CHANDIGARH UNIVERSITY

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INSTITUTE-UNIVERSITY INSTITUTE OF ENGINEERING

ACADEMIC UNIT-II

Computer Science Engineering

Subject Name-Biology For Engineers

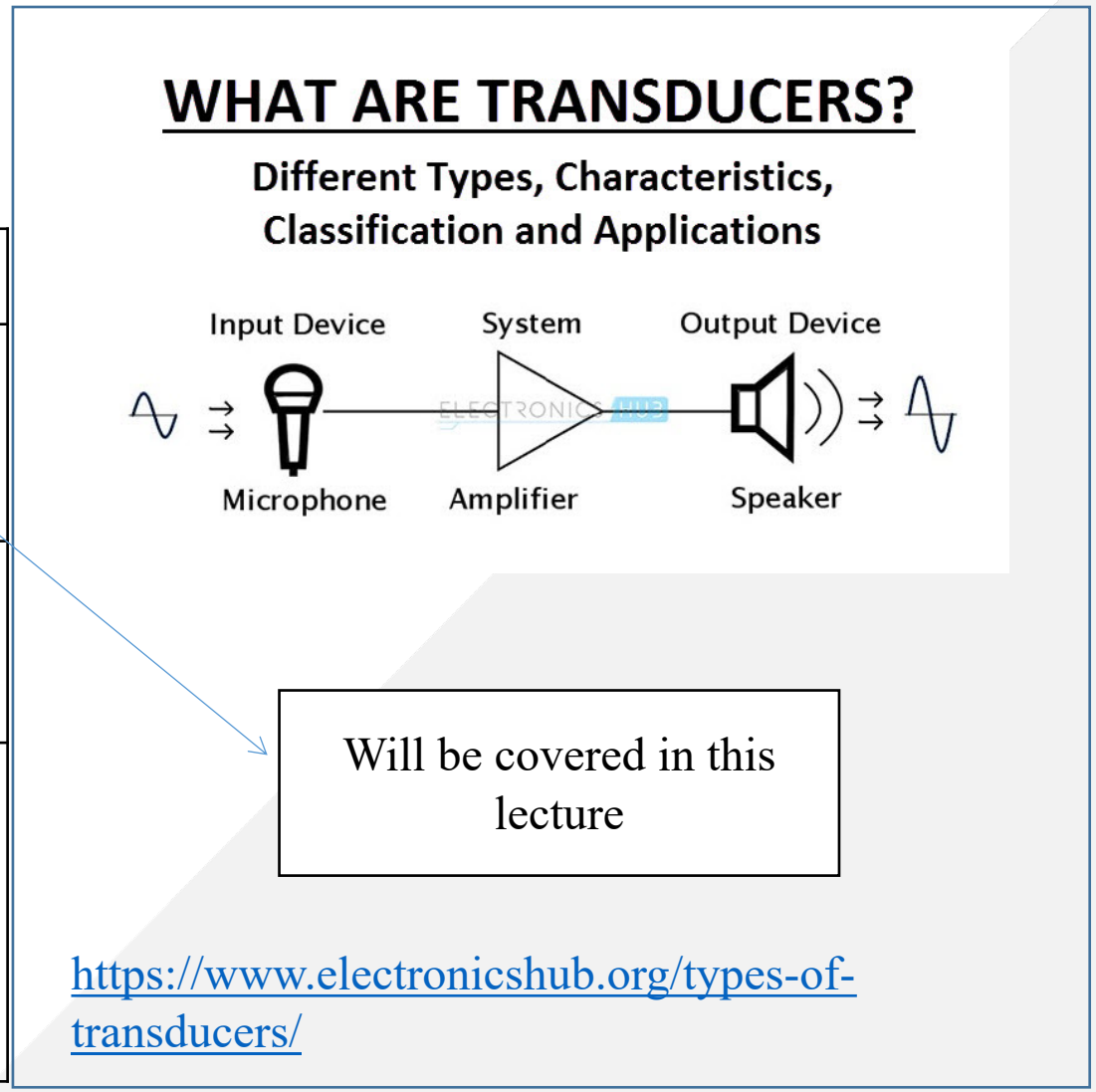
Subject Code- 20SZT148

ENZYMES

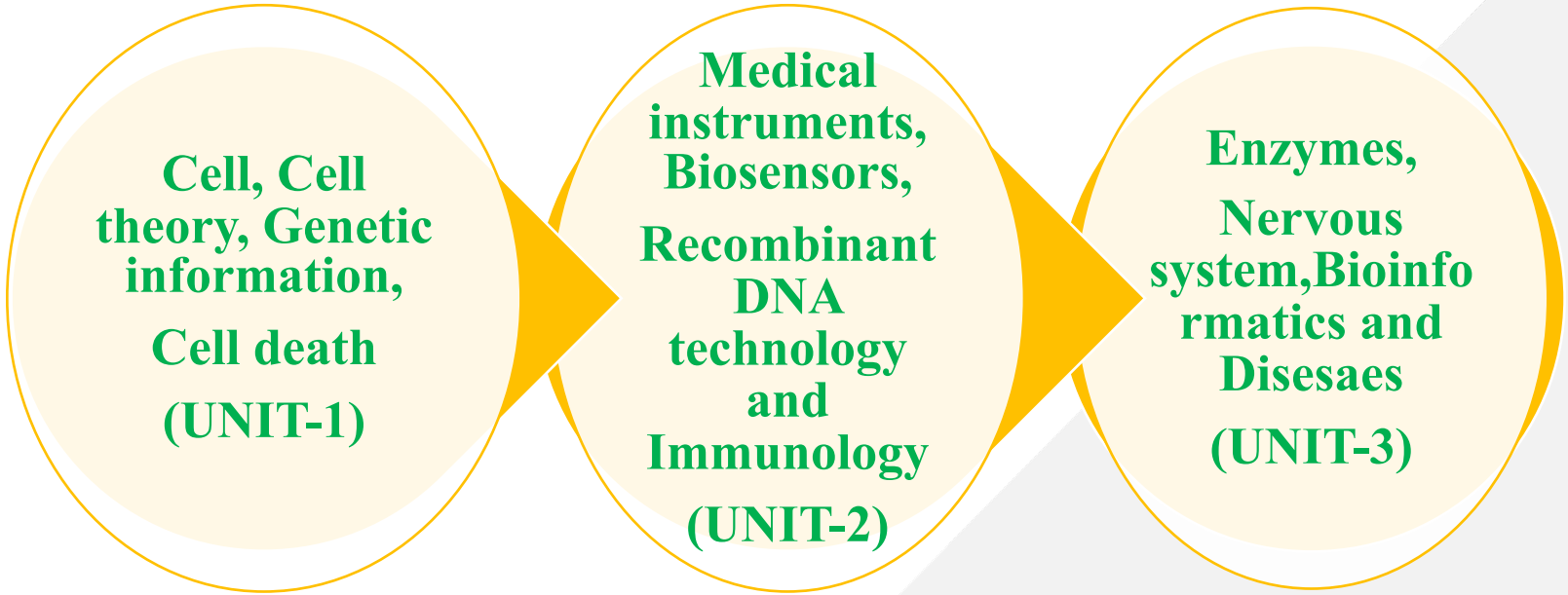
ENZYMES

Course Outcome

CO Number	Title	Level
CO1	It gives an idea about the about the basic cell biology.	**Understanding**
CO2	It deals with the idea of uses of biology in engineering.	**Understanding**
CO3	It provide knowledge about the uses of softwares in biology field.	**Remembering**



BIOLOGY FOR ENGINEERS



ENZYME

- An enzyme is a protein or RNA produced by living cells, which is highly specific and high catalytic to its substrate.

- Enzymes are very important type of macromolecular biological catalyst. Due to the action of enzymes, chemical reactions in organism can also be carried out efficiently and specifically under mild conditions

ENZYME

Difference from catalysts

• Like catalysts, the enzymes do not alter the chemical equilibrium point of a reversible reaction but only the speed of the reaction is changed

• Differ from catalysts in being the biological products, i.e., produced from the living cells.

