

## SEMESTER I

### BI 103T: Bio-Analytical Techniques (core)

#### Unit-I:Spectroscopy

1.	Beer Lambert's Law and Molar extinction coefficient
2.	Absorption maximum
3.	UV-Vis:Spectroscopy, principle,instrumentation,application
4.	UV-Vis:Spectroscopy, principle,instrumentation,application
5.	Colorimetry-principle,instrumentation,application
6.	Fluorescence Spectroscopy-principle,instrumentation,application
7.	Fluorescence Spectroscopy-principle,instrumentation,application
8.	Atomic Absorption Spectrometry-principle,instrumentation,application
9.	NMR-principle,instrumentation application
10.	ESR-principle,instrumentation application
11.	CD-principle,instrumentation,application
12.	ORD-principle,instrumentation,application
13.	Mass spectroscopy principle,instrumentation,application
14.	X-raycrystallography
15.	X-raycrystallography

1.Principles and Techniques of Practical Biochemistry-

Wilson.K. And Walker.J.Pub:CambridgePress

2.PhysicalBiochemistry-Friefelder,PublisherD.W.H.FreemanPress

3.BiophysicalChemistry:Principlesand Techniques, 2<sup>nd</sup> edition by A.Upadhyay, K.Upadhyay and N.Nath.HimalayaPublishingHouse,Delhi.

4.LehningerPrinciples of Biochemistry, DavidL.Nelson, Michael M.Cox Publisher: W.H.Freeman

5.The Tools of Biochemistry, Cooper TG, JohnWiley and Sons

#### Unit-II:Chromatography

1.	Partitioning and countercurrent distribution
2.	PC-principle,instrumentation,application
3.	TLC-principle,instrumentation,application
4.	GC-principle,instrumentation,application
5.	GC-principle,instrumentation,application
6.	Ion-exchange-principle,instrumentation,application
7.	Ion-exchange-principle,instrumentation,application
8.	Gel filtration(Gel exclusion chromatography)-principle,application
9.	Affinity chromatography-principle instrumentation,application;immunoprecipitation
10	Affinity chromatography-principle instrumentation,application;immunoprecipitation
11	HPLC and RP-HPLC-principle,instrumentation,application
12	HPLC and RP-HPLC-principle,instrumentation,application
13	FPLC,LC-principle,instrumentation,application
14	Peptide mapping and N-terminal sequencing of proteins

1.Principles and Techniques of Practical Biochemistry-

Wilson.K. And Walker.J.Pub:CambridgePress

2.PhysicalBiochemistry-Friefelder,PublisherD.W.H.FreemanPress

3. Biophysical Chemistry: Principles and Techniques, 2<sup>nd</sup> edition by A. Upadhyay, K. Upadhyay and N. Nath. Himalaya Publishing House, Delhi.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman
5. The Tools of Biochemistry, Cooper TG, John Wiley and Sons

### Unit-III: Centrifugation and Electrophoresis

1. Centrifugation, RCF and types of rotors
2. Ultra centrifugation—principle, instrumentation, application
3. Ultra centrifugation—principle, instrumentation, application
4. CsCl density gradient and sucrose gradient centrifugation—principle, application
5. Electrophoresis—moving boundary and zonal electrophoresis
6. Native and SDS PAGE,
7. IEF and 2D PAGE
8. Agarose gels, PFGE
9. Zymography,
10. PAGE for DNA sequencing
11. DNase-I hypersensitivity mapping
12. DNA-Foot-printing
13. Chromatin IP methods
14. Denaturing gels for RNA,
15. Southern and Northern Blots

1. Principles and Techniques of Practical Biochemistry- Wilson. K. And Walker. J. Pub: Cambridge Press
2. Physical Biochemistry- Friefelder, Publisher D. W. H. Freeman Press
3. Biophysical Chemistry: Principles and Techniques, 2<sup>nd</sup> edition by A. Upadhyay, K. Upadhyay and N. Nath. Himalaya Publishing House, Delhi.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman
5. The Tools of Biochemistry, Cooper TG, John Wiley and Sons

### Unit-IV: Tracer Techniques

1. Stable and radioactive isotopes, Radioactivity theory,
2. Half-life and emission spectra of Half-life of biologically useful isotopes- 2H, 3H, 14C, 18O, 32P, 35S, 125I
3. Isotopes used for labeling proteins (3H, 14C, 35S, 125I)
4. Isotopes used for nucleic acids (3H, 32P)
5. Detection of radioactivity by Scintillation counting
6. Autoradiography, Fluorography, Phosphor-imaging, applications
7. GM counter,
8. Gammacounter
9. Radiation hazards and safe disposal of radioactivity waste;
10. Luxometry and chemiluminescence as alternative to radioactivity

11.	Isotope dilution method-pulse chase
12.	Historic examples-14C and 18O to study photosynthesis
13.	Historic examples-31P and 32S to study viral replication (Hershey-Chase experiment)
14.	Historic examples-14N and 15N in DNA replication (Meselson and Stahl experiment)

### References:

1. Principles and Techniques of Practical Biochemistry- Wilson.K. And Walker.J.Pub:Cambridge Press
2. Physical Biochemistry-Friefelder, Publisher D.W.H. Freeman Press
3. Biophysical Chemistry: Principles and Techniques, 2<sup>nd</sup> edition by A.Upadhyay, K.Upadhyay and N.Nath. Himalaya Publishing House, Delhi.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman
5. The Tools of Biochemistry, Cooper TG, John Wiley and Sons

BI104T: Bioenergetics and Cell Biology (core)

### Unit-I: Bioenergetics

1.	Elements of importance in biochemistry (H, C, N, O, P, S), types and energy of bonds
2.	interactions (ionic, covalent, coordinate, H-bonds, vander Waals, hydrophobic interactions)
3.	Laws of thermodynamics, Gibbs free energy, relevance of entropy
4.	Enthalpy in biological systems and reactions
5.	First and second-order reactions
6.	<b>Log</b> and <b>ln</b> scales in biological processes (exponential growth curves, radio active decay)
7.	Biological oxidation, high energy compounds
8.	High energy bonds, redox and phosphate potential
9.	Structure of membrane, forces stabilizing membranes
10.	Formation of ion gradients across a membrane (proton gradients in organelles),
11.	Role of transporters and channels
12.	ETC in mitochondria and chloroplasts, un-couplers and inhibitors of energy transfer
13.	Polarization of cell, resting potential, action potential, propagation of impulse
14.	Biological fluorescence (GFP and derivatives), Bioluminescence

### References:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman
2. Molecular Biology of the Cell, 3<sup>rd</sup> edition. Bruce Alberts, Dennis Bray, Julian Lewis,

MartinRaff,KeithRoberts,andJamesDWatson.PublisherNewYork:GarlandScience;3.The Cell:A  
MolecularApproach,FifthEdition,byGeoffreyM.Cooperand RobertE.Hausman,publishedbyASMPress

## Unit-II: Structure of Prokaryotic cells

1.	Classification of prokaryotes(systems of classification)
2.	Ultra-structure of eubacteria,cyanobacteria,mycoplasma
3.	Motility of bacteria,bacterial films,
4.	Isolation of bacteria from natural sources
5.	Sterilization of materials :autoclaving,dryheat,
6.	filtration,chemical disinfection,irradiation
7.	Commonly-used media(minimal,enriched,selective)for bacterial growth
8.	Staining methods for bacteria;maintenance,and preservation of bacterial cultures
9.	Growthcurve,Doubling time,
10.	Factors effecting growth-pH,temperature,oxygen,agitation
11.	Batch and continuous growth of bacteria,chemostat,synchronized cultures
12.	Industrial(large-scale)growth of bacteria,fermenter design
13.	Bacteria of industrial importance,development of commercially valuable strains
14.	Discovery of antibiotics,mode of action of various classes of antibiotics,
15.	Antibiotic resistance

## References:

1.LehningerPrinciplesofBiochemistry,DavidL.Nelson,MichaelM.CoxPublisher:W.H.Free man2.MolecularBiologyoftheCell,3rdedition.BruceAlberts,DennisBray,JulianLewis, MartinRaff,KeithRoberts,andJamesDWatson.PublisherNewYork:GarlandScience;3.The Cell:A  
MolecularApproach,FifthEdition,byGeoffreyM.Cooperand RobertE.Hausman,publishedbyASMPress

## Unit-III: Structure of Eukaryotic cells

1.	Ultra-structure of animalcells
2.	Ultra-structure of plantcells
3.	Composition of cytoskeleton-microfilaments,
4.	Microtubules,intermediate filaments
5.	Nuclear skeleton-lamina,scaffold
6.	Vesicle trafficking (endocytosis,exocytosis),
7.	Role of Rabs and Rab GTPases
8.	Structure of chromatin and chromosomes (centromere,telomere,kinetochore)
9.	Mitosis, meiosis, and interaction of chromatin with cytoskeleton (attachment of spindle fibers).
10.	Formation and structure of special chromosomes (polytene,lampbrush)

11.	Cellcycle
12.	Cell Cycle
13.	Apoptosis

**References:**

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman  
 2. Molecular Biology of the Cell, 3rd edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson. Publisher New York: Garland Science; 3. The Cell: A Molecular Approach, Fifth Edition, by Geoffrey M. Cooper and Robert E. Hausman, published by ASM Press

**Unit-IV: Methods of Cell Study**

1.	Simple and compound microscope.
2.	Phase contrast,
3.	dark field and polarization microscopy.
4.	Electron microscopy, SEM,
5.	TEM; freeze fracture.
6.	Fluorescence and Confocal microscopy; imaging live cells.
7.	FRET
8.	FRAP.
9.	Atomic force microscopy.
10.	Flow-Cytometry and cell sorting (FACS)
11.	Flow-Cytometry and cell sorting (FACS).
12.	Plant tissue culture.
13.	Animal and insect tissue culture.
14.	insect tissue culture
15.	Methods of cell disruption and fractionation, isolation of organelles.

