

**M.Sc I. Biochemistry Semester I Paper IV Bioenergetics & Biological Oxidation  
Question Bank**

Unit I

Q.1) Choose the correct alternative (each carry 1 mark)

- The study of energy relationship & conversion in biological system is called.....  
a) Biophysics                      b) Biotechnology                      **c) Bioenergetics**                      d) Microbiology
- What is relationship between  $\Delta G$  &  $\Delta G^\circ$   
**a)  $\Delta G = \Delta G^\circ + RT \ln Keq$**                       b)  $\Delta G^\circ = \Delta G + RT \ln Keq$   
c)  $\Delta G^\circ = \Delta G - RT \ln Keq$                       d) None of above
- If enthalpy change for reaction is zero then  $\Delta G^\circ$  equal to.....  
a)  $-T\Delta S$                       b)  $T\Delta S$                       c)  $-\Delta H$                       d)  $\ln keq$
- If  $\Delta G^\circ$  of the reaction  $A \rightarrow B$  is  $-40 \text{ KJ/mol}$  under standard conditions then the reaction.....  
a) Will never reach equilibrium  
b) Will not occur spontaneously  
c) Will produces at rapid rate  
**d) Will proceed from left to right spontaneously**
- Which of the following statement is false  
a) The reaction tends to go in forward direction if  $\Delta G$  is large & positive.  
b) The reaction tends to move in backward direction if  $\Delta G$  is large & negative.  
c) The system is at equilibrium if  $\Delta G = 0$   
**d) The reaction tends to move in backward direction if  $\Delta G$  is large & positive**
- The relationship between  $keq$  &  $\Delta G^\circ$  is  
a)  $\Delta G^\circ = RT \ln Keq$   
**b)  $\Delta G^\circ = -RT \ln Keq$**   
c)  $\Delta G^\circ = R Keq$   
d)  $\Delta G^\circ = -RKeq$

Q.2) Fill in the blanks (each carry 1 mark)

- First law of thermodynamics state that energy can neither be **created** nor be destroyed, but it can be changed from one form to another.
- All spontaneous process **increase** entropy.
- Second law** state that the entropy in an isolated system always increase.
- When **entropy** increases work cannot be done.
- Entropy is quantitative analysis depend on their **degree of randomness**.
- The energy actual available to do work is known as **Free energy**.
- The term standard free energy represented by  **$\Delta G^\circ$** .

8. Enthalpy is measured of the change in **heat content** to reacts compared to products.

Q.3) Answer in one sentence

(each carry 1 mark)

1. What is enthalpy?
2. Which is end product of glycolysis?
3. What is unit of heat?
4. Enlist the measurement of free energy.
5. What is Gibb's free energy?
6. What is nucleotide potential?
7. Define standard free energy.
8. What is exergonic reaction?

Q.4) Long answer questions

(each carry 8 marks)

1. Describe phosphorylation potential with their types.
2. Describe first and second law of thermodynamics.
3. Describe the following in shorts
  - a) Gibb's free energy
  - b) High energy bond
4. Describe standard free energy & its measurements.

Q.5) Short answer questions

(each carry 4 marks)

1. Short notes on ATP & interconversion of nucleotide phosphate.
2. Write about High energy bonds.
3. Explain free energy
4. Explain measurements of standard free energy.
5. Short note on phosphorylation potential.
6. What is second law of thermodynamics?
7. Applications of first law of thermodynamics with explanation.

Unit II

Q.1) Choose the correct alternative

(each carry 1 mark)

1) Electron transport system is present in which of the following part of mitochondria.

- a) **Inner membrane**
- b) Outer membrane
- c) Matrix
- d) Stroma

2) A biological redox reaction always involves....

- a) A loss and gain of electrons
- b) A reducing agent
- c) An oxidizing agent
- d) **All of above**

3) What is the last carrier in the electron transport chain

- a) GTP
- b)  $H^+$
- c) NADH
- d)  **$O_2$**

4) Which electron carrier moves from complex III to ATP synthatase.

- a) Flavin
- b) Ubiquinone
- c) Iron sulphur cluster
- d) **Cytochrome**

5) Ubiquinone transfers its electron to....

