Lesson plan of Advanced Bioinorganic chemistry

First lecture

Prokaryotic and Eukaryotic cells. The 12 organelles in a cell: (1) nucleolus (2) ribosome (3) vesicle (4) rough endoplasmic reticulum (5) golgi apparatus (6) cytoskeleton (7) smooth endoplasmic reticulum (8) mitochondria (9) vacuole (10) cytosol (11) lysosome (12) centriole

Second lecture

The structural features of 20 amino acids. Their polar R groups and optical behaviors.

Third lecture

Titration curves of amino acids, separation by electrophoresis, ion exchange chromatography. Peptide chain.

Fourth lecture

Proteins, classification according to their biological roles: (enzymes, transport, nutrient and storage, contractile or mutile, structural, defense, regulatory ….) and shape (globular and fibrous). Separation of proteins by: dialysis, gel filtration, electrophoresis and ion exchanges chromatography.

Fifth lecture

Determination of amino acid sequence of the hormone insulin. Sequentor machine. Immune response. Denaturation of proteins by metal complexes and other agents.

Sixth lecture

Primary structure, configuration, conformation, X-Ray of covalent back bone and rigidity in peptide bond. Secondary structure.

Seventh lecture

α- and β-keratins, hair ropes, silk, biochemical engineering and collagen.

Eighth lecture

Elastin in blood vessel. Actin and myosin in muscle contraction.

Ninth lecture

Globular proteins. Tertiary structure of myoglobin containing heme, cytochrome-c containing heme, lysozyme and ribonuclease without heme.

Tenth lecture

Forces maintaining tertiary structure of globular proteins. Quarternary structure of hemoglobin (an oligomeric protein). Red blood cells and hemoglobin.

Eleventh lecture

Binding curve of myoglobin and hemoglobin. Oxy-hemoglobin and deoxy-hemoglobin and the breathing. Cooperativity phenomena (symmetry model and sequential model).

Twelfth lecture

Enzymes are classified on the bases of the reaction they catalyze. Catalysts lower the activation energy barrier. Effect of substrate concentration on enzymatic reaction. The Michaelis-Menten equation. Lineweaver-Burk equation.

Thirteenth lecture

Many enzymes catalyze reactions in which there are two substrates. Effect of pH on enzyme activities. Unit of enzyme activity, specific activity, turnover number, specificity and active site of enzymes. Irreversible and reversible (competitive, non-competitive) inhibitors.

Fourteenth lecture

Factors governing catalytic efficiency: proximity and orientation, strain and distortion or induced fit, general acid-base catalysis and covalent catalysis. Pacemaker or regulatory enzymes (non-covalent and covalent). Multiple form enzymes. Defected enzymes. Possible mechanism of hydrolysis by chymotrypsin.

Fifteenth lecture

Nucleic acids (DNA and RNA) associated with Mg^{2+}. Nucleosides of DNA contain phosphate, purine and pyrimidine bases. Nucleotides of DNA form DNA-double strands.

Sixteenth lecture

Nucleosides and nucleotides of RNA. Replication of DNA. DNA binding sites for metal complexes. Type of forces governing in groove-, intercalate-, electrostatic- and covalent- binding between DNA and metal complexes. Interaction studies between DNA and metal complexes using UV-Vis spectroscopic technique (k_{app}, $L_{1/2}$).

Seventeenth lecture

Interaction of metal complexes with DNA using 1) fluorescence spectroscopic techniques, 2) stability, 3) lipophilicity (partition coefficient), 4) gel electrophoresis, determination of ΔG^0, ΔH^0 and ΔS^0… etc.

Eighteenth lecture

Oxidative phosphorylation, co-enzymes such as: NAD^+/ NADH, FMN/$FMNH_2$ and ubiquinone.

Nineteenth lecture

Glycolysis/ T.C.A cycle in carbohydrate metabolism. Energetics of glycolysis. Metabolism of lipids. β-oxidation of palmitic acid.

Twentieth lecture

Photosynthesis: catabolism (degradation), anabolism (synthesis), dark-reactions, light-reactions, photosystem (II) and (I) in Z-scheme. Cyclic and acyclic schemes.

Twenty first lecture

Mid-semester exam.

Twenty second lecture

1) Alkaline phosphatase and 2) carbonic anhydrase, their introduction, catalyzed reaction, active site and mechanism.

Twenty third lecture

1) Carboxy peptidases and 2) thermolysines.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty fourth lecture

1) Alcohol dehydrogenases and 2) chlorophyll a and b.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty fifth lecture

1) Hemocyanine 2) hemerythrin and 3) zinc finger.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty sixth lecture

1) Copper-zinc superoxide dismutase and 2) bioinorganic chips.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty seventh lecture

1) Catechol oxidase and 2) superoxide dismutase.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty eighth lecture

1) Catalase 2) peroxidase 3) Fe-S clusters and aconitase.

Their introduction, catalyzed reaction, Active site and mechanism.

Twenty ninth lecture

1) Reactive oxygen species (ROS)

2) Reactive nitrogen species (RNA)

3) Oxygen paradox

Their introduction, catalyzed reaction, Active site and mechanism.

Thirtieth lecture

1) Hemoglobin 2) vitamin B_{12} and 3) chlorophyll

Compare their axial and equatorial ligands

Their introduction, catalyzed reaction, Active site and mechanism.

Thirty first lecture

1) Concept of Na^+, K^+ channel

2) Potassium channels

3) Sodium-potassium ATPase

4) Role of K^+ in telomere (G-quarter and G-quadruplex formation)

Thirty second lecture

Methionine aminopeptidase is a coenzyme- B_{12}- dependent enzyme.

Their introduction, catalyzed reaction, Active site and mechanism.