• unlike catalysts, most individual enzymes are very specific in that they act either on a single or at the most on some structurally related substrates.

ENZYME

Nomenclature

• Enzymes are generally named according to the reaction they catalyze or by suffixing “ase” after the name of substrate

• The International Union of Biochemistry and Molecular Biology developed a nomenclature for enzymes

• Each enzyme is described by a sequence of four numbers preceded by "EC". EC denotes Enzyme Commission and the number of enzyme is called EC numbers.

• When classified, each enzyme is assigned the EC number, in the form of digits separated by periods. The first number categorizes the enzyme based on its reaction.

ENZYME

Nomenclature

• The first three numbers represent the class, subclass and sub-subclass to which an enzyme belongs, and the fourth digit is a serial number to identify the particular enzyme within a sub-subclass.

ENZYME

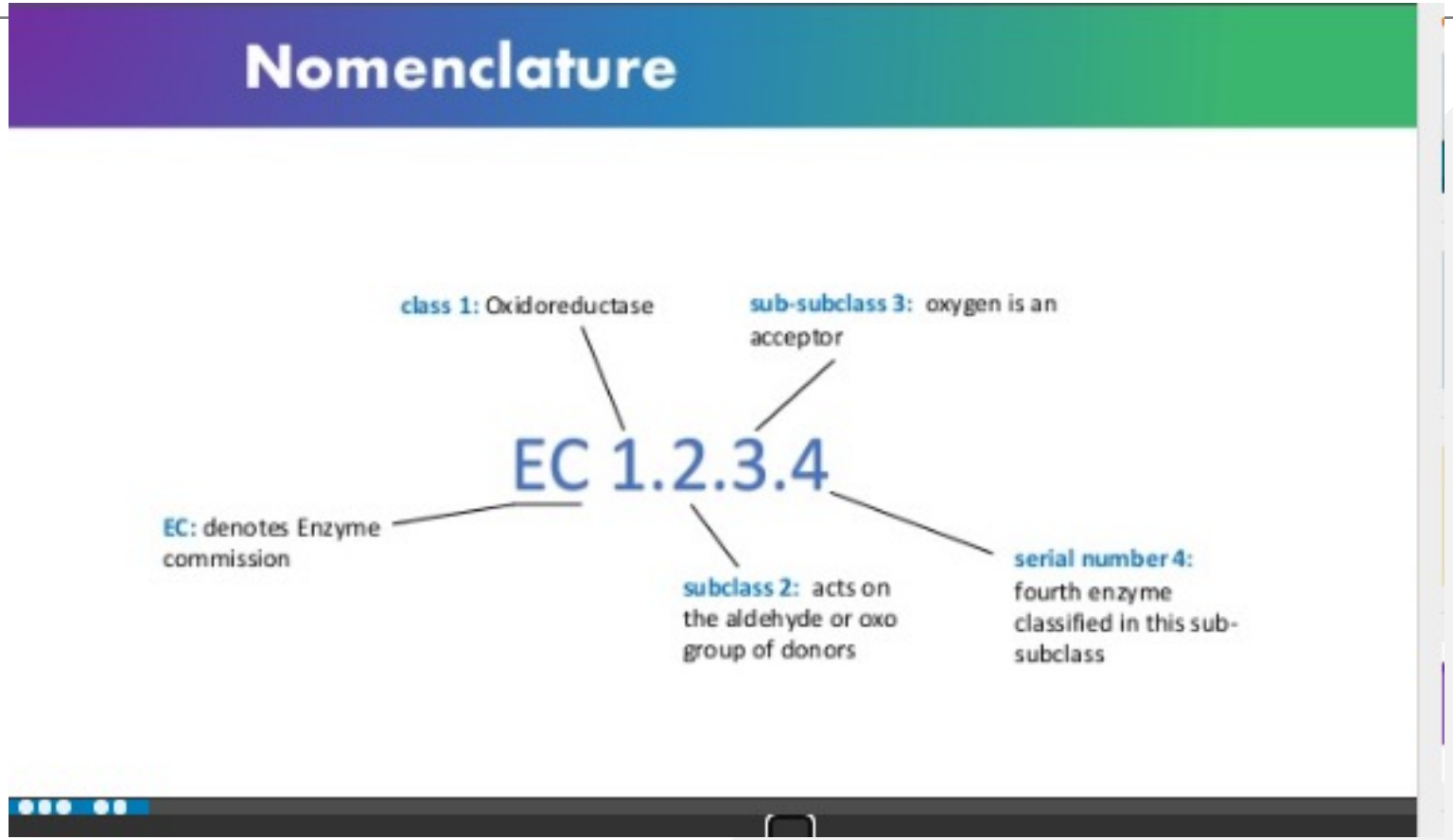
Nomenclature

- The class, subclass and sub-subclass provide additional information about the reaction classified.

- For example, in the case of EC 1.2.3.4, the digits indicate that the enzyme is an oxidoreductase (class 1).

- it acts on the aldehyde or oxo group of donors (subclass 2), that oxygen is an acceptor (sub-subclass 3) and that it was the fourth enzyme classified in this sub-subclass (serial number 4).

ENZYME



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ENZYME

Classification of Enzymes

The 7 major classes of enzymes with some important examples from some subclasses are described below :

1. Oxidoreductases
2. Transferases
3. Hydrolases
4. Lyases or Desmolases
5. Isomerases
6. Ligases or Synthetases
7. Translocases

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ENZYME

