

Paper 13- BOHT 405: BIOCHEMISTRY

THEORY

Marks: 100

1. Biomolecules

(Chapter 3,4,7,8 and 10: Nelson and Cox) (8 Lectures)

Over view of amino acids, proteins and carbohydrates.

Lipids- Fatty acids, triacyl glycerols; glycerophospholipids, sphingolipids, sterols.

Nucleic acids- Nucleotides, Nitrogenous Bases- Purines and Pyrimidines; tautomers of bases, nucleotide derivatives, nucleotides as regulating molecules, different types of DNA and RNA

2. Enzymes Classification- Kinetics and Control

(Chapter 6: Nelson and Cox) (8 Lectures)

The Michaelis-Menten equation-derivation and physiological significance, the double reciprocal plots, kinetics of multisubstrate reactions, enzyme inhibition, turn over number of enzymes, *Regulatory enzymes*: General properties of allosteric enzymes, theories of allosteric regulation, regulation by covalent modification, kinetics, multienzyme complexes, negative and positive cooperativity, zymogens, isoenzymes, abzymes, ribozymes. *Mechanisms* of enzyme-catalysis, specificity, reactions rate, equilibrium, interaction between an enzymes and substrate, role of binding energy, acid base and covalent catalysis, lock and key & induced fit theories.

3. Coenzymes

(Chapter 6: Nelson and Cox) (2 Lectures)

Classifications (metabolite derived/vitamin derived) function of various types, structure of NAD^+ , NADP^+ , FAD & FMN,

4. Metabolism and Bioenergetics

(Chapter 13: Nelson and Cox) (4 Lectures)

Principles of bioenergetics-Standard free energy change, experimental measurement of ΔG , ATP and other reaction molecules, metabolic roles of ATP-Phosphoryl group transfer, nucleotidyl group transfer, biological oxidation-reduction reactions. General scheme of studying metabolic pathways, their local and global regulatory agents, energetics, disorders associated with the malfunctioning of pathways.

5. Metabolic Pathways:

(Chapter 14,16,17,21,18,22: Nelson and Cox) (32 Lectures)

Carbohydrates metabolism:

8

Glycolysis, alcoholic and lactic acid fermentation, Pasteur Effect, gluconeogenesis, Cori-cycle, glucose-alanine cycle, futile cycle. TCA cycle, HMP shunt, glycogenolysis & glycogen synthesis.

Disorders associated with defects in carbohydrate metabolism- a brief account on fructose intolerance, lactose intolerance, lactic acidosis, disorders related to glycogen metabolism, genetic deficiency of Glucose-6-phosphate dehydrogenase, Galactosemia, pentosuria, Diabetes Mellitus (NIDDM and IDDM)

Lipid metabolism:

8

Mobilization of triglycerides, metabolism of glycerol, β -oxidation of saturated, mono-unsaturated and poly-unsaturated fatty acids, even and odd chain fatty acids. Ketone bodies.

Biosynthesis of fatty acids, fatty acid elongation and desaturation, biosynthesis of triacylglycerols.

Disorders associated with defects in Lipid metabolism: Refsum's disease, Gaucher's disease, Niemann Pick's disease, Tay Sach's disease

Metabolism of amino acids:

8

Assimilation of Ammonia: its incorporation in glutamate, glutamine and alanine as nitrogen carrier, regulation of glutamate dehydrogenase and glutamine synthetase, transamination reactions-role of pyridoxal phosphate, nitrogen excretion and *urea cycle*.

An overview of degradation pathways of amino acids with detailed pathway of phenylalanine and branched chain amino acids.

Disorders associated with defects in protein and amino acid metabolism: disorder associated with deficiency of Urea cycle enzymes, Phenylketonuria, Alcaptonuria, Maple syrup urine disease, tyrosinemia

Metabolism of Nucleotides:

8

Brief outline of *Denovo* synthesis of purines and pyrimidines, salvage pathway, reduction of ribonucleotides to deoxyribonucleotides, degradation of purines and pyrimidines, nucleotide analogs as chemotherapeutic agents.

Disorders associated with defects in nucleotide metabolism- Gout, Lesch Nyhan Syndrome, SCID, Orotic aciduria.