- a) Complex I
- b) Complex II
- c) Matrix
- d) **Cytochrome C**

6) Cytochromes are present in....

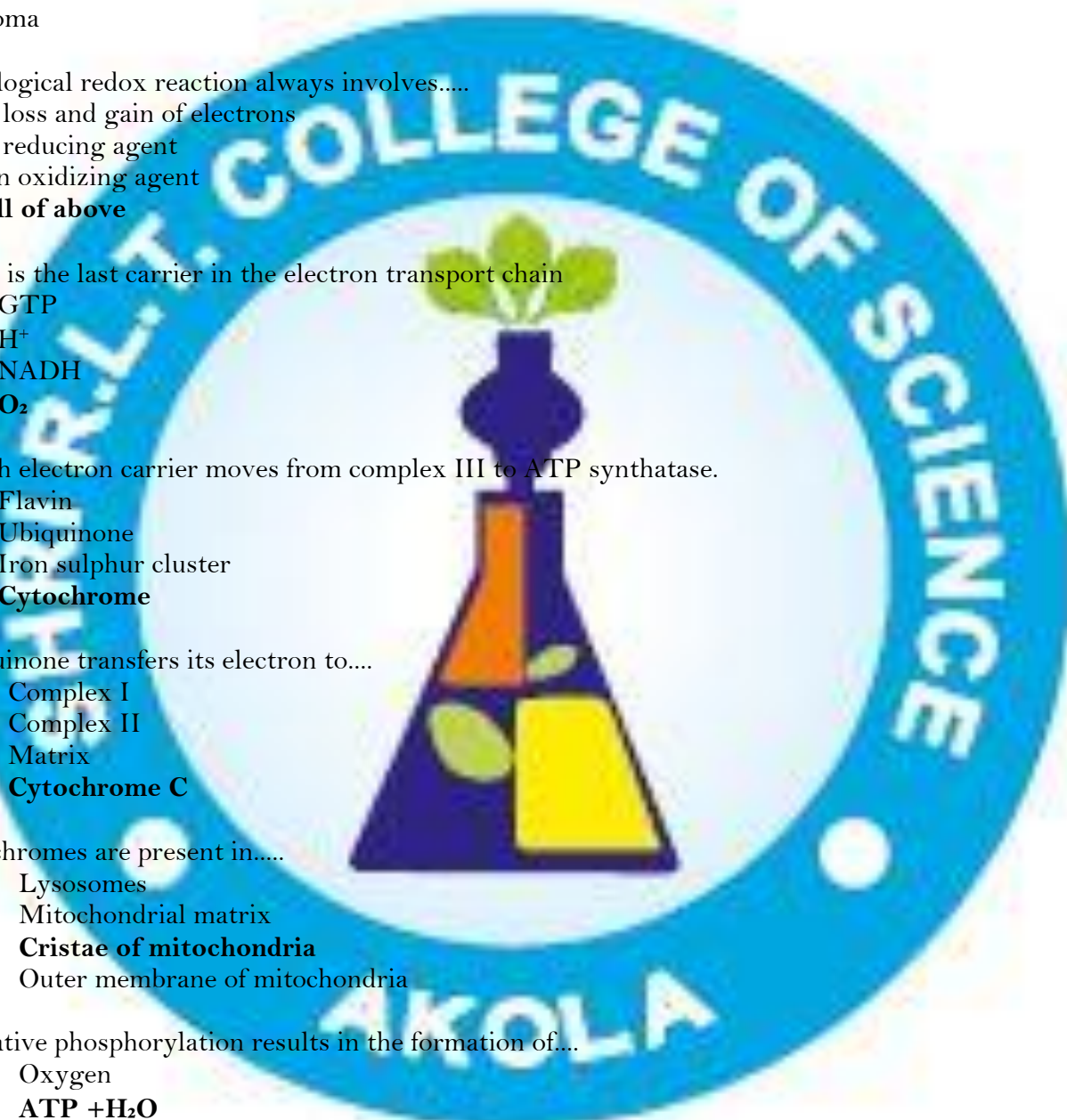
- a) Lysosomes
- b) Mitochondrial matrix
- c) **Cristae of mitochondria**
- d) Outer membrane of mitochondria

7) Oxidative phosphorylation results in the formation of....