1. Oxidoreductases EC1

- This class comprises the enzymes which were earlier called dehydrogenases, oxidases, peroxidases, hydroxylases, oxygenases etc
- The group, in fact, includes those enzymes which bring about oxidation-reduction reactions between two substrates

$$A_{red} + B_{ox} \rightleftharpoons A_{ox} + B_{red}$$

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ENZYME

1. Oxidoreductases EC1

- Catalyze redox reaction and can be categorized into oxidase and reductase
- More precisely, they catalyze electron transfer reactions. In this class are included the enzymes catalyzing oxidoreductions of CH—OH, C=O, CH—CH, CH—NH2 and CH=NH groups
- Alcohol dehydrogenase, Acetyl-CoA dehydrogenase, Cytochrome oxidase, Catalase

$$H_2O_2 + H_2O_2 \rightleftharpoons 2H_2O + O_2$$

$$A_{red} + B_{ox} \rightleftharpoons A_{ox} + B_{red}$$

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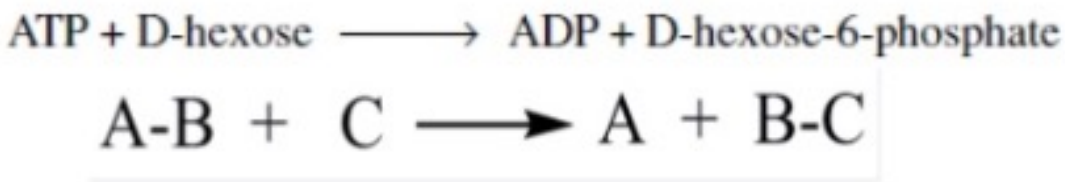
ENZYME

2. Transferases EC2

- Catalyze the transfer or exchange of certain groups among some substrates
- In these are included the enzymes catalyzing the transfer of one-carbon groups, aldehydic or ketonic residues and acyl, glycosyl, alkyl, phosphorus or sulfur-containing groups
- Choline acetyltransferase, Phosphorylase, Hexokinase



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ENZYME

3. Hydrolases EC3

- Accelerate the hydrolysis of substrates
- These catalyze the hydrolysis of their substrates by adding constituents of
- water across the bond they split
- The substrates include ester, glycosyl, ether, peptide, acid-anhydride, C—C, halide and P—N bonds
- Lipase, Beta-galactosidase, Arginase, Trypsin. Pepsin, plasmin,

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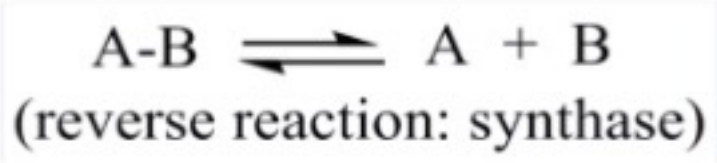
ENZYME