**References:**

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman  
 2. Molecular Biology of the Cell, 3rd edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson. Publisher New York: Garland Science; 3. The Cell: A Molecular Approach, Fifth Edition, by Geoffrey M. Cooper and Robert E. Hausman, published by ASM Press

**SEMESTER II**

**BI203T: Biochemical Genetics and Model Organisms (core)**

**Paper -203**

**Unit-I: Mendelian Genetics**

1.

2. Mendel's Laws, Importance of meiosis in heredity
3. Non-Mendelian Inheritance–Maternal effect,
4. Maternal influence, Cytoplasmic inheritance
5. Gene interactions-Epistasis, Expressivity, Penetrance
6. Sexlinked, sexlimited and sex influenced genes;
7. Polygenic inheritance and polyploidy
8. Mutations (spontaneous/induced, somatic/germinal, forward/reverse, transition/transversions)
9. Mutations (Silent, missense, nonsense, and frameshift mutations, conditional, leaky)
10. Detection, selection & isolation of microbial mutants,
11. Estimation of mutation rates
12. Reversion and suppression of mutations
13. Mutagens–physical,
14. Chemical Mutagens
15. Transposon mutagenesis,
16. site-directed mutagenesis

1. Griffith AJF, Wessler SR, Lewontin RC and Carroll SB (2007). An Introduction to Genetic analysis, 9th edition. WH Freeman and Co., New York, USA.
2. E.J. Gardner, M.J. Simmons, D.P. Snustad (2001). Principles of Genetics, 8th edition, John Wiley and Sons, Inc., New Jersey, USA.
3. Strickberger M.W (2003). Genetics, 3rd edition. Prentice-Hall of India Pvt Ltd., New Delhi.
4. Robert.H. Tamarin, 2002, Principle of Genetics, 7th edition, Tata McGraw Hill, New Delhi.
5. Hartl, D. L. and Jones, E.W (2005). Genetics: Analysis of genes and genomes, 6th ed., Jones and Bartlett publishers, Inc, Sudbury, MA.
6. Catherine Baker (2004), Behavioral Genetics. American Association for the Advancement of Science Publications, Washington DC.
7. Peter J Russel (2006). iGenetics: A Molecular Approach (2nd ed.) Pearson Education Inc. Publishers
8. Benjamin A. Pierce. (2008) Genetics: A Conceptual Approach. Benjamin A. Pierce. WH Freeman and Company, New York

## Unit-II: Linkage and Mapping

1. Discovery of linkage,
2. Morgan's experiments
3. Cytological proof of crossing over
4. 2- and 3-point crosses
5. Recombination
6. Interference
7. Tetrad analysis
8. Mapping human genes by pedigree analysis;
9. Fundamentals of population genetics (H-W Law)

10.	Pedigrees of AR,AD,XR and XD inherited traits
11.	Mobile genetic elements–Zea Ac,Ds and Spm elements
12.	<i>Drosophila copia</i> ,
13.	Yeast Ty elements
14.	Using recombination to make knockout cells/organisms

9. Griffith AJF, Wessler SR, Lewontin RC and Carroll SB (2007). An Introduction to Genetic analysis, 9th edition. WH Freeman and Co.,New York, USA.
10. E.J. Gardner, M.J.Simmons, D.P.Snustad (2001). Principles of Genetics, 8th edition, John Wiley and Sons, Inc., New Jersey, USA.
11. Strickberger M.W (2003). Genetics, 3rd edition. Prentice- Hall of India Pvt Ltd., New Delhi.
12. Robert.H.Tamarin, 2002, Principle of Genetics, 7th edition, Tata McGraw Hill, New Delhi.
13. Hartl, D. L. and Jones, E.W (2005). Genetics: Analysis of genes and genomes, 6th ed., Jones and Bartlett publishers, Inc, Sudbury, MA.
14. Catherine Baker (2004), Behavioral Genetics. American Association for the Advancement of Science Publications, Washington DC.
15. Peter J Russel (2006). iGenetics: A Molecular Approach (2nd ed.) Pearson Education Inc. Publishers
16. Benjamin A. Pierce. (2008) Genetics: A Conceptual Approach. Benjamin A. Pierce. WH Freeman and Company, New York

### Unit–III:Bacterial Genetics

1.	Discovery of conjugation
2.	Mapping bacterial genes by conjugation
3.	Discovery of transformation
4.	Mapping bacterial genes by transformation
5.	Discovery of transduction
6.	Mapping Bacterial genes by transduction
7.	Discovery of transposition
8.	Structure of transposons, replicative and
9.	Conservative transposition, use as mutagens
10.	Mapping phage genes–Fine structure of rII locus:
11.	Complementation analysis
12.	Deletion mapping

1. Griffith AJF, Wessler SR, Lewontin RC and Carroll SB (2007). An Introduction to Genetic analysis, 9th edition. WH Freeman and Co.,New York, USA.
2. E.J. Gardner, M.J.Simmons, D.P.Snustad (2001). Principles of Genetics, 8th edition, John Wiley and Sons, Inc., New Jersey, USA.
3. Strickberger M.W (2003). Genetics, 3rd edition. Prentice- Hall of India Pvt Ltd., New Delhi.
4. Robert.H.Tamarin, 2002, Principle of Genetics, 7th edition, Tata McGraw Hill, New Delhi.

5. Hartl, D. L. and Jones, E.W (2005). Genetics: Analysis of genes and genomes, 6th ed., Jones and Bartlett publishers, Inc, Sudbury, MA.
6. Catherine Baker (2004), Behavioral Genetics. American Association for the Advancement of Science Publications, Washington DC.
7. Peter J Russel (2006). iGenetics: A Molecular Approach (2nd ed.) Pearson Education Inc. Publishers
8. Benjamin A. Pierce. (2008) Genetics: A Conceptual Approach. Benjamin A. Pierce. WH Freeman and Company, New York

#### **Unit-IV:Model Organisms**

1. <i>Dictyostelium</i> to study cell-cell communication and differentiation.
2. <i>Saccharomyces</i> to study homologous recombination in mating type switch;
3. Site of formation of buds
4. <i>Neurospora</i> to study one gene-one enzyme hypothesis
5. <i>Drosophila</i> to study embryonic development(homeotic mutations)
6. <i>C.elegans</i> to study development and nervous system
7. <i>Danio</i> to study vertebrate development,
8. GLOfish
9. <i>Xenopus</i> to study embryogenesis
10. <i>Mus</i> in bred and knockout strains,
11. NOD and nudemice
12. <i>Zea</i> to demonstrate cytological proof of crossingover
13. <i>Arabidopsis</i> to study flower development

1. Griffith AJF, Wessler SR, Lewontin RC and Carroll SB (2007). An Introduction to Genetic analysis, 9th edition. WH Freeman and Co.,New York, USA.
2. E.J. Gardner, M.J.Simmons, D.P.Snustad (2001). Principles of Genetics, 8th edition, John Wiley and Sons, Inc., New Jersey, USA.
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4. Robert.H.Tamarin, 2002, Principle of Genetics, 7th edition, Tata McGraw Hill, New Delhi.
5. Hartl, D. L. and Jones, E.W (2005). Genetics: Analysis of genes and genomes, 6th ed., Jones and Bartlett publishers, Inc, Sudbury, MA.
6. Catherine Baker (2004), Behavioral Genetics. American Association for the Advancement of Science Publications, Washington DC.
7. Peter J Russel (2006). iGenetics: A Molecular Approach (2nd ed.) Pearson Education Inc. Publishers
8. Benjamin A. Pierce. (2008) Genetics: A Conceptual Approach. Benjamin A. Pierce. WH Freeman and Company, New York



## BI 204T: Endocrinology and Metabolic Disorders (core)

### Unit-I:Hormones and Endocrine glands

1.

2. History of endocrinology
3. Organization and classification of hormones and endocrine systems
4. Basic mechanism of action of peptide hormones and receptors
5. Basic mechanism of action of peptide hormones and receptors
6. Basic mechanism of action of steroid hormones and receptors
7. Basic mechanism of action of steroid hormones and receptors
8. Chemistry,physiology,and disorders related toHypothalamus-Pituitary axis
9. Chemistry,physiology,and disorders related to thyroid
10. Chemistry,physiology,and disorders related to parathyroidglands
11. Glycoprotein hormones(LSH,FSH,TH,hCG,POMC)
12. Glycoprotein hormones(TH,hCG,POMC)
13. Growth hormone family(GH,hCS,Prolactin)
14. Adrenal hormones
15. Gonadal hormones

Williams Textbook of Endocrinology –Larsen, R.P. Korenberg, H.N.Melmed, S. and Polensky, K.S.Saunders.