- a) Oxygen
- b)  **$ATP + H_2O$**
- c) NADH
- d) ADP

8) What is the full form of FMN?

- a) Flavin mini nucleotide
- b) Flvoro mono nucleotide
- c) **Flvin mono nucleotide**
- d) Flvoro mini nucleotide



Q.2) Fill in the blanks

(each carry 1 mark)

1. **Cytochrome a<sub>3</sub>** is the terminal electron carrier which is donating electron to oxygen.
2. Electron transport system is present in **inner mitochondrial membrane**.
3. **NADH dehydrogenase** is first complex of ETC.
4. Ubiquinone transfer electron to **cytochrome C**.
5. Oxidative phosphorylation takes place in **inner mitochondrial membrane**.
6. Cytochromes are present in **crisetae** of mitochondria.
7. ATP synthesis by ATP synthase is driven by the movement of **proton motive force**.
8. The end result of oxidative phosphorylation is formation of **ATP+H<sub>2</sub>O**.
9. **Complex II** is does not account for pumping out proton from mitochondria in ETC.
10. **Cytochrome C oxidase** is the complex IV in ETC.
11. **NADH & FADH<sub>2</sub>** is the product of glucose oxidation which is necessary for oxidative phosphorylation.

Q.3) Answer in one sentence

(each carry 1 mark)

1. Define oxidative phosphorylation.
2. Enlist the name of complexes in ETC.
3. Write the names of translocase in respiratory control.
4. What is the end product of ETC?
5. Enlist the any two electron carriers.
6. What is the site of ETC?
7. Which subunit present in F<sub>1</sub> component of ATP synthatase complex.
8. Which hazardous compound is formed during reduction of oxygen.

Q.4) Long answer questions

(each carry 8 marks)

- 1) Explain respiratory control
- 2) Ultra structure of mitochondria with their application
- 3) Explain ETC and factor affecting ETC
- 4) Explain electron carriers with their sequences

Q.5) Short answer questions

(each carry 4 marks)

- 1) Explain the sequence of electron carriers.
- 2) Write about heme binding proteins.
- 3) Explain about flavin proteins.
- 4) What are redox potential & their examples?
- 5) Explain cytochrome oxidase.
- 6) Explain site of ETC.
- 7) Explain Adenine nucleotide translocase.
- 8) Explain incomplete reduction of oxygen.

Unit III

Q.1) Choose the correct alternative

(each carry 1 mark)

- In which part of cell oxidative phosphorylation takes place?
  - inner membrane of mitochondria**
  - outer membrane of mitochondria
  - grana of chloroplast
  - stroma of chloroplast
- ATP synthesis by ATP synthase is driven by the movement of \_\_\_\_\_.
  - Proton**
  - NADH
  - Electron
  - All of above
- Oxidative phosphorylation result in formation of
  - Oxygen
  - ADP
  - ATP+ water**
  - NADH
- Which of the following products of glucose oxidation are necessary for oxidative phosphorylation.
  - Pyruvate
  - NADH and flavin nucleotide**
  - Acetyl coA
  - NADH & ATP
- Complex V of ETC is made by which of the following components.
  - ATP synthase**
  - Cytochrome
  - Oxygen
  - Ubiquinone
- The synthesis of ATP occur by which enzyme
  - ATP synthase
  - Hexokinase
  - Lyase
  - Dehydrogenase
- What do the inhibitors in ETC?
  - Blockage of proton pumping
  - Prevent ATP syntythesis
  - Blockage of oxygen uptaken
  - All of the above**

Q.2) Fill in the blanks

(each carry 1 marks)

- Oxidation of **NADH & FADH** is coupled with the phosphorylation of ADP to form ATP.

2. Oxidative phosphorylation occurs inside the **inner mitochondrial membrane**, which contains the electron transport & ATP synthatase complex.
3. The **outer membrane** of the mitochondria is most permeable due to its porins.
4. **ATP synthatase** complex involves participation in the synthesis of ATP.
5. **F<sub>0</sub>-F<sub>1</sub>** complex have function of rotator motor activity.
6. **Albert Lehninger** coined electron transport system.