6. Electron-transport chain (ETC) and oxidative phosphorylation:

(Chapter 19: Nelson and Cox) (6 Lectures)

Constituents of ETC & their sequence (Complex I-IV) & location, inhibitors of ETC, chemiosmotic theory, ATP synthase complex- structure and function, dicarboxylic acid shuttle, glycerol phosphate shuttle, P:O ratio, regulation of oxidative phosphorylation.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Lehningers Principles of Biochemistry, David L. Nelson and Michel M. Cox., 5th Edition, WH Freeman, 2008.

References Books:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. 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, McGraw Hill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning, 2005.

BOHP 405: BIOCHEMISTRY

PRACTICALS

Marks: 50

1. Separation of Biomolecules by electrophoresis.
2. Qualitative analysis of sugars.
3. To study the principle of spectrophotometer and verify Beer's law.
4. To plot absorption spectrum of DNA and protein and find λ_{max} .
5. Quantitative estimation of DNA/RNA.
6. Quantitative estimation of protein using spectrophotometer.
7. To perform biochemical assay of an enzyme under optimal conditions.
8. To study the effect of pH/temperature/heavy metals on the activity of enzymes (any one factor).
9. To determine K_m and V_{max} of an enzyme.
10. Case studies related to metabolic disorders (Tay Sach / Niemann Pick, von Gierke's / Galactosemia, Phenylketonuria / Maple syrup, Gout / ADA)

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 2nd Edition, Alpha Science International, 2005.
2. Principles and Techniques of Practical Biochemistry, Keith Wilson (Editor), John Walker (Editor), John M. Walker, 5th Edition, Cambridge University Press, 2000.

Paper 14 - BOHT 406: MEDICINAL CHEMISTRY

THEORY

Marks: 100

1. **General Introduction:** (2 Lectures)
Definition and scope of medicinal chemistry

2. **Principles of drug design** (Chapter 2: Silvermann) (6 Lectures)
Strategies in the search for new lead compounds
Analogue synthesis versus rational drug design,
Prodrugs

3. **Physicochemical principles of drug action** (Chapter 13: Patrick) (16 Lectures)
Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailability, stereochemical aspects of drug action, electronic structure (Hammett correlations), determining relationship between chemical and biological data (Hansch approach.)

4. **Introduction to Quantitative Structure Activity Relationships** (Chapter 13: Patrick) (6 Lectures)
Statistical techniques behind QSAR, classical QSAR

5. **Measurement of drug effects** (Chapter 3: Nogrady) (10 Lectures)
Kinetic analysis of ligand receptor interactions using Schatchard, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response)

6. **Drug target classification** (16 Lectures)
Proteins as drug targets (Chapter 4,5: Patrick)
Enzymes: Enzyme inhibitors (competitive, non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors. 4
Receptors: The receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency. 8
Nucleic acids as drug targets (Chapter 7: Patrick)
Classes of drugs that interact with DNA: DNA intercalators (amsacrine), Groove binders (netropsin), DNA alkylators (amines: mechlorethamine, nitrosoureas: carmustine), Antisense therapy (Introduction). 4

7. **Introduction to combinatorial synthesis**

(Chapter 2: Silvermann; Chapter 14: Patrick) (4 Lectures)

Methods of parallel synthesis, methods in mixed combinatorial synthesis (mix and split method), limitations of combinatorial synthesis.

REFERENCE BOOKS FOR THEORY PAPER

Text Books:

1. Introduction to Medicinal Chemistry: Graham I. Patrick, 3rd Edition, Oxford University Press, 2006.
2. The Organic Chemistry of Drug Design and Drug Action: Richard B. Silvermann, 2nd Edition, Elsevier, Academic Press, 2004.
3. Medicinal Chemistry: A Molecular and Biochemical Approach: Thomas Nogrady and Donal F. Weaver, 3rd Edition, Oxford University Press, 2004.

Reference Books:

1. Wilson Gisvold textbook of Organic Medicinal and Pharmaceutical Chemistry: Edited by Block & Beale, 11th Edition, Baltimore, Lippincott, 2004.
2. The Practice of Medicinal Chemistry: Camille G. Wermuth, 2nd Edition, Academic Press, 2003.
3. Principles & Practice of Medicinal Chemistry: Frank. D. King. 2nd Edition, The Royal Society of Chemistry, 2002.
4. Principles of Medicinal Chemistry: William O. Foye, David A. Williams, Thomas L. Lemke, 5th Edition, B.I. Bayer Pvt. Ltd., 2002.
5. Introduction to Medicinal Chemistry: How Drugs Act and Why, Alex Gringauz, 2nd Edition, Wiley-VCH, 2009.
6. Burger's Medicinal Chemistry and Drug Discovery: Edited by Daniel J. Abraham, 6th Edition, Wiley Interscience, John, Wiley Sons, Inc., 2003.