2. Human Physiology –Chatterjee.C.C, Medical Allied Agency

3. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill

4. The metabolic basis of Inherited diseases (Vol I & II) Scriver CR..Valle D, Pub McGraw Hill

5. Text book of medical physiology by Guyton and hall

6. Tietz textbook of clinical chemistry and molecular diagnostics edited by Carl A. Burtis et al.

### Unit-II:Endocrine regulation

1. Regulatory pathways (positive,negative,feedbackloops),
2. Regulation of biosynthesis of steroid hormones by peptide hormones(LH,FSH)
3. Regulation of biosynthesis of steroid hormones by peptide hormones(ACTH)
4. Endocrine regulation of growth
5. Endocrine regulation of stress
6. Endocrinology of Ca homeostasis
7. Endocrinology of blood sugar, hunger, digestion and obesity
8. Endocrine regulation of renal function
9. Endocrine regulation of cardio vascular system (angiotensin,BNP,ET1)
10. Endocrinology of fertility (changes in menstruation, pregnancy and menopause)
11. Medical uses of steroid hormones (contraception, HRT, hydrocortisone, anabolicsteroids)
12. Erythropoietin,
13. Adipo-cytokines,Orexins

Williams Textbook of Endocrinology –Larsen, R.P. Korenberg, H.N.Melmed, S. and Polensky, K.S.Saunders.

2. Human Physiology –Chatterjee.C.C, Medical Allied Agency

3. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill

4. The metabolic basis of Inherited diseases (Vol I & II) Scriver CR..Valle D, Pub McGraw Hill

5. Text book of medical physiology by Guyton and hall

6. Tietz textbook of clinical chemistry and molecular diagnostics edited by Carl A. Burtis et al.

### **UnitIII: Disorders of AminoAcid and Carbohydrate Metabolism**

1. Hyper phenyl alaninemia
2. Disorders of proline and hydroxyl proline metabolism
3. Alcaptonuria
4. Disorders of lysine metabolism
5. Disorders of tyrosine metabolism
6. Hemoglobinopathies;
7. Thalassemia
8. Disorders of glycogen storage
9. Disorders of fructose metabolism
10. Disorders of Galactose metabolism
11. Pentosuria,
12. Diabetes

Williams Textbook of Endocrinology –Larsen, R.P. Korenberg, H.N.Melmed, S. and Polensky, K.S.Saunders.

2. Human Physiology –Chatterjee.C.C, Medical Allied Agency

3. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill

4. The metabolic basis of Inherited diseases (Vol I & II) Scriver CR..Valle D, Pub McGraw Hill

5. Text book of medical physiology by Guyton and hall

6. Tietz textbook of clinical chemistry and molecular diagnostics edited by Carl A. Burtis et al.

### **Unit-IV: Disorders of Lipids and Nucleic Acids Metabolism**

1. Disorders of acid Lipase deficiency
2. Farber's disease
3. Neeman-Picks disease
4. Goucher's disease
5. Krabbe disease
6. Sulphatide-lipidosis disease
7. Fabry disease
8. Downs Syndrome
9. Turner's syndrome
10. Hyperuricemia and Gout
11. Hereditary Xanthine Urea
12. Lesch-Nyhan syndrome

1. Williams Textbook of Endocrinology –Larsen, R.P. Korenberg, H.N.Melmed, S. and Polensky, K.S.Saunders.
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill
4. The metabolic basis of Inherited diseases (Vol I & II) Scriver CR..Valle D, Pub McGraw Hill
5. Text book of medical physiology by Guyton and hall
6. Tietz textbook of clinical chemistry and molecular diagnostics edited by Carl A. Burtis et al.

### **SEMESTER III**

#### **BI303T: Clinical Biochemistry/Nutrition (Elective)**

##### **Unit – I: Clinical Biochemistry-I**

1.

2. Free radical metabolism,
3. ROS in disease
4. Neuro-endocrine regulation
5. Endocrine regulation of growth
6. Endocrine regulation of salt, electrolyte and water,
7. Acid base balance and imbalance
8. Endocrine regulation of calcium & phosphate
9. Specimen collection.
10. Automation and QA in clinical laboratories
11. Examination of Urine & Blood
12. Examination of Sputum & CSF
13. Pregnancy test,
14. prenatal diagnosis & genetic counseling
15. Clinical importance of Enzymes and isoenzymes

##### **References:**

1. Text book of Biochemistry and Human Biology –Talwar , G.P. and Srivastava. L.M., Printice Hall of india
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
4. Lehninger Principles of Biochemistry 5thEdByDavid L. Nelson and MichaelM. Cox,WH Freeman and Company.
5. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rdEd By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.

6. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
7. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd

### Unit – II: Clinical Biochemistry-II

1.	1 Physiological Interrelationship between cardiovascular, respiratory and renal systems
2.	2 Normal values for different blood tests and clinical implications
3.	3 Diagnosis of anemia, thalassemia
4.	4 hyper cholesterolemia, atherosclerosis.
5.	5 Diagnostic enzymes: Principles of diagnostic enzymology.
6.	6 Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine
7.	kinase
8.	7 Clinical significance of aldolase and lactate dehydrogenase.
9.	8 Enzyme tests in determination of myocardial infarction
10.	9 Biochemical tests for the diagnosis of heart diseases- HDL/LDL cholesterol, SGOT, LDH,
11.	CK, C-reactive protein, cardiac troponins.
12.	10 Diagnostic and therapeutic uses of radioisotopes

### References:

1. Text book of Biochemistry and Human Biology –Talwar , G.P. and Srivastava. L.M., Printice Hall of india
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
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6. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
7. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd

### Unit – III: liver and Renal function tests

1.	1 Structure and functions of the liver.
2.	2 Liver diseases: jaundice, hepatitis, cirrhosis, Fatty liver
3.	3 Liver function tests: conjugated and total bilirubin in serum, albumin: globulin ratio,
4.	hippuric acid and bromsulphthalein tests.
5.	4 Serum enzymes in liver diseases: SGPT, GGT and alkaline phosphatase.
6.	5 Kidneys-structure of nephron, urine formation
7.	6 Normal and abnormal constituents of urine.
8.	7 Normal values for different urine tests and clinical implications
9.	8 Biological buffers.

10.	9Role of kidneys in maintaining acid-base and electrolyte balance in the body.
11.	10Renal function tests- creatinine and urea clearance tests, phenol red test.

**References:**

1. Text book of Biochemistry and Human Biology –Talwar , G.P. and Srivastava. L.M., Printice Hall of india
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
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6. Harper's Biochemistry (Lange Medical Books) (Paperback)By Robert K. Murray,Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
7. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd

**Unit – IV: Clinical aspects of disorders of lipid metabolism and gastric, thyroid function tests**

1.	1Physiology of lipids/lipoproteins.
2.	2 Lipidosis.
3.	3lipoproteins and apolipoproteins.
4.	4Disorders of lipid metabolism: lipoproteinemias
5.	5Clinical interrelationships of lipids (sphingo-lipidosis and multiple sclerosis)
6.	6Diagnostic tests for HDL-cholesterol, LDL-cholesterol and triglyceride disorders.
7.	7Fractional gastric analysis: Achylia gastric, Stimulation tests, Tube less gastric analysis
8.	8Tests based on primary function of thyroid, Tests measuring blood levels of thyroid
9.	hormones,
10.	9Tests based on metabolic effects of thyroid hormones,
11.	10Thyroid scanning, Immunological tests for thyroid functions

**References:**

1. Text book of Biochemistry and Human Biology –Talwar , G.P. and Srivastava. L.M., Printice Hall of india
2. Human Physiology –Chatterjee.C.C, Medical Allied Agency
3. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
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7. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd

**Paper-II: 304T: Human Physiology and Xenobiotics (4 Credits; 100 Marks)**

**Unit – I: Neurophysiology**

1. Types of neuronal cells – Neuroglia, microglia, astrocytes, oligodendrocytes,
2. Schwann, satellite and epididymal cells
3. Nerves: regeneration of nerve fibers, generation of nerve impulse, all or none principle.
4. Mechanism of synaptic transmission,
5. Transmission of nerve impulse.
6. Types of neurotransmitters and their receptors, mode of signaling
7. Electrical synapse and giant neurons
8. Division of vertebrate nervous system: CNS, PNS,
9. ANS, regions of the brain
10. Sensory organs – eye, ear, skin, tongue
11. Vision: visual system, rhodopsin
12. Classical GPCR mechanism, termination of visual signal
13. Cone cells, specialization in color vision, physiology of colour blindness
14. Similarity between vision, olfaction and gestation

**Unit – II: Structure and Physiology of Muscle**

1. Structure of various types of muscle: striated, cardiac, smooth, fast twitch, slow twitch
2. Mechanism of muscle contraction,
3. Regulation of contraction
4. Role of actin and myosin in non-muscle cells.
5. Cytochalasins and cytokinesis.
6. Muscle gene expression, regulation at transcriptional and posttranscriptional level.
7. Role of muscle proteins in cell locomotion
8. Neuro-muscular transmission
9. Electromyography
10. Sherrington starling Kymograph (recording drum)
11. Disorders of muscle: dystrophy, myopathy
12. Disorders of muscle: monocytosis, myotonia, paralysis, Myasthenia gravis
13. Detection and treatment of muscle disorders