Q.3) Answer in one sentence

(each carry 1 marks)

- 1) What is oxidative phosphorylation?
- 2) Define F<sub>1</sub>-F<sub>0</sub> complex.
- 3) What is ATP?
- 4) Define electron transport chain.
- 5) What are inhibitors?
- 6) Function of inhibitors.
- 7) Who coined ETC?
- 8) What are uncouplers?

Q.5) Short answer questions

(each carry 4 marks)

- 1) Write about ATP synthase complex.
- 2) Explain oxidative phosphorylation.
- 3) What are uncouplers of energy transfer?
- 4) Explain about inhibitors.
- 5) What are coupled reactions?

Q.4) Long answer questions

(each carry 8 marks)

- 1) Explain F<sub>0</sub>-F<sub>1</sub> complex with diagram.
- 2) Chemiosmotic coupling hypothesis.
- 3) Conformational coupling hypotheis.
- 4) Explain about inhibitors with detail examples.
- 5) Explain about uncouplers with detail examples.

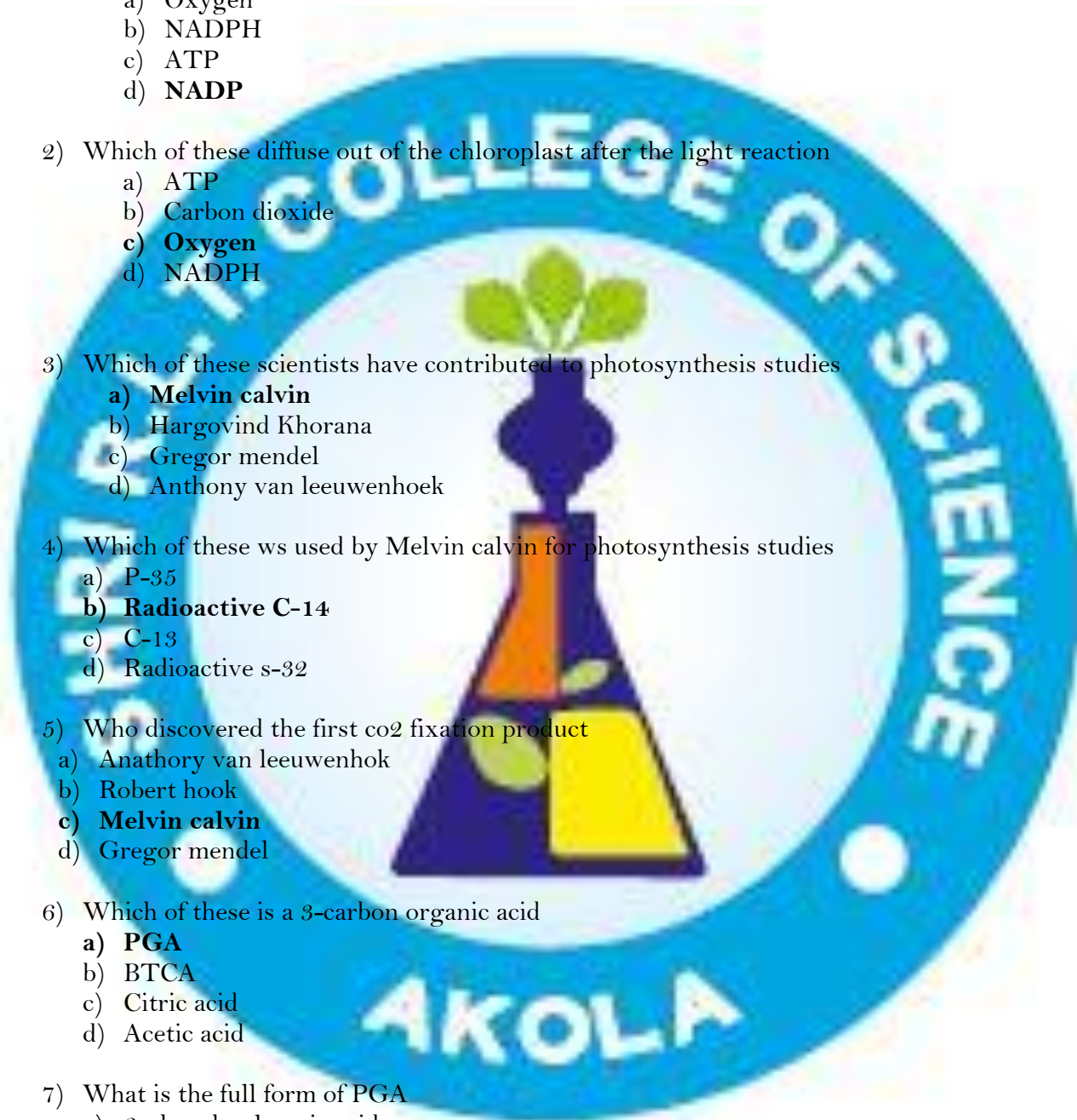


Unit IV

Q.1) Choose the correct alternative

(each carry 1 marks)

- 1) Which of these is not a product of light reaction
  - a) Oxygen
  - b) NADPH
  - c) ATP
  - d) **NADP**
- 2) Which of these diffuse out of the chloroplast after the light reaction
  - a) ATP
  - b) Carbon dioxide
  - c) **Oxygen**
  - d) NADPH
- 3) Which of these scientists have contributed to photosynthesis studies
  - a) **Melvin calvin**
  - b) Hargovind Khorana
  - c) Gregor mendel
  - d) Anthony van leeuwenhoek
- 4) Which of these ws used by Melvin calvin for photosynthesis studies
  - a) P-35
  - b) **Radioactive C-14**
  - c) C-13
  - d) Radioactive s-32
- 5) Who discovered the first co<sub>2</sub> fixation product
  - a) Anathory van leeuwenhok
  - b) Robert hook
  - c) **Melvin calvin**
  - d) Gregor mendel
- 6) Which of these is a 3-carbon organic acid
  - a) **PGA**
  - b) BTCA
  - c) Citric acid
  - d) Acetic acid
- 7) What is the full form of PGA
  - a) 2-phosphoglyceric acid
  - b) 2-phosphoglutamic acid
  - c) 3-phosphoglutamic acid