4. Lyases EC4

- Promote the removal of a group from the substrate to leave a double bond reaction or catalyze its reverse reaction
- In these are included the enzymes acting on C—C, C—O, C—N, C—S and C—halide bonds
- Aldolase, Fumarase, Histidase



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ENZYME

5. Isomerases EC5

- Facilitate the conversion of isomers, geometric isomers or optical isomers
- Alanine racemase, Cis-trans isomerases. Retinine isomerase, Glucosephosphate isomerase

D-glucose-6-phosphate ⟶ D-fructose-6-phosphate

All *trans*-retinene ⟶ 11-*cis*-retinene

A-B-C ⇌ A-C-B

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ENZYME

6. Ligases EC6

- Catalyze the synthesis of two molecular substrates into one molecular compound with the release energy
- These are the enzymes catalyzing the linking together of two compounds utilizing the energy made available due to simultaneous breaking of a pyrophosphate bond in ATP or a similar compound
- This category includes enzymes catalyzing reactions forming C—O, C—S, C—N and C—C bonds
- Acetyl-CoA synthetase, Glutamine synthetase, Acetyl-CoA carboxylase

$$\text{ATP} + \text{acetate} + \text{CoA} \longrightarrow \text{AMP} + \text{pyrophosphate} + \text{acetyl-CoA}$$

$$\text{A} + \text{B} + \text{ATP} \longrightarrow \text{A-B} + \text{ADP} + \text{P}_i$$