**Unit – III: Human Reproductive Biology**

1. Female reproductive system: anatomy
2. Female reproductive system: endocrinology
3. Causes of female infertility (acquired and genetic),
4. female infertility: Treatments
5. Male reproductive system: Anatomy
6. Male reproductive system: Endocrinology
7. Causes of male infertility (environmental and genetic),
8. Male infertility treatments
9. Puberty, reproductive aging (menopause and andropause)
10. Gametogenesis and fertilization (natural and assisted ( <i>in vitro</i> ))
11. Implantation and placenta
12. Milestones in first trimester of pregnancy ( <a href="http://www.ehd.org/virtual-human-embryo/">http://www.ehd.org/virtual-human-embryo/</a> )
13. Milestones in second trimester of pregnancy
14. Milestones in third trimester of pregnancy, child birth
15. Placenta as source of stem cells, cord banking

#### Unit – IV: Liver and Xenobiotics

1. Liver functions,
2. Pharmacopeia drug deposition and
3. mechanisms of drug detoxification
4. Cytochrome P450 enzymes, molecular biology, catalytic cycle,
5. Isozymes, inhibitors
6. Dose response relationship, drug-receptors interactions
7. Pharmacodynamics;
8. Pharmacokinetics
9. Phase I reactions - modifications
10. Phase II reactions - conjugation
11. Phase III reactions - modifications and elimination,
12. Environmental factors influencing drug metabolism
13. Effects and metabolism of model toxins: aflatoxins,
14. Bacterial exotoxins (types I, II, and III)
15. Nutrient drug interactions – I and II

#### References:

1. Human Physiology by Guyton and Hall Press Pub Saunders
2. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
3. Human reproductive Biology by Jones and Lopez Pub
4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill

#### SEMESTER IV

#### Paper-IV: BI 401T: Biostatistics and Bioinformatics (4 Credits: 100 Marks)

#### Unit – I: Biostatistics-I

1. Biostatistics fundamentals (sample, population, variable)
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2. Types of variables
3. Measurement and measurement scales
4. Measures of central tendency (mean, median, mode)
5. Measurement of dispersion (range, variance, standard distribution)
6. Study of bivariate data: correlation and regression;
7. Regression to calculate concentration of DNA/protein, molecular weight of DNA/protein
8. Graphical methods to depict data (histograms, bar-plots, pie charts, line graphs)
9. Probability in biology,
10. Laws of Probability
11. Bayesian probability
12. Normal distribution.
13. Binominal distribution.
14. Poisson distribution

### References:

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biochemical Calculations –Segel, I.H. John Wiley & Sons.
3. Math's from Scratch for Biologists Alan J, Cann, John Wiley & Sons
4. Calculus for Biology and Medicine, Claudida Neuhauser (third edition ) Publications Prentice Hall
5. Biostatistics –Arora & Malhan, Himalaya Publishing House
6. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
7. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
8. Discovering Genomics, Proteomics and Bioinformatics – Campell & Heyer, Benjamin /Cummings pub

### Unit – II: Biostatistics-II

1.

2. Design of experiments
3. Factorial experiments
4. Student's t – test
5. F – test
6. Chi – square test;
7. Contingency tests
8. CRD: Completely Randomized Design;
9. 1-way ANOVA
10. RCBD: Randomized Complete Block Design;
11. 2-way ANOVA
12. Non parametric tests: sign test
13. Wilcoxon signed rank test,
14. Mann-Whitney test
15. Kruskal-Wallis test,
16. Friedman tests
17. Quality control in biochemistry



**References:**

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biochemical Calculations –Segel, I.H. John Wiley & Sons.
3. Math's from Scratch for Biologists Alan J, Cann, John Wiley & Sons
4. Calculus for Biology and Medicine, Claudida Neuhauser (third edition ) Publications Prentice Hall
5. Biostatistics –Arora & Malhan, Himalaya Publishing House
6. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
7. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
8. Discovering Genomics, Proteomics and Bioinformatics – Campell & Heyer, Benjamin /Cummings pub

**Unit – III: Genomics**

1.

2. Genomics and branches of genomics (Why study a genome?)
3. HGP
4. Strategies for sequencing genomes (shotgun and hierarchical sequencing)
5. 1st generation sequencing methods (Maxam and Gilbert Method; Sanger's method)
6. 2nd and 3rd Generation DNA sequencing methods (Next Generation Sequencing)
7. Genetic and Physical maps of the genome,
8. EST, STS
9. DNA sequence databases, Use of databases;
10. Data mining
11. Comparing DNA sequences, pairwise local and global alignment
12. BLAST, FASTA,
13. PAM and BLOSUM matrices
14. Multiple sequence alignments (Phylogenetic trees, Clustal-W, COBALT)
15. Epigenomics
16. Metagenomics

**References:**

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biochemical Calculations –Segel, I.H. John Wiley & Sons.
3. Math's from Scratch for Biologists Alan J, Cann, John Wiley & Sons
4. Calculus for Biology and Medicine, Claudida Neuhauser (third edition ) Publications Prentice Hall
5. Biostatistics –Arora & Malhan, Himalaya Publishing House

6. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
7. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
8. Discovering Genomics, Proteomics and Bioinformatics – Campell & Heyer, Benjamin /Cummings pub

#### **Unit – IV: Transcriptomics and Proteomics**

1. Relation of transcriptome to genome and proteome (Why study a transcriptome?)
2. Tools of transcriptomics: Northern blots, RNase protection assays, RT-PCR and Q-PCR
3. HT tools of transcriptomics: Microarrays for expression profiling, alternate sequencing
4. HT RNA sequencing: SAGE, MPSS,
5. RNA-Seq, GIGA
6. Identifying expressed sequences by ChIP-seq,
7. DNase-seq
8. Transcriptome databases (ESTs, Transcriptome Shotgun Assembly, ArrayExpress)
9. Methods for sequencing proteins: Edman degradation
10. MS – MALDI.
11. LC-MS,
12. Tandem MS (MS-MS)
13. Micro-arrays for proteins,
14. 2D gels and peptide maps
15. Proteins structure databases;
16. Peptide sequence and MS profiles databases, Comparing
17. Protein sequences, alignment

#### **References:**

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biochemical Calculations –Segel, I.H. John Wiley & Sons.
3. Math’s from Scratch for Biologists Alan J, Cann, John Wiley & Sons
4. Calculus for Biology and Medicine, Claudida Neuhauser (third edition ) Publications Prentice Hall
5. Biostatistics –Arora & Malhan, Himalaya Publishing House
6. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
7. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
8. Discovering Genomics, Proteomics and Bioinformatics – Campell & Heyer, Benjamin /Cummings pub

## BI402T: Cell-Cell Communication and Signal Transduction (core)

### UNIT : I ECM and cell surface

1. Molecules in the ECM in plant
2. Molecules in the ECM in animals
3. Transport across cell membrane, Ficks Law
4. Types of transport – simple, passive, facilitated
5. Active transport- primary transport systems
6. Secondary active transport systems
7. Ionophores, gated channels (voltage and Ligand)
8. Cell communication
9. Type of signaling molecules
10. Types of receptors and their structures
11. GPCR, inhibitory and stimulatory
12. Type of down stream effectors
13. Signal termination
14. Monomeric G-proteins their role
15. Drugs targeting signaling molecules

### References:

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell. New York: W. H Freeman

### UNIT II: Cell signaling

1. Cell division
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2. Cell differentiation
3. Autocrine, paracrine & endocrine systems
4. Growth factors – EGF, PDGF,
5. VEGF, IGF
6. Second messengers – Ca, calmodulin,
7. Inositol, NO
8. cAMP, cGMP
9. Receptor tyrosine kinases
10. Insulin signaling
11. MAPK pathway, role in signaling
12. Role of post-translational modification of proteins in signaling – Phosphorylation
13. Acylation, glycosylation
14. ADP ribosylation, myristoylation
15. Signal cascades
16. Inhibitors of signal cascades

**References:**

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell. New York: W. H Freeman

UNIT III :Signal transduction and cancer

1. Discovery of oncogenes
2. Protooncogenes
3. Modes of action of oncogenes – G proteins – Ras
4. Growth factors – Erb, Sis
5. Transcription factors – Fos, Jun,
6. AP1, V-erbA
7. Discovery of tumor suppressor genes
8. RB and retinoblastoma,
9. APC and colon cancer
10. Modes of action of TS genes – p110, p16,
11. p21, pTEN
12. p53 and cancer risk
13. Selected examples – cMyc and leukemia
14. BRCA and breast cancer

**References:**

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ

4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell. New York: W. H Freeman

#### UNIT IV: Signal transduction in bacteria and plants

1. Introduction to signaling components in bacteria
2. Chemotaxis
3. Protein kinases in bacteria
4. His kinases structure and role
5. Plant signaling system an over view
6. Stress signaling in plants (abiotic)
7. Stress signaling in plants (abiotic)
8. Stress signaling in plants (biotic)
9. Stress signaling in plants (biotic)
10. Plant hormones and their mechanism of action
11. Plant hormones and their mechanism of action
12. Signaling in yeast
13. STAT pathway in yeast

