene,code of conduct. Overview of Lymphatic system, Urinary system, respiratory system and circulatory system.

Sample collection-Urine, sputum, Blood. Types of blood collection: capillary puncture,venipuncture, Anticoagulants. Composition of blood. Outline of Hematopoiesis. ABO blood grouping, Rh typing. Blood transfusion- Donor selection, Screening of donor (history, age, weight, Hb, pulse, BP, temperature, interval, registration), Post donation care, Preservation of samples.

Blood cells count: Total count, differential cell count, platelet count, Hemoglobin Estimation, Packed cell volume (PCV) , Erythrocyte Sedimentation Rate [E.S.R.] – Westergren’s Method, Bleeding time, clotting time, Latex agglutination test. Pregnancy test.

Introduction to Histopathology, Tissue preparation, labeling, Fixation – Simple fixative, compound fixative, histochemical fixative, Dehydration- Ethyl alcohol – Acetone, Clearing, impregnation, embedding- Paraffin wax, sectioning. Microtome and its application. Staining of tissues - H&E Staining. Bio-Medical waste management- an overview.

Diagnostic Methods- Outline of Radio imaging, X-Ray, MRI, CT, Ultra sound scan, Mamography, ECG, EEG, Nephelometry, sphygmomanometer. Auto analyser-Types of Auto Analysers-Semi and Fully automated Electrolyte Analyser (ISE). Need for Automation, Advantages of Automation.

### **Practical:**

1. Blood collection
2. Differential count of Leucocyte
3. Estimation of Haemoglobin
4. Packed Cell Volume [PCV]
5. Erythrocyte Sedimentation rate [ESR]
6. Bleeding Time, Clotting Time.
7. Latex Agglutination

8. Liver function tests (SGPT, SGOT)
9. Pregnancy test

### **Reference Books:**

- Bernadette F. Rodak, George A. Fritsma, Kathryn Doig (2007) Hematology: Clinical Principles and Applications 3rd Ed, Elsevier HealthSciences.
- RamanicSood, Laboratory Technology (Methodsandinterpretation) 4<sup>th</sup> Ed. J.P.Bros, NewDelhi
- Mukharji, Medical Laboratory Techniques, Vol - I, II & III, 5th Edn. Tata McGraw Hill, Delhi.
- GradWohl, Clinical Laboratory-methods and diagnosis, Vol-I Kanai L. Mukherjee, Medical Laboratory Technology Vol. I. Tata McGraw Hill 1996, NewDelhi.
- Gradwohls, 2000. Clinical Laboratory Methods and Diagnosis. (ed) AlesC.
- Sonnenwirth and Leonard jarret, M.D. B.I. Publications, NewDelhi
- Sood Ramnik,(2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications

## **BBTC105SB: Basics of Forensic Science**

**L T P**  
**4 0 0**

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

### **Practical:**

1. Documentation of crime scene by photography, sketching and field notes.
2. A) Simulation of a crime scene for training.  
B) To lift footprints from crime scene.
3. Case studies to depict different types of injuries and death.
4. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
5. Investigate method for developing fingerprints by Iodine crystals.
6. PCR amplification on target DNA and DNA profiling,
7. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

## Reference Books:

- Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
- M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
- S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
- W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
- R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
- W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene - Investigation, CRC Press, Boca Raton (2013).