  - d) **3-phosphoglyceric acid**
- 8) How many carbon atoms does OAA contain?
  - a) 3
  - b) 2



- c) 4
- d) 1

9) Which is the first product of  $\text{CO}_2$  fixation in the  $\text{C}_3$  pathway?

- a) NADPH
- b) OAA
- c) ATP
- d) **PGA**

10) Which is the first product of  $\text{CO}_2$  fixation in the  $\text{C}_4$  pathway?

- a) NADPH
- b) PGA
- c) **OAA**
- d) ATP

Q.2) Fill in the blanks

(each carry 1 marks)

- 1) 3-phosphoglyceric acid is the product of carboxylation.
- 2) Kranz anatomy is the special leaf anatomy in  $\text{C}_4$  plant.
- 3)  $\text{C}_4$  plant is maize.
- 4) OAA is the  $\text{C}_4$  acid.
- 5) Calvin cycle is common to  $\text{C}_3$  and  $\text{C}_4$  plant.
- 6) The calvin pathway occurs in  $\text{C}_4$  plant in the bundle sheath cells.
- 7) Presence of large cell around the vascular bundles known as Bundles sheath cells.
- 8) The first step of the calvin cycle is the carbon dioxide fixation.
- 9) The active site of RuBisCo can bind to both oxygen and carbon dioxide.
- 10) During the process of photorespiration, the active site of RuBisCo binds to oxygen.

Q.3) Answer in one sentence

(each carry 1 marks)

- 1) Which is the only product in cycle photo-phosphorylation?
- 2) In PSII, which are the last electron acceptors?
- 3) Which electron carriers accepts the electrons from pheophytin?
- 4) What is chemiosmosis?
- 5) Which of these scientists have contributed to photosynthesis studies?
- 6) Define photorespiration
- 7) What is chloroplast?
- 8) What is photosystem I?
- 9) What is photosystem II

Q.4) Long answer questions

(each carry 8 marks)

- 1) Short note on ultra structure of chloroplast.
- 2) Note on photorespiration.
- 3) Explain the PS-I.
- 4) Explain the PS-II.
- 5) Short note on light harvesting complex .
- 6) Location and mechanism of energy transfer.
- 7) Short note on location of photosynthetic ETC.