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ENZYME

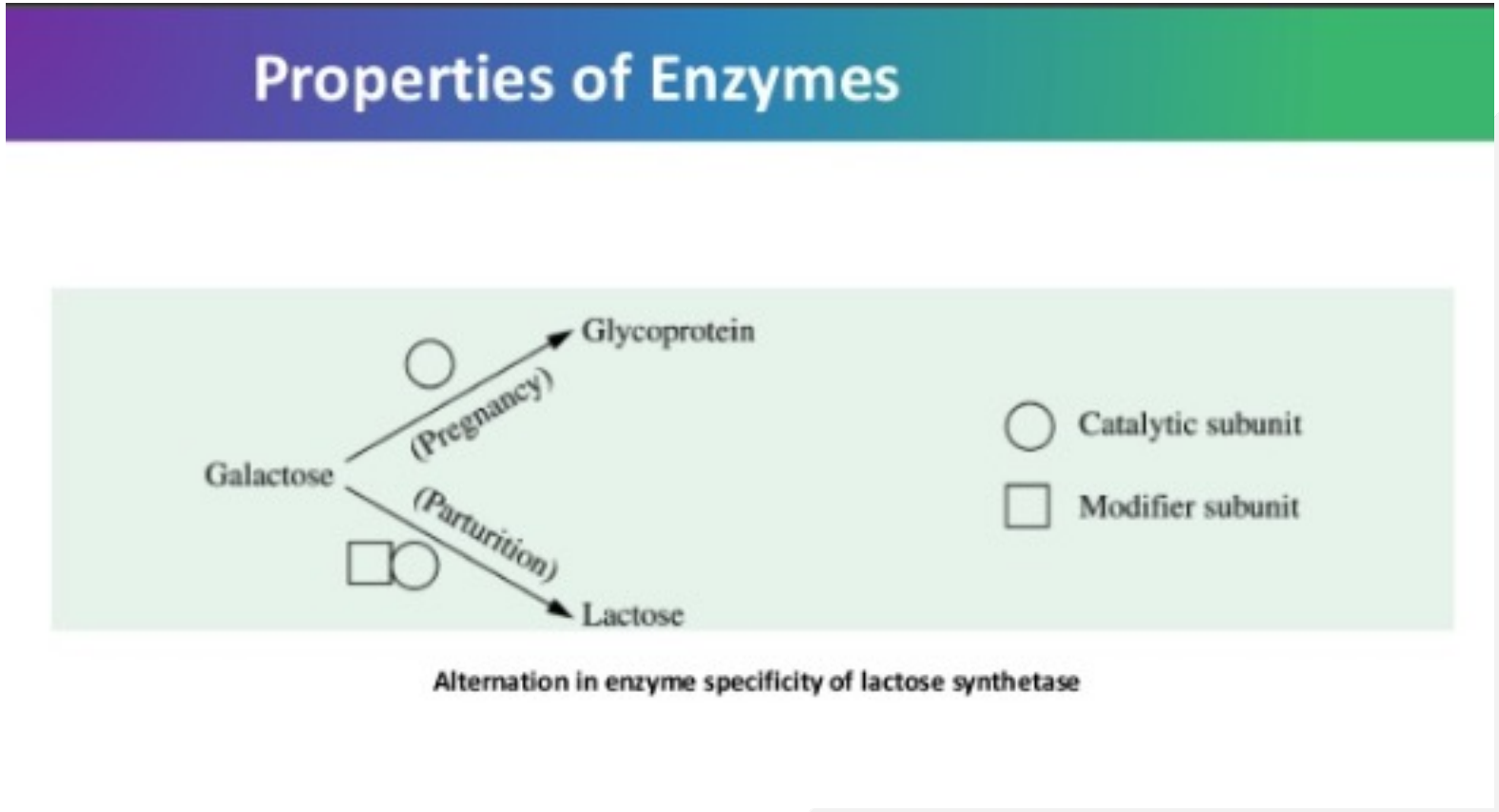
Properties of Enzymes

1. Colloidal Nature

• On account of their large size, the enzyme molecules possess extremely low rates of diffusion and form colloidal systems in water

• Being colloidal in nature, the enzymes are nondialyzable although some contain dialyzable or dissociable component in the form of coenzyme.

ENZYME



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PROTEASE

