JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095
DEPARTMENT OF BIOCHEMISTRY
B.Sc. VI SEMESTER BIOCHEMISTRY PAPER VIII SYLLABUS (2021 NEP BATCH)
BIOENERGETICS AND METABOLISM

COURSE TITLE	**BIOENERGETICS AND METABOLISM**
COURSE CODE	**21VIBC8(T)**
COURSE CREDITS	**04**
TOTAL CONTACT HOURS	**60 Hours**
DURATION OF ESE	**2 ½ Hours**
FORMATIVE ASSESSMENT MARKS	**40 Marks**
SUMMATIVE ASSESSMENT MARKS	**60 Marks**

Course Objectives:

Through this course, the student is imparted with

- The application of the principles of classical thermodynamics to the study of the fundamental biochemical processes.
- Knowledge on how living organisms acquire and transform energy to perform biological work.
- The understanding of metabolic pathways in the process of bioenergetics.
- In depth knowledge of various catabolic and anabolic pathways and its regulation

Course Learning Outcome:

At the end of the course the students will be able to:

- Illustrate how the laws of thermodynamics, entropy and enthalpy, Gibb`s energy, free energy change applies to biological systems.
- Understand the concepts of metabolism, characteristics of metabolic pathways and strategies used to study these pathways.
- Systematically learn the breakdown and synthesis of amino acids and

nucleotides in humans and recognize its relevance with respect to nutrition and human diseases

- Understand the role of inhibitors of nucleotide metabolism which are potentially being used as chemotherapeutic drugs
- Comprehend how the amino acid and nucleotide metabolism are integrated with carbohydrate and lipid metabolism.

CO NO.	Course outcomes statement	Knowledge level
1	Illustrate how the laws of thermodynamics, entropy and enthalpy, Gibb`s energy, free energy change applies to biological systems.	K1, K2 & K3
2	Understand the concepts of metabolism, characteristics of metabolic pathways and strategies used to study these pathways.	K2, K3 & K4
3	Systematically learn the breakdown and synthesis of amino acids and nucleotides in humans and recognize its relevance with respect to nutrition and human diseases	K2, K4 & K5
4	Understand the role of inhibitors of nucleotide metabolism which are potentially being used as chemotherapeutic drugs	K1, K2, K5 & K6
5	Comprehend how the amino acid and nucleotide metabolism are integrated with carbohydrate and lipid metabolism	K2, K4 & K5

- K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6- Create

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	√	√		√			√		√	√
CO2	√	√					√			√
CO3	√	√	√			√	√		√	√
CO4	√	√	√	√		√	√		√	√
CO5	√	√					√			√

Programme Objectives aligned with Graduate attributes

- PO1- Knowledge
- PO2- Scientific thinking
- PO3- Entrepreneurial skills
- PO4- Analytical skills

- PO5- Communication skills
- PO6- Social commitment
- PO7- Research and Inquiry
- PO8- Conservation of Environment
- PO9- Employability
- PO10- Academic orientation

UNIT I **13 hours**

Bioenergetics: Laws of thermodynamics, free energy change, Relationship between equilibrium constant and energy change, High energy compounds, ATP cycle, phosphorylation potential, and phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, Oxidative phosphorylation: Proton gradient generation, redox loop, Q cycle, Proton pumping. The electron transport chain inside mitochondria. Peter Mitchell's Chemiosmotic hypothesis and Proton motive force. Fo-F1 ATP synthase, structure and mechanism of ATP synthesis.

UNIT II : **16 hours**

Introduction to metabolism

Anabolism and catabolism, compartmentalization of metabolic pathways

Metabolism of Carbohydrates

Reactions and energetics of glycolysis, entry of fructose, galactose, mannose and lactose into glycolytic pathway. Fates of pyruvate - conversion of pyruvate to lactate, alcohol and acetyl CoA. Cori's cycle. Reactions and energetics of TCA cycle, amphibolic and integrating roles of TCA cycle. Anaplerotic reactions. Regulatory steps of glycolysis and TCA cycle, Gluconeogenesis and glycogenolysis. Pentose phosphate pathway and its significance.

UNIT III

Metabolism of Lipids: **10 hours**

Introduction, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, β-oxidation of saturated and unsaturated fatty acids, ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Fatty Acid Synthase complex, Lipogenesis (Denovo synthesis of Fatty acid), Elongation of Fatty acid (Mitochondrial

elongation). Biosynthesis of TAG, Phospholipids (Lecithin and Cephalin). Biosynthesis of cholesterol. Normal range of cholesterol level.

UNIT IV **5 hours**

Metabolism of Nucleic acids

Degradation of nucleic acids, action of nucleases- DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines. Salvage pathways. De novo biosynthetic pathways of purine and pyrimidine nucleotides. Conversion of ribonucleotides to deoxy ribonucleotides.

UNITV **16 hours**

Metabolism of Amino acids

General mechanism of amino acid metabolism, Deamination- oxidative and non – oxidative deamination, transamination, decarboxylation - biologically important amines and desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids. Urea cycle and its significance. Synthesis and catabolism of alanine, serine and cysteine.

REFERENCES

1. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4thEdition, John Wiley and Sons Inc, 2012
2. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn.Macmillan Publications 2012
3. Biochemistry- the chemical reactions of living cells, David E Metzler, 2nd Edition,Elsevier Academic Press,
4. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.
5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Freeman andcompany, 7th Edition, 2010.
6. Harper's Illustrated Biochemistry, Victor W Rodwell, et.al,31st edition, McGraw HillEducation Lange ® 2018.

BIOCHEMISTRY PRACTICAL PAPER 8

COURSE TITLE	**BIOENERGETICS AND METABOLISM**
COURSE CODE	**21VIBC8 (P)**
COURSE CREDITS	**02**
CONTACT HOURS	**4 Hours/Week**
DURATION OF ESA	**03 Hours**
FORMATIVE ASSESSMENT MARKS	**25 Marks**
SUMMATIVE ASSESSMENT MARKS	**25 Marks**

I : Experiments

1. Estimation of blood sugar by OT method.
2. Estimation of pyruvate by DNPH method
3. Estimation of inorganic phosphate by Fiske -Subbarow method
4. Estimation of Urea
5. Estimation of Uric acid
6. Estimation of creatinine
7. Estimation of cholesterol
8. Determination of urinary ammonia
9. Estimation of Serum Calcium by ammonium oxalate method.
10. Estimation of urine Calcium by ammonium oxalate method.
11. Estimation of RNA by orcinol method.
12. Determination of A/G ratio.

II : Report:

Visit to scientific/research institute – Tour report.

OR

Submission of assignment on recent trends in biochemistry

REFERENCES:

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam , A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer , 3rd edition 2017
4. Laboratory manual in Biochemistry, J. Jayaraman 2011.