#### References:

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell. New York: W. H Freeman

## Semester I

### Paper-I: BI 101T: Chemistry and Metabolism of Proteins and Lipids & Porphyrins (4Credits; 100 Marks)

#### **Unit–I: Chemistry of AminoAcids &Proteins**

1.Classification-i: classification of aminoacids based on polarity, metabolic fate, chemical structure and solubility,

nutritional requirement, Classification-ii

Structure of 20aa-i: structures of 20 aa, special groups present in it, denoting of aminoacids in 3 letter and one letter form,

essential, non-essential,unusual-i and non-protein-ii:

definitions of essential, non-essential, unusual and non-protein aminoacids and their functions

2. General properties of aa: physical and chemical properties of aminoacids-i, acid-base titrations: pKa: definition, acid-base titration curve and pKa-ii

3. Peptidebond-stability and formation-i: Definition of peptide bond, formation of peptide bond,

Primary structure-ii: Definition, formation of primary structure

GN Ramachandranplots-iii: Definition, about scientists who worked on this, Applications

4. Secondarystructure and motifs-i:  $\alpha$ helix,  $\beta$ sheet, 3-10helix

5. Leucinezipper, Zincfinger-i, Trans-membraneregions,  $\beta$ LHL-ii: about these domains, structures and example of proteins with these domains

6. Tertiary & Quaternarystructure (myoglobin,hemoglobin)-i: formation of these structure with the specific bonds involved in them, structures and stabilization of these structures with examples

7. Protein-protein interactions (actin, tubulin)-i: formation of actin and tubulin, polymerization and depolymerization

8. Small peptides (glutathione,peptidehormones)-i:definition, structure and functions , Cyclicpeptides (Gramicidin)-ii:history, structure and applications

9. Classification of proteins-globular, fibrous, membrane, metallo-proteins-i: classification, definition, functions and examples of the same, SCOP, CATH-ii: full form, definition of these databases and applications

10. Denaturation (pH,temperature,chaotropicagents)-i: definition, agents which cause denaturation, examples of agents, refolding-ii: definition, examples Role of chaperones in folding-iii: what are chaperones, classification of chaperons, examples of chaperons,

role of chaperones

## **Unit–II: Metabolism of Aminoacids & Proteins**

1. Metabolic fate of dietary proteins and aminoacids-i: digestion and absorption of proteins
2. Degradations to glucose-i and ketone bodies-ii: aminoacids degraded to products which form glucose and ketone bodies
3. Aminoacids degraded to Pyruvate-i, Oxaloacetate-ii: Metabolism of Aminoacids degraded to Pyruvate, Oxaloacetate with structures
4. Aminoacids degraded to Acetyl-CoA-i, Succinyl-CoA-ii: Metabolism of Aminoacids degraded to Acetyl-CoA, Succinyl-CoA
5. Metabolism of branched chain aminoacids-i: Metabolism of branched chain aminoacids
6. Role of glutamate cycle in formation & circulation of ammonia-i: glutamate cycle, ammonia formation from aminoacids breakdown, its circulation in the blood
7. Glucose alanine cycle-i: what is Glucose alanine cycle, its importance, cycle with structures, ureacycle-ii: History, tissues in which it takes place, importance of this cycle, formation of urea from ammonia with structures, energetics of the same
8. Linking of citric acid and ureacycles-i: Linking points of citric acid and ureacycles, its importance, regulation of ureacycle: Regulating compounds, hormones, drugs etc and enzymes regulating the cycle
9. Genetic defects in metabolism of aminoacids (albinism, Phenylketonuria-i, maple syrup urine disease, homocystinuria-ii, alkaptonuria, methyl malonic Acidemia-iii): definitions, synonyms, enzyme deficiency, symptoms, genes involved, prevalence, preventive measures, drugs suitable and diets to be followed
10. Genetic defects in metabolism of urea (Argininemia, Argininosuccinic Acidemia-i, Carbamoyl Phosphate Synthetase-I deficiency-ii): definitions, synonyms, enzyme

deficiency, symptoms, genes involved, prevalence, preventive measures, drugs suitable and diets to be followed

### **Unit–III: Chemistry of Lipids & Porphyrins**

1. Classification –i & biological significance of lipids-ii: classification, solubility, structures, functions of different lipids & fatty acids: fatty acids structure, classification of different fatty acids, examples
2. Steroids, Sterols-i, relation to vitamin D and steroid-ii: definitions, structures, classification of sterols, functions of sterols and steroids
3. Bile acids and salts-i : definition, structures and importance, Phospholipids-ii : definition, types, structures and importance
4. Oils, waxes-i, isoprene units-ii: definition, types, structures and importance
5. Lipoproteins-i : definition, types, importance and diseases related to them
6. Glycolipids, Sphingolipids-i: definition, sites of their presence, types, importance and diseases related to them
7. Structure & function of porphyrins-i (e.g.Heme, Chlorophyll): structures and their importance
8. Cerebrosides, Gangliosides-i: structures, types and their importance
9. Prostaglandins, Prostacyclins-i: structures and their importance
10. Thromboxanes, Leukotrienes-i: structures and their importance

### **Unit–IV: Metabolism of Lipids & Porphyrins**

1. Fate of dietary lipids-i: digestion and absorption of lipids and Apo-lipoproteins-ii: definition, importance, diseases related to them



2. Fattyacid biosynthesis-i: biosynthesis of fatty acids with structures, energetics  
Desaturation of fattyacids-ii: Desaturation of fattyacids with structures
3. Beta oxidation-i: Beta oxidation of fatty acids with structures, energetics,  
Break down of odd chain fatty acids,energy yields-ii: Break down of odd chain fatty acids with structures, energy yields
4. Regulation of  $\beta$ -oxidation-i,  $\omega$ -oxidation &  $\alpha$ -oxidation-ii:  
 Enzymes, Hormones etc. involved in regulation
5. Metabolism of phospholipids -i & Sphingolipids-ii: Metabolism with structures, Diseases related to it.
6. Regulation and Biosynthesis of cholesterol -i and other steroids-ii: Biosynthesis, Regulation of cholesterol and diseases related to it and other steroids.
7. Fate of acetyl CoA-i: metabolisms where acetyl CoA involved, formation of ketone bodies and ketosis-ii: definition, structures, metabolism, disease related to it.
8. Biosynthesis of prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes-i: biosynthesis of the prostaglandins with structures, their regulation, importance  
Biosynthesis of prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes-ii
9. Role of HDL, LDL and Very-low-density lipoprotein (VLDL) and cholesterol levels in body-i: Role, normal and abnormal levels of lipoproteins
10. Catabolism of Porphyrins-i: catabolism of porphyrins with structures, importance  
Genetic defects in lipid and nucleotide metabolism-ii: genes, enzymes involved in defects of the metabolisms mentioned, symptoms, care to be taken and diet to be followed

Medium chain acyl coenzymeA dehydrogenase deficiency MCAD-i, Long-chain3-hydroxyacyl-CoAdehydrogenase (LCHAD) deficiency-ii, Familial hyper cholesterolemia, Gout-iii: symptoms, causes, genes and enzymes involved, care to be taken and diet to be followed

## References:

1. Lehninger Principles of Biochemistry, David L.Nelson, Michael M.Cox Publisher: W.H.Freeman.
2. Biochemistry-Jeremy M Berg, John L Tymoczko, and Lubert Stryer.:WHFreeman
3. Biochemistry, 4<sup>th</sup> Edition-Donald Voet, Judith G.Voet.–Publisher JohnWiley & Sons.

**PaperII BI 102T: Chemistry Metabolism of Carbohydrates,  
NucleicAcids and Vitamins.(4Credits;100Marks)**

**Unit–I: Chemistry of Carbohydrates**

1 Classification-i: classification, examples with structures and their importance, monosaccharides (aldoses & ketoses)-ii: different monosaccharides, their structures, their importance

2 Configuration and conformation of monosaccharides-i (pyranose & furanose, chair & boat): conformations with structures

3 Reducing and optical properties of sugars-i: definition, importance of these properties

4 Stability of glycosidic bond disaccharides-i: how it is stabilized, , oligosaccharides-i: different oligosaccharides with structures and their importance

5 Structural polysaccharides-cellulose, hemicelluloses-i, pectin, lignin, chitin, chitosan-ii: structures, location of their presence, their importance

6 Storage polysaccharides-i,ii: starch, glycogen, inulin: structures, location of their presence, their importance

7 Steric factors in polysaccharides folding-i, sugar code and lectin-ii: definition, history, importance

8 Glycosaminoglycans-i, mucopolysaccharides, hyaluronic acid-ii: definition, history, structures, importance

9 Chondroitin sulfate, keratin sulfate, dermatan sulfate-i: definition, history, structures, importance

10 Bacterial cell wall–proteoglycans and peptidoglycans-i: structures and importance

## **Unit–II: Metabolism of Carbohydrates**

- 1 Reactions and energy balance in Glycolysis-i: pathway with structures and energetics
- 2 Reactions and energy balance in Gluconeogenesis-i: pathway with structures and energetics
- 3 Reactions and energy balance in TCA cycle-i: pathway with structures and energetics
- 4 Pentose phosphate-i: pathway with structures and energetics  
, Pasteur and Crab tree effect-ii: definition and importance
- 5 Anaplerotic reactions-i: definition, reactions with structures
- 6 Glyoxylate cycle-i: pathway with structures and importance
7. Glucuronic acid cycle-i: pathway with structures and importance
8. Glycogen metabolism-i: pathway with structures and importance
9. Photosynthesis reactions for biosynthesis of glucose-i: reactions with structures
- 10 . C3 –i and C4 cycle in plants-ii: pathway and importance