BOHP 406: MEDICINAL CHEMISTRY

PRACTICALS

Marks: 50

1. Preparation of Benocaine
2. Preparation of Benzoquinone
3. Preparation of Aspirin and determination of partition coefficient in octanol-water system
4. Preparation of Paracetamol
5. Preparation of Phenacetin
6. Extraction of caffeine from Tea leaves and study its absorption properties.
7. Preparation of Hippuric acid
8. Preparation of s-benzyl thiuronium salt
9. Effect of inhibitor (methotrexate) of NAD⁺ dependent enzyme activity

(Minimum of Eight practicals must be conducted from the given 12 practicals.)

REFERENCE BOOKS FOR PRACTICAL PAPER

1. Advance Practical Medicinal Chemistry by Ashutosh Kar, 4th Edition, Publisher New Age International Pvt. Ltd., 2007.

Paper 15 - CBHT 402: CELL BIOLOGY-II

THEORY

Marks: 100

Unit 1. The Plasma Membrane

(Ch 13 Cooper *et al.*)

Structure; Transport of small molecules, Endocytosis

Unit 2. Cell Wall, the Extracellular Matrix and Cell Interactions Cooper *et al.*)

(Ch 14

Bacterial and Eukaryotic Cell Wall; the extracellular matrix and cell matrix interactions; cell-cell interactions.

Unit 3. Cell Signaling

(Ch 15 Cooper *et al.*)

Signaling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway; signaling networks.

Unit 4. The Cell Cycle

(Ch 16 Cooper *et al.*)

Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase, Meiosis and Fertilization.

Unit 5. Cell Death and Cell Renewal

(Ch 17 Cooper *et al.*)

Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning.

Unit 6. Cancer

(Ch 18 Cooper *et al.*)

Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Cancer Treatment- molecular approach.

CBHP 402: CELL BIOLOGY-II

PRACTICALS

Marks: 50

1. To demonstrate the presence of mitochondria in striated muscle cells using vital stain Janus Green B.
2. Study of polyploidy in Onion root tip by colchicine treatment.
3. Preparations of temporary mount of Grasshopper testis and study the different stages of Meiosis.
4. Study of mitosis and meiosis from permanent slides.
5. Identification and study of cancer cells –Slides/ photomicrographs

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. 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.

Paper 16 - MBHT 402: MOLECULAR BIOLOGY-II

THEORY

Marks: 100

Unit 1. Mechanism of Transcription

(Ch 12 Watson/ Ch 21 Becker)

RNA Polymerase and the transcription unit

Transcription in Prokaryotes

Transcription in Eukaryotes

Unit 2. RNA Modifications

(Ch 13 Watson)

Split genes, concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.

Unit 3. Translation (Prokaryotes and Eukaryotes)

(Ch 14 Watson/ Ch 22 Becker/ Ch 21 DeRobertis)

Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis.

Regulation of translation

Translation-dependent regulation of mRNA and Protein Stability.

Unit 4. Transcription Regulation in Prokaryotes

(Ch 16 Watson)

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons

Unit 5. Transcription Regulation in Eukaryotes

(Ch 17 Watson)

Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene Silencing

Unit 6. Regulatory RNAs

(Ch 18 Watson)

Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X-inactivation

MBHP 402: MOLECULAR BIOLOGY-II

PRACTICALS

Marks: 50

1. Preparation of culture medium (LB) for *E.coli* (both solid and liquid) and raise culture of *E.coli*.
2. Demonstration of antibiotic resistance. (Culture of *E.coli* containing plasmid (pUC 18/19 in LB medium with or without antibiotic pressure and interpretation of results).
3. Isolation and quantitative estimation of salmon sperm / calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
4. To perform Ames test in *Salmonella/ E. Coli*. To study mutagenicity.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. 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.
4. 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.