- Protease (Mixture of Peptidases and Proteinases) are enzymes that perform the hydrolysis of Peptide bonds.
- Peptide bonds links the amino acids to give the final structure of a protein.
- Proteinases are extracellular and Peptidases are endocellular.
- Second most important enzyme produced on a large scale after Amylase

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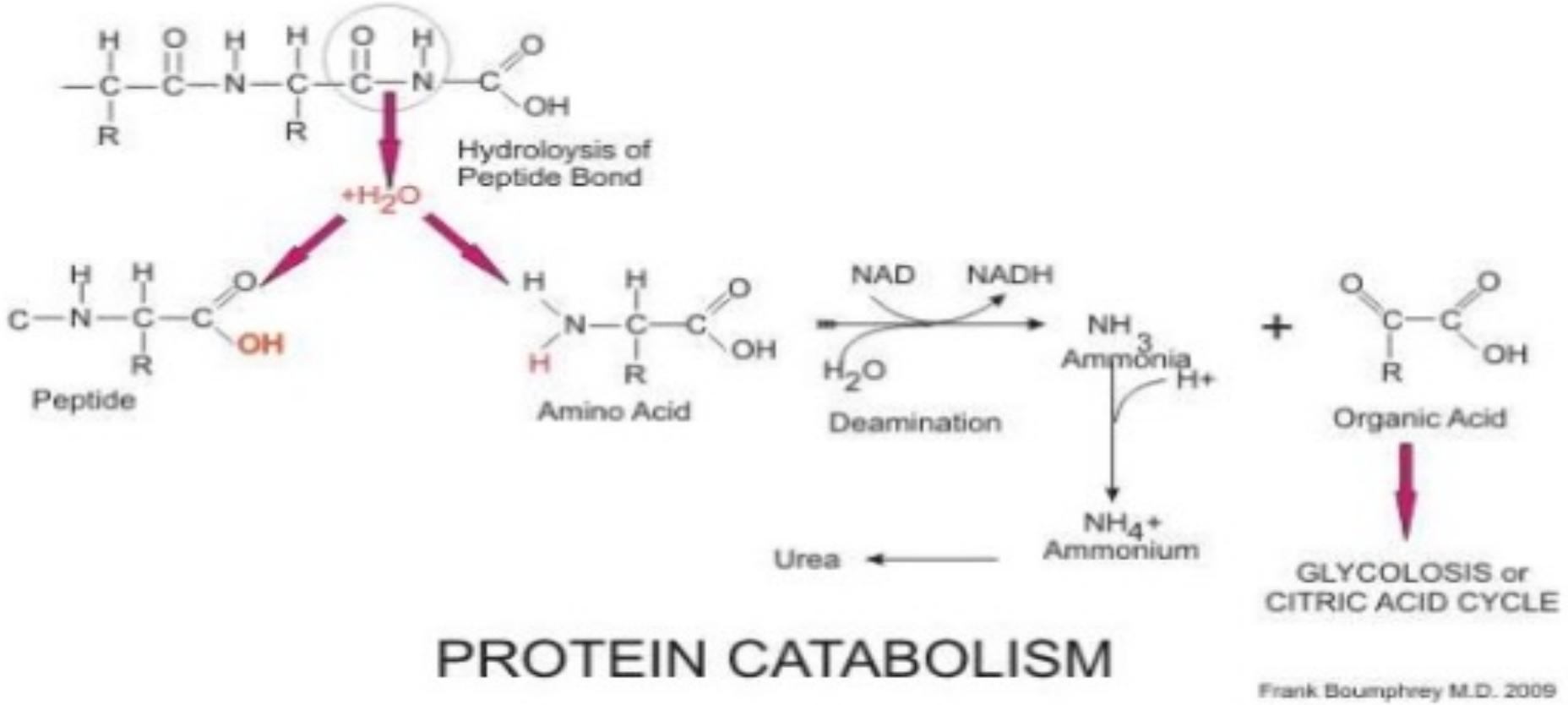
Mode of Action