## **Unit–III: Chemistry and Metabolism of Nucleic Acids**

- 1 Purines, pyrimidines, nucleosides, nucleotides, unusual bases-i: structures and importance
- 2 Structure of DNA–Watson Crick Model-i: history, explanation of structure A and Z-forms: differentiation between the forms

- 3 Super coiling of DNA–negative and positive, linking number-i: what is Super coiling of DNA, how it is formed, linking number and importance
- 4 Structure of RNA, tRNA, rRNA-i, siRNA/miRNA-ii: full form, structures, locations, functions
- 5 Properties of NA–denaturation and renaturation-i: definition, temperatures at which denaturation and renaturation takes place, importance
- 6 T<sub>m</sub> (factors affecting T<sub>m</sub>) and C<sub>0</sub>t curves-i: definition of T<sub>m</sub> different factors affecting T<sub>m</sub>, importance of C<sub>0</sub>t curves
- 7 Hetero duplex mapping–D loops and R loops-i
- 8 Biosynthesis of purines and pyrimidines-i: Metabolic reactions of Biosynthesis of purines and pyrimidines
- 9 Degradation of purines and pyrimidines-i: Metabolic reactions of degradation of purines and pyrimidines
- 10 Regulation: *denovo*, salvation-i, nucleotide analogs-ii:  
different nucleotide analogs with similar structure and their importance

#### **Unit–IV: Chemistry and Metabolism of Vitamins**

- 1 Discovery of vitamins-i: History, classification, RDA: in children, pregnant woman,
- 2 Vitamin A-i–source, biological role, deficiency: including structure
- 3 Vitamin B1–Thiamine-i–source, biological role, deficiency: including structure

4 Vitamin B2–Riboflavin-i–source, biological role, deficiency: including structure

5 Vitamin B3–Niacin-i including structure, source, biological role, deficiency and B5–Pantothenic acid-ii– including structure, sources, biological role, deficiency

6 Vitamin B6–Pyridoxamine-i including structure, source, biological role, deficiency and B7–Biotin-ii– including structure, source, biological role, deficiency

7 Vitamin B9–Folic acid-i including structure, source, biological role, deficiency and B12–Cobalamine-ii– including structure, source, biological role, deficiency

8 Vitamin C–Ascorbic acid-i– source, biological role, deficiency: including structure

9 Vitamin D– Calciferol-i–source, biological role, deficiency: including structure

10 Vitamin E-i: including structure, source, biological role, deficiency, Vitamin K-i– structures of different types of vitamin Ks, source, biological role, deficiency

## References:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman.
2. Biochemistry-Jeremy M Berg, John L Tymoczko, and Lubert Stryer.: W.H. Freeman
3. Biochemistry, 4<sup>th</sup> Edition-Donald Voet, Judith G. Voet–Publisher John Wiley & Sons

4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, ... White A, McGraw Hill

## **Semester II**

### **Paper-I: BI 201T:Enzymology. (4 Credits; 100 Marks)**

#### **Unit-I: Enzymes, Coenzymes and catalysis**

- 1 Thermodynamics of catalysis-i, Energy of activation, Relation of  $\Delta G$  and  $K_{eq}$  -ii
- 2 Coupled reactions (endergonic and exergonic) in biochemical pathways-i
- 3 Methods to isolate and purify enzymes-i: different chromatographic methods involved, Assays, Activity Units, Specific activity
- 4 Nomenclature and classification of enzymes-i: EC, SCOP, CATH-ii: full form, description and applications
- 5 Metal, co-factor and co-enzyme requirements-i: definition and examples of reactions
- 6 Vitamin cofactors: TPP, FMN/FAD-i, NAD/NADP, Pantothenic acid-ii: structures and their role
- 7 Vitamin cofactors-i, ii: PLP, Biotin, Folate, Cobalamine, Phylloquinone: structures and functions of vitamin cofactors
- 8 Factors affecting catalysis-i (pH, temperature, pressure, enzyme and substrate concentration)
- 9 Chemicals to identify active site residues-i: Arg, Cys, Lys, His
- 10 Site-directed mutagenesis to identify active site

residues-i: Triose Phosphate Isomerase

## **Unit–II: Enzyme Kinetics**

- 1 Single substrate assumptions, Briggs-Haldane equation-i.
- 2 Steady state, Michaelis-Menton kinetics-i  
(derive equation and transformations)
- 3 Transformation of Michaelis-Menton equation-i.
- 4 Bi substrate reactions: ordered, random-i, sequential, Ping-Pong-ii
- 5 Distinction between ordered and random addition of substrates and products release-i.
- 6 Inhibitors (competitive, uncompetitive, noncompetitive, suicide), effect on kinetic constants-i: definition, types of inhibitions and graphical representation, examples
- 7 Enzyme inhibitors as drugs-i: RT and Protease inhibitors as anti-HIV drugs
- 8 Cooperativity in binding (oxygen binding to hemoglobin)-i: definition and picture, graphical representation of cooperativity explanation
- 9 Multiple sites; Cooperativity-i: MWC model, KNF model
- 10 Slow transition and Hysteretic behavior in enzymes-i

## **Unit–III: Catalytic Mechanisms**

- 1 Types of catalysis-i: acid-base, transition state, covalent intermediates
- 2 Reversible and irreversible activation of enzymes-i (pro-



- enzymes, phosphorylation)
- 3 Enzymes activation by ligand binding and dimerization (protein tyrosine kinase receptors)-i
  - 4 Catalytic mechanism of RNase-i
  - 5 Catalytic mechanism of Chymotrypsin-i, Trypsin-ii
  - 6 Catalytic mechanism of Lysozyme-i
  - 7 Catalytic mechanism of Carboxy peptidase-i, Subtilisin-ii
  - 8 Allosteric regulation of Aspartate Transcarbamylase-i: definition and regulation mechanism
  - 9 Regulation of Glutamine Synthetase-i
  - 10 Multi-enzyme Complex: fatty acid synthase-i: definition, composition, function

#### **Unit–IV: Enzymes in Physiology and Biotechnology**

- 1 Regulatory enzymes in carbohydrate metabolism-i (glycolysis, TCA cycle): Examples of several enzymes, mechanism of regulation
- 2 Regulatory enzymes in nucleotide metabolism-i: Examples of several enzymes, mechanism of regulation
- 3 Enzyme cascades-i, ii (blood clotting, complement activation): definition and enzymatic reactions, importance of the cascades
- 4 Enzyme cascades-i, ii (cell division and apoptosis): definition and enzymatic reactions, importance of the cascades

- 5 Convergent and divergent evolution of enzymes-i
- 6 Reporter enzymes for gene expression-i (gal, -glucuronidases, CAT);  
Restriction enzymes and ligases in recombinant DNA technology-ii
- 7 Enzymes in dairy-i (Rennin, lipases, lactases),  
brewing-ii (amylases, proteases, glucanases)  
Food processing technology-iii (invertase,  
pectinases, papain)
- 8 Enzymes in detergent-i (lipases, cellulases,  
proteases), paper-ii (cellulases) and tanning
- 9 Enzymes in bioremediation-i, biofuel industry-ii  
(cellulases)
- 10 Enzyme engineering-i, ii: Catalytic RNA and antibodies;  
Designing High-Through put enzyme assays

## References:

1. Fundamentals of Enzymology, Price.NC. And Stevens. L.,  
Oxford University Press
2. Enzymes-Biochemistry, Biotechnology, Clinical chemistry-  
Palmer,T., Affiliated East-West press 3.Fundamentals of Enzyme  
Kinetics,SegelIH;Wiley Inter science
4. Biochemical calculations, 2<sup>nd</sup> Edition ByIrwinH.Segel.John  
Wiley & Sons,
5. Lehninger Principles of Biochemistry, DavidL.Nelson, Michael  
M.Cox Publisher: W.H.Freeman

## **Paper II: BI 202T: Molecular Biology.(4Credits;100Marks)**

### **Unit–I: DNA Replication**

- 1 Models of replication–random, conservative, semi conservative-i:  
Explanation of different models and meselson and stahl experiment
- 2 Prokaryotic and eukaryotic DNA polymerases-i,ii: different types of DNA polymerases, their functions  
helicases, ligases, topoisomerases-iii: structure and functions
- 3 Initiation: mechanism and proteins involved –primosome-i: components of primosome, its importance, ori-sequences-ii: definition and importance, accessory proteins
- 4 Elongation: mechanism and proteins involved–replisome-i: proteins forming replisome and importance, leading and lagging strands, Okazaki fragments
- 5 Termination-i: mechanism and proteins involved in termination, Inhibitors of replication
- 6 Replication of circular chromosomes by theta model- $\phi$ X174-i, E.coli
- 7 Replication of circular chromosomes by rolling circle (lambda phage)-i and Strand displacement models (mt-DNA)-ii
- 8 Replication of linear chromosomes, telomeres, telomerase-i
- 9 Amplification–Polytene and double minute chromosomes-i
- 10 Invitro replication-PCR-i: definition, steps involved, applications, variants of PCR

