ZOOL-303A & 303L BIOCHEMISTRY II Cr. 3 (2+1)

Course Objectives:

1. To understand the principles of bioenergetics;
2. To know the dietary requirements of man and animals;
3. To provide knowledge of metabolism of dietary and endogenous carbohydrate, lipid, and protein;
4. To impart the knowledge of principles and major mechanisms of metabolic control and molecular signalling by hormones;

Course Learning Outcome

By the end of the course, students should be able to:

1. **DEMONSTRATE** knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition;
2. **DEMONSTRATE** knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signalling;
3. **USE BASIC** laboratory skills and apparatus to obtain reproducible data from biochemical experiments;
4. **IMPLEMENT** experimental protocols, and adapt them to plan and carry out simple investigations;
5. **ANALYSE,** interpret, and participate in reporting to their peers on the results of their laboratory experiments;
6. **BUILD** on their knowledge and understanding in tackling more advanced and specialised courses, and more widely to pursue independent, self- directed and critical learning.

Course Contants

1. Bioenergetics

- Concept of Free Energy; Standard Free Energy change:
- Energy rich compounds and their role in metabolism.

2. Metabolism

- Detailed description of Glycolysis and Catabolism of other Hexoses;
- Regulation and Bioenergetics of Glycolysis. Anabolic role of Glycolysis;
- Fate of Pyruvate under Aerobic and Anaerobic conditions, Lactate and Alcoholic Fermentation;
- Gluconeogenesis, its Regulation and significance in the tissues; Feeder Pathways in Glycolysis; Utilization of other carbohydrates in Glycolysis;
- Phosphorolysis of Glycogen and Starch; Regulation of Glycogen metabolism; Utilization of dietary polysaccharides (Starch) and Disaccharides (Sucrose and Galactose). Biosynthesis of Glycogen, Starch and Sucrose;
- Pentose phosphate pathway of Glucose oxidation and its major role in the animal tissues.
- Citric acid (TCA) cycle: Conversion of Pyruvate to Acetyl CoA, Pyruvate dehydrogenase, a multi-enzyme complex;
- Detailed description of citric acid cycle; Bioenergetics and conservation of Energy produced in the cycle. Anabolic or Biosynthetic role of citric acid cycle intermediates; Replenishing or Anaplerotic reactions and their role; Regulation of Citric acid cycle.

3. Lipid metabolism

- Digestion, mobilization and transport of Fats; Biosynthesis of Triacylglycerol;
- Utilization of Triacylglycerol; Oxidation of Fatty acids; Activation of Fatty acids and their transportation to mitochondria;
- Beta (ß)-Oxidation; Bioenergetics of ß-oxidation; Omega (ω)- Oxidation pathway;
- Biosynthesis of Saturated Fatty acid, Supply of raw material for palmitic acid synthesis; Fatty acid synthetase (FAS) multienzyme complex;
- Models of FAS system in Bacteria, Plants, vertebrate tissue and Yeast cell; Biosynthesis of unsaturated Fatty acids, Aerobic and Anaerobic pathways. Ketone bodies and their biosynthesis, utilization and role in the tissues;

4. Cholesterol metabolism

- Cholesterol biosynthesis and its Regulation; Steroid hormones, their types and main functions; Prostaglandins, their types, synthesis, inhibition and main functions.

5. Nitrogen metabolism

- Metabolic fate of amino acids; Catabolism of amino acids; Deamination and Transamination;
- Role of glutamate, glutamine and alanine in transport of ammonia in tissues;
- Nitrogen excretion and urea cycle; Regulation of urea cycle;
- Pathways of amino acid degradation showing entry points in Citric acid cycle; Decarboxylation of amino acids to biological amines.
- Biosynthesis of some amino acids; Incorporation of ammonia in glutamate and glutamine;
- Purine and Pyrimidine biosynthesis showing the sources of various atoms in both molecules.

Practical:

1. Preparation of standard curve of proteins using Lowry's technique.
2. Estimation unknown samples of proteins using Lowry's technique.
3. Estimation of Free Amino Acids in Biological samples colorimetrically.
4. Separation and identification of various amino acids by paper chromatography.
5. Separation of proteins by Polycrylamide Gel Electrophoresis (PAGE).
6. Preparation of standard curve and estimation of DNA by colorimetric analysis using Diphenylamine method.
7. Preparation of standard curve and estimation of total RNA by colorimetric analysis using Orcinol method.
8. Quantitative analysis of Amylase activity from blood serum or liver.
9. Effect of temperature and pH on enzymatic rate of reaction.

Teaching-Learning Strategies

Teaching will be a combination of class lectures, class discussions, and group work. Short videos/films will be shown on occasion.

Assignments

The sessional work will be a combination of written assignments, class quizzes, presentation, and class participation/attendance.

Assessments and Examination

Books Recommended:

1. Plummer, David T., 1990. An Introduction to Practical Biochemistry, 4th Edition McGraw Hill Book Company, London.
2. Wilson, K and Walker, J., 1994. Practical Biochemistry: Principles and Techniques, 4th Edition, Cambridge University Press.
3. Alexander, R.R. and Griffiths, J.M. 1993. Basic biochemical methods. Wiley– Liss, New York.
4. Sawhney, S. K. and Singh, R., 2006. Introductory Practical Biochemistry, 2nd Edition, Narosa Publishing House.
5. Oser, B. L., (Latest Edition). Hawk's Physiological Chemistry, McGraw Hill Book Company.
6. David L. Nelson, and Michael M. Cox, 2005. Lehninger Principles of Biochemistry 4th Edition, Macmillan Worth Publishers, New York.
7. James R. Mckee; Trudy Meckee, . 6th Edition.Oxford University Press.

Additional Readings:

1. Lubert Stryer, 1995. Biochemistry, 4th Edition, W.H. Freeman & Company, New York.
2. Murray, R. K., Granner, D. K., Mayer, P. A. and Rodwells, V. W., 2000.
3. Harper's Biochemistry, McGraw Hill Bok Company, New York.
4. Elliott, W. H. and Elliot, D. C., 2002. Biochemistry and Molecular Biology, Oxford Medical Publications, Oxford University Press.
5. Voet, D., Voet, J. G. and Pratt, C. W., 1999. Biochemistry, John Wiley & Sons.
6. Zubay, G. 1993. Biochemistry, Wm. C. Brown Publishers, Oxford.