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Classification Based upon the residues in the Catalytic site

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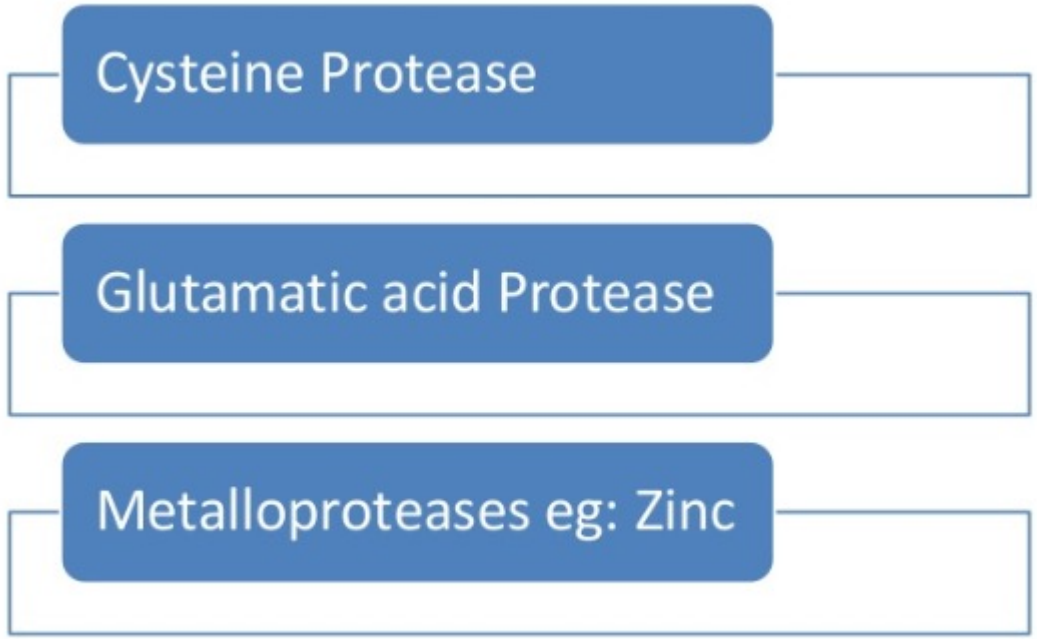
PROTEASE