## **Unit–II: DNA Repair**

- 1 Types of damage–oxidation, deamination, alkylation, adducts, breaks-i
- 2 Direct repair–MGMT, photo-reactivation, AlkB-i: Enzymes and mechanism involved
- 3 Base Excision Repair (Short and Long Patch)-i: mechanism and importance
- 4 Nucleotide Excision Repair-i: mechanism and importance
- 5 Mismatch Repair-i: mechanism and importance
- 6 Repair of DSBs by NHEJ and Homologous recombination-i
- 7 Holliday junctions and repair of collapsed forks-i, ii
- 8 SOS and bypass repair-i: mechanism, enzymes involved and importance
- 9 Diseases due to defects in DNA repair-i: different types of diseases
- 10 Roles of ATM, BRCA in DNA repair-i, ii: full form of ATM, BRCA, genetics, proteins involved

## **Unit–III: Transcription and Translation**

- 1 Prokaryotic and eukaryotic RNA polymerases-i: different Prokaryotic and eukaryotic RNA polymerases and their functions
- 2 Initiation-i: mechanism and importance  
prokaryotic and eukaryotic promoter sequences
- 3 Elongation-i: mechanism and importance,

- Termination—rho dependent and independent
- 4 Post-transcriptional modifications-capping, Poly A addition-i:
  - 5 Splicing, RNA editing-i; mechanism, enzymes involved and importance  
Inhibitors of transcription-ii
  - 6 Structure of ribosome-i: structure and importance  
, nature of genetic code-ii: what is genetic code and its importance
  - 7 Initiation of translation (role of cap, IRES, IFs)-i: mechanism, proteins involved and its importance
  - 8 Elongation of translation (role of EFs)-i: mechanism, proteins involved and its importance
  - 9 Termination of translation (role of RFs)-i: mechanism, proteins involved and its importance
  - 10 Inhibitors of protein synthesis-i

#### **Unit–IV: Protein Sorting, Targeting and degradation**

- 1 Post translational modifications of proteins-i: different types of modifications and their importance, role in targeting (isoprenylation)- ii: definition of targeting and its importance
- 2 Signal peptide (ERLS)-i: definition, structure  
role of SRP in translation of secreted proteins
- 3 NLS-i: definition, structure,  
Mitochondrial & chloroplast LS
- 4 Chaperones-i: definition, structure, types and importance of  
HSPs in protein folding

- 5 Lysosomal pathways-i, ii (endocytosis, crinophagy, macroautophagy, Micro autophagy, direct translocation from cytosol)
- 6 Lysosomal storage diseases-i: definition and different types
- 7 Ubiquitin-proteasome pathway-i: proteins involved and importance, N-end rule: definition and its role
- 8 Immuno-proteasomes, Misfolded proteins in neuro degenerative diseases-i,
- 9 PEST sequences and proteolysis-i: explanation of PEST and proteolysis mechanism
- 10 Action of cytotoxic, hemotoxic, myotoxic & hemorrhagic venoms-i, ii

## **References:**

1. Lehninger Principles of Biochemistry, David L.Nelson, Michael M.Cox Publisher: W.H. Freeman.
2. Molecular Biology of the Cell, 3<sup>rd</sup> edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts ,and James DWatson. Publisher NewYork: Garland Science;
- 3.Biochemistry, 4thEdition-DonaldVoet, JudithG.Voet–Publisher JohnWiley & Sons
- 4.The Cell:A Molecular Approach, by Geoffrey M.Cooper and Robert E.Hausman, pub. ASM Press

**Paper-I: BI 301T: Gene Regulation and Genetic engineering (Core 4 Credits; 100 Marks)**

**Unit – I: Gene Regulation in Prokaryotes and Viruses**

1 Operon concept for gene regulation-i: definition of operon, genes present and their functions

2 Positive (+ve) & Negative (-ve) control – Lac operon-i: mechanism and proteins involved

3 Attenuation – Trp operon-i: genes present in operon, functions of the same, importance of the operon

4 Dual promoters – gal operon-i: genes present in operon, functions of the same, importance of the operon

: Dual function of repressor – ara operon-ii: genes present in operon, functions of the same, importance of the operon

5 Phase variation in *Salmonella* flagellar protein synthesis-i: mechanism and importance

6 Sporulation gene expression in *Bacillus*-i: mechanism and importance

7 Riboswitch-i: History, mechanism, types and functions

8 Anti – termination in lambda phage-i: definition, different proteins involved and mechanism

9 Lytic / lysogenic switch in lambda phage-i: different proteins involved and mechanism

10 Control of plasmid copy number-i: mechanism involved and its importance

**Unit – II: Gene Regulation in Eukaryotes**

1 Chromatin structure in active and inactive regions-i: basic structure of chromatin, euchromatin and heterochromatin, proteins present in the chromatin

DNA methylation-ii: what is DNA methylation, enzymes involved & its importance

- 2 Euchromatin, histone acetylation, H2AX foci, histone code-i, ii
- 3 Transcriptional control – cell specific expression – promoters, enhancers, Transcription factors-i, ii
- 4 Posttranscriptional control – alternative splicing-i: definition, types and examples, RNA editing-ii: definition, and importance, examples.
- 5 RNA transport and stability-i.
- 6 Translational feedback-i.
- 7 Gene silencing – inactivation of mammalian X chromosome-i: definition importance and mechanism.
- 8 Regulation by siRNA-i: definition, mechanism and functions
- 9 Gal operon of yeast-i: components of operon, regulation mechanism.
- 10 MAT locus and mating type switch in yeast-i: genes involved in mating type switch and importance, Antigenic variation in Trypanosoma-ii:definition and mechanism

### **Unit – III: Genetic Engineering-I**

- 1 Enzymes in rDNA technology: Restriction endonucleases –i (discovery, properties): definition, types, nomenclature and examples
- 2 Enzymes in rDNA technology: DNA and RNA polymerases - i
- 3 Enzymes in rDNA technology-i, ii: Nucleases, Kinases, Phosphatases and Ligases
- 4 Prokaryotic and Eukaryotic vectors-i, ii (plasmids, cosmids, phage, phagemid, BAC, YAC)
- 5 Shuttle vectors, Targeting vectors, Expression vectors (insect, plant, mammalian cells)-i, ii
- 6 Construction of cDNA and genomic DNA libraries-i: definition, libraries preparation, applications
- 7 Screening a library (+ve) & (-ve) selection strategies-i, Preparation of probes: definition, types, preparation and applications-ii
- 8 Creating KO cells, Cre – Lox systems-i.
- 9 Sequencing DNA by Maxam-Gilbert and Sangar method-i, ii: difference between these two methods, merits and demerits
- 10 Sequencing DNA by Pyrosequencing-i: requirements, methodology and applications



## **Unit – IV: Genetic Engineering-II**

- 1 Yeast 2 hybrid-i: methodology, applications
- 2 Phage display-i: methodology, applications
- 3 Reporter genes – GFP, b – gal, luciferase-i, ii
- 4 Expression in heterologous systems – bacteria-i
- 5 Expression in heterologous system – yeast cells-i
- 6 Expression in heterologous system – insect cells-i
- 7 Expression in heterologous system – mammalian cells-i
- 8 Molecular markers – RFLP, AFLP-i, ii: full forms, procedure, applications
- 9 Random amplification of polymorphic DNA (RAPD), Short tandem repeat, single nucleotide polymorphism (SNP)-i, ii: full forms, procedure, applications
- 10 Ribotyping-i: procedure, applications

## **References:**

1. Genes VIII, Lewin, B, Publish Oxford University Press
2. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
3. Molecular Biotechnology Glick, BR and Paternak, JJ. Publish ASM Press
4. Molecular Biology of the Gene by Watson JD, Losick R. Pub Pearson Education

## **Paper-II: BI 302T: Immunology and Immunotechnology (Core 4 Credits; 100 Marks)**

### **Unit – I: Components of the Immune System**

- 1 History of immunology-i
- 2 Natural & acquired immunity-i, Specific & non-specific immune response-ii.
- 3 Cells & organs of immune system-i  
Cells & organs of immune system-ii

- 4 Antigenic determinants, Epitopes, Haptens-i, Properties of strong antigens-ii
- 5 Adjuvants – types, mode of action, and applications-i.
- 6 Classification, structure –I and biological properties of immunoglobulins-ii
- 7 Isotypes, allotype, idiotypes-i.
- 8 Theories of antibody formation-i, Generation of antibody diversity-ii
- 9 Genomic rearrangements of light and heavy – chain loci in B-cells-i
- 10 Genomic rearrangements in T-cell receptor-i, structure of CD3, CD4, CD8-ii