Unit V

Q.1) Choose the correct alternative

(each carry 1 marks)

- 1) Photophosphorylation is the process utilize which energy?
  - a) Chemical energy
  - b) Mechanical energy
  - c) Light energy
  - d) Wind energy
- 2) The movement of the electron in cyclic manner for synthesising ATP molecule is called
  - a) Phosphorylation
  - b) Photo phosphorylation
  - c) Non cyclic photophosphorylation
  - d) Cyclic photophosphorylation
- 3) The process in which complete movement  $e^-$  in unidirectional manner is called
  - a) Non-cyclic photophosphorylation
  - b) Phosphorylation
  - c) Oxidative phosphorylation
  - d) Non of above
- 4) Which process help in producing carbohydrates by green plants using carbon dioxide and water in presence of sunlight ?
  - a) Photosynthesis
  - b) Photophosphorylation
  - c) Oxidation
  - d) Phosphorylation

Q.2) Fill in the blanks

(each carry 1 marks)

- 1) The reaction center of PS II consist **chlorophyll-A 680**.
- 2) During **photosynthesis** photophosphory lation occurs.
- 3) Non-cyclic photophosphorylation comprising **two** different chlorophyll photosystem.
- 4) The reaction center PS I consist of **chlorophyll-A 700**.
- 5) The photophosphorylation takes place in **chloroplast**.
- 6) Photophosphorylation is the conversion **ADP to ATP** using the energy of sunlight by activation pf PS II.
- 7) The process which involves, the splitting of the water molecules in oxygen and hydrogen proton( $H^+$ ) is known as **photolysis**.
- 8) Cyclic photophosphorylation usvally takes place in **thylakoid membrane**.

Q.3) Answer in one sentence

(each carry 1 marks)

- 1) What is photophosphorylation?
- 2) Where photophosphorylation does occurs.
- 3) What is cyclic photophosphorylation?
- 4) Which product produces by photophosphorylation.
- 5) In PSI which types of chlorophyll occur?
- 6) Which pigment occurs at the centre of photosystem.

- 7) In non cyclic photophosphorylation which PS system involves?
- 8) In which photophosphorylation water required?

Q.4) Long answer questions

(each carry 8 marks)

- 1) Write notes on following
  - a) Photoregulation.
  - b) cyclic & non cyclic photophosphorylation.
- 2) Describe molecular mechanism of photophosphorylation.



## Syllabus

### **Paper - IV**

#### **(Bio-Energetics and Biological oxidation)**

**Unit I : Free Energy Concept -**

- a) Concept of free energy, standard free energy and measurement of free energy.
- b) Application of first and second law of thermodynamics to biological systems.
- c) High energy bonds - ATP and interconversion of nucleotide phosphates, phosphorylation potential.

**Unit II :** Mitochondrial Electrontransport - Mitochondrial organisation, sequence of electron carriers and site of oxidation phosphorylation, heme and non-heme iron binding proteins (Electron transport particles), Thermodynamic consideration, Redox potential, phosphate group transfer potential, Respiratory controls, Factors affecting ETC, reversible ETC.

**Unit III :** Oxidative phosphorylation - ATP synthetase complex, F1 - F5 ATP ase coupling factors, Theories of oxidative phosphorylation, Mechanism of oxidative phosphorylation coupled reactions, Uncouplers and inhibitors of energy transfer.

**Unit IV :** Photosynthetic Electron Transport - Ultra structure of chloroplast, Light harvesting complexes, photosystem I and II, Location and mechanism of energy transfer, Photosynthetic Electron Transport, Photo respiration.

**Unit V :** Photophosphorylation - Cyclic and non-cyclic photo phosphorylation, Molecular mechanism of photo phosphorylation. Photoregulation.