### **Unit – II: Events in Immune Response**

- 1 Humoral –i & cell-mediated immune response-ii
- 2 Activation of T cells –i & B cells-ii
- 3 Kinetics and regulation of primary and secondary immune response-i
- 4 MHC proteins structure –i & functions-ii
- 5 Antigen processing & presentation-i
- 6 Transplantation immunology; Graft Versus Host Disease-i
- 7 Complement fixation: pathways-i and biological consequences-ii
- 8 Discovery and action of Interferons-i
- 9 Cytokines; Inflammation; Role in obesity, cancer-i
- 10 Tumor immunology-i

### **Unit – III: Immune Disorders**

- 1 Hypersensitivity; Coombs classification-i
- 2 Type I-V hypersensitivity-i
- 3 Tests for diagnosis of hypersensitivity (Coombs), Tuberculin test-i
- 4 Auto immune diseases; classification-i  
Auto immune diseases; classification-ii
- 5 Study of selected auto – immune disorders of types I – V,-i
- 6 Immuno- deficiency disorders – primary and secondary deficiencies-i
- 7 Gene therapy for ADA deficiency-i
- 8 Immunology of AIDS-i  
Immunology of AIDS-ii
- 9 Immunosuppressive drugs/agents-i & their mechanism of action-ii

10 Immune evasion by bacteria and viruses-i

### **Unit – IV: Immunotechnology**

1 Production of polyclonal antibodies-i; Animals models for production of antibodies-ii

2 Methods of antibody purification: Salt precipitation-i, Affinity chromatography-ii

3 Antigen-antibody binding (Equilibrium dialysis, Surface Plasmon Resonance); Affinity, Avidity-i

4 Immunoprecipitation methods - gel diffusion (Ouchterlony; Mancini)-i;

Immune-electrophoresis (Rocket, counter-, 2-D)-ii

5 Agglutination tests (Direct and indirect), Inhibition of Agglutination-i, Complement fixation test, Inhibition of complement fixation-ii

6 ELISA, RIA Western Blots-i; use of antibody staining for FACS-ii

7 Hybridoma technology – production of monoclonal antibodies-i; applications in research and immunotherapy; antibody engineering-ii

8 History and types of Vaccines-i; Conventional vaccines - killed, attenuated, and subunit vaccines-ii

9 Modern vaccines; peptide, DNA-i, recombinant / vector, and anti-idiotypic vaccines-ii

10 Schedules of common vaccination-i, Benefits and adverse consequences of vaccination-ii

### **References:**

1. Kuby Immunology – Edited Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co

2. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves

3. Veterinary Immunology: Ian R. Tizard, I.R. Thomson press

4. The Immune System. By Peter Parham Publisher Garland publishing

**Paper-III: BI 403T: Microbiology (Core, 4Credits:100 Marks)**

## **Unit I: Bacteriology**

1. Classification of prokaryotes-i,
2. Staining methods-i,
3. Common culture methods (minimal, enriched, selective)-i.
4. Structure of bacterial cell-i.
5. Motility of bacteria-i, bacterial films-ii,
6. Sterilization methods –i (autoclaving, dry heat, filtration, chemical disinfectants, irradiation), Sterilization methods -ii
7. Maintenance and preservation of microbial cultures-i.
8. Bacterial culture growth conditions-i, growth curve, doubling time-ii.
9. Factors affecting growth –pH, temperature, oxygen and agitation-i.
10. Chemostat, continuous and synchronous cultures-i

## **Unit II: Mycology**

1. Classification: classification of Fungi (Ainsworth, 1973) upto sub-division –i, with diagnostic characters and examples-ii.
2. Hyphal forms-i,
3. Fungal spore forms-i and mode of liberation-ii,
4. Sexual reproduction and degeneration of sex-i,
5. Homothallism and heterothallism-i, life cycle patterns-ii,
6. Anamorphic fungi and parasexuality 3-i.
7. Life history of synchytrium-i,
8. Life history of Rhizopus-i, Ascobolus-ii,
9. Life history of Agaricus-i, Micorrhiza types with salient features-ii,
10. Role in agriculture and forestry-i.

## **Unit III: Prokaryotic viruses**

1. Discovery of bacteriophages-i
2. Structure and composition of bacteriophages-i; classification-ii
3. Genome diversity –i and host-specific interactions-ii

4. Isolation and purification by filtration, ultracentrifugation –i and affinity chromatography-ii
5. Plaque assay –i and other assay methods-ii
6. One step growth-i, single burst and eclipse experiments-ii
7. Life cycle of model bacteriophages infecting *E.coli* – lambda phage (lytic and lysogenic)-i
8.  $\Phi$ x174-i, Q $\beta$ -ii, M13-iii
9. T4-i, T7-ii
10. Phages in therapy-i

#### **Unit-IV: Eukaryotic viruses**

1. Classification of animal viruses-i, Virioids and virusoids-ii
2. Structure of naked and enveloped viruses-i
3. Host-virus interactions-i, permissive/non-permissive hosts; cytopathic effects-ii
4. Isolation and purification of viruses-i
5. Assay methods-Pock assay-i, hemagglutination assay, transformation assay-ii
6. Cultivation of viruses in animals and tissue culture-i
7. Life cycle of animal viruses – SV40-i
8. Adenovirus-i, Poliovirus-ii
9. Retroviruses – RSV/HIV-i
10. Plant viruses – TMV-i, CaMV-ii

#### **References:**

1. [The Fundamentals of Bacteriology](#) by Charles Bradfield Morrey
2. [Bacteriology Textbook](#) by Charles P. Davis, Gail Woods and David Niese
3. [Basic Bacteriology](#) by C.C. Chen, Ph.D., D.D.S
4. [Fungi Their Nature and Uses](#) by Mordecai Cubitt Cooke
5. [Biology of Fungi](#) by Chet Cooper

6. An Introduction To The Study of Fungi by E. F. Legner
7. [Basic Virology by Elliott J. Blumenthal](#) by Elliott J. Blumenthal
8. Veterinary Virology by Dr. M. A. Oyekunle, Dr O. E. Ojo and Dr. M. Agbaje
9. [Molecular Virology](#) by Moses P. Adoga
10. Viruses of Prokaryotes by Hans-Wolfgang Ackermann, Michael S. Dubow
11. Viruses of Fungi and Simple Eukaryotes by Y. Koltin

**Paper-IV: BI 404T: Biotechnology. (Core, 4 Credits: 100 Marks)**

**Unit – I: Microbial Biotechnology**

- 1 Large scale cultivation of microbes-i; Fermenter design and control of growth-ii
- 2 Downstream processing-i
- 3 Production of biomass-i, single cell protein-ii
- 4 Production of low molecular weight primary and secondary metabolites-i
- 5 Microbial insecticides-i
- 6 Production of enzymes for industry-i (high fructose corn syrup, cheese, food processing)-i  
Production of enzymes for industry-ii
- 7 Microbial polysaccharides-i-Xanthan gum, Dextran, Pullulan, Mannan, Curdlan, Alginate; Microbial polysaccharides-ii
- 8 Microbial mining (mineral leaching)-i
- 9 Microbial production of interferon-i, tissue plasminogen activator-ii
- 10 Microbial degradation of oil (bioremediation)-i

**Unit – II: Plant Biotechnology**

- 1 Plant cell culture-i: callus, protoplast fusion, differentiation into plantlets-ii
- 2 Plant vectors, Ti plasmids-i
- 3 GM plants-i, GM foods -ii

4. IPR and farmers' rights in GM plants-i  
IPR and farmers' rights in GM plants-ii
- 5 Anti sense RNA and DNA-i
- 6 Plantibodies-i
- 7 Case studies (genes involved, commercial value, problems) of StarLink corn-i, Bt cotton-ii
- 8 Case studies of Zeneca tomato paste-i, FlavrSavr tomato-ii
- 9 Case studies of Golden rice-i, Herbicide resistant plants-ii
- 10 Virus resistant plants-i.

### **Unit – III: Animal Biotechnology**

- 1 Development, maintenance-i and growth of animal cell lines-ii
- 2 Cloning of mammalian species (Dolly)-i
- 3 Production of viral vaccines-i
- 4 Production high value therapeutics-i, interferon-ii
- 5 Plasminogen activator, urokinase-i
- 6 Monoclonal antibodies-i, chimeric antibodies-ii
- 7 Immunotoxins as therapeutic agents-i
- 8 Gene knockouts –i and transgenic animals-ii
- 9 Human gene therapy-i
- 10 “Humanized” animals as organ farms-i

### **Unit – IV: Protein Engineering**

- 1 Methods and applications of immobilized cells-i
- 2 Methods and applications of immobilized enzymes-i
- 3 Large-scale and site-directed mutagenesis-i,
- 4 Natural and recombinant fusion proteins-i, tags for protein purification-ii
- 5 Altering kinetic properties and pH dependence of enzymes-i
- 6 Increasing stability-i, enhancing specific activity of enzymes-ii
- 7 Directed enzyme evolution-i
- 8 PEGylated interferon-i
- 9 Macro-modifications-i, Macro-modifications-ii
- 10 Methods of drug design and delivery-i  
Methods of drug design and delivery-ii

**References:**

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications

**Note: i=1<sup>st</sup> hr, ii=2<sup>nd</sup> hr, iii=3<sup>rd</sup> hr**