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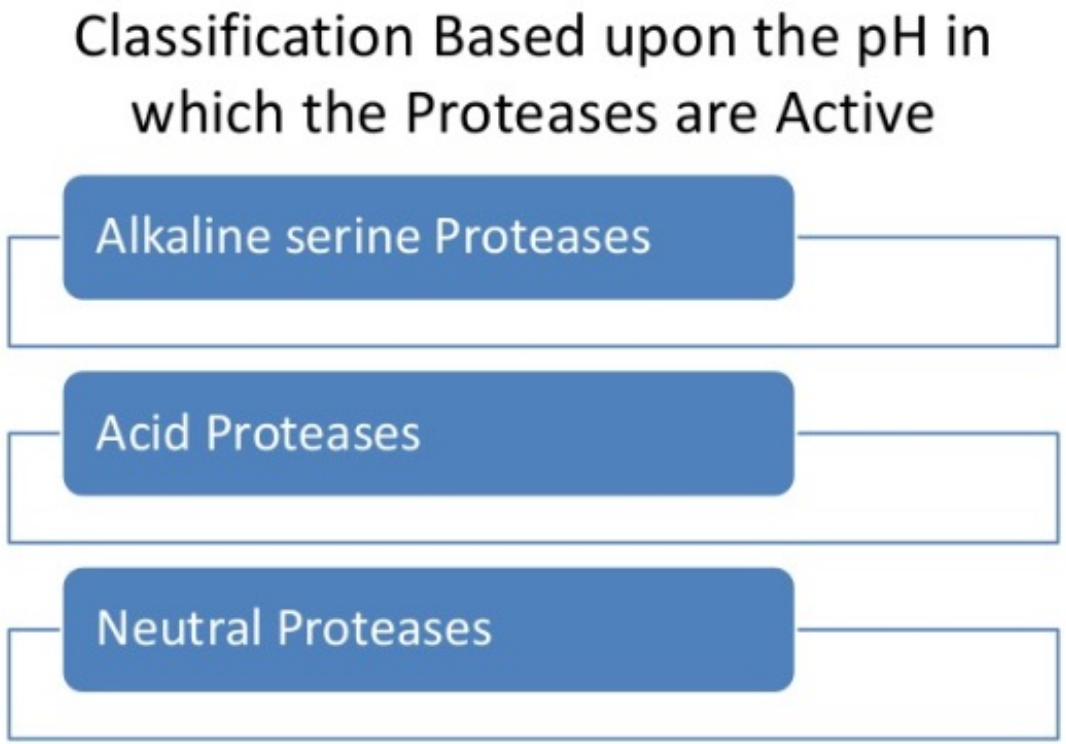
PROTEASE



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PROTEASE

Alkaline Serine Proteases

- pH of the production medium is kept at 7.0 for satisfactory results.
- Have serine at the active site
- Optimum temperature maintained is 30° to 40° C.
- Important producers are B. licheniformis, B. amyloliquefaciens, B. firmus, B. megaterium, Streptomyces griseus, S. fradiae, S. rectus and fungi like A. niger, A. oryzae, A.flavus.

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PROTEASE

- Enzymes used in detergents are chiefly proteases from bacillus strains (Bacillopeptidases)
- Best known proteases are Subtilisin Carlsberg from B. licheniformis and Subtilisin BPN and Subtilisin Novo from B. amyloliquefaciens.
- These enzymes are not inhibited by EDTA (Ethylene diamine tetraacetic acid) but are inhibited by DFP (Di isopropyl fluorophosphate)

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PROTEASE

Proteases for the Use in Detergent industries

- Stability at high temperature
- Stability in alkaline range (pH- 9 to 11)
- Stability in association with chelating agents and perborates
- But shelf life is affected in presence of surface active agents.

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PROTEASE

Screening

- Because the enzymes should be stable in alkaline conditions, screening for better producers is done by using highly alkaline media.
- It was found that B. licheniformis and B. subtilis showed growth is the range of pH 6-7 by new strains were found to grow even in pH 10-11.
- Genetic Manipulation can also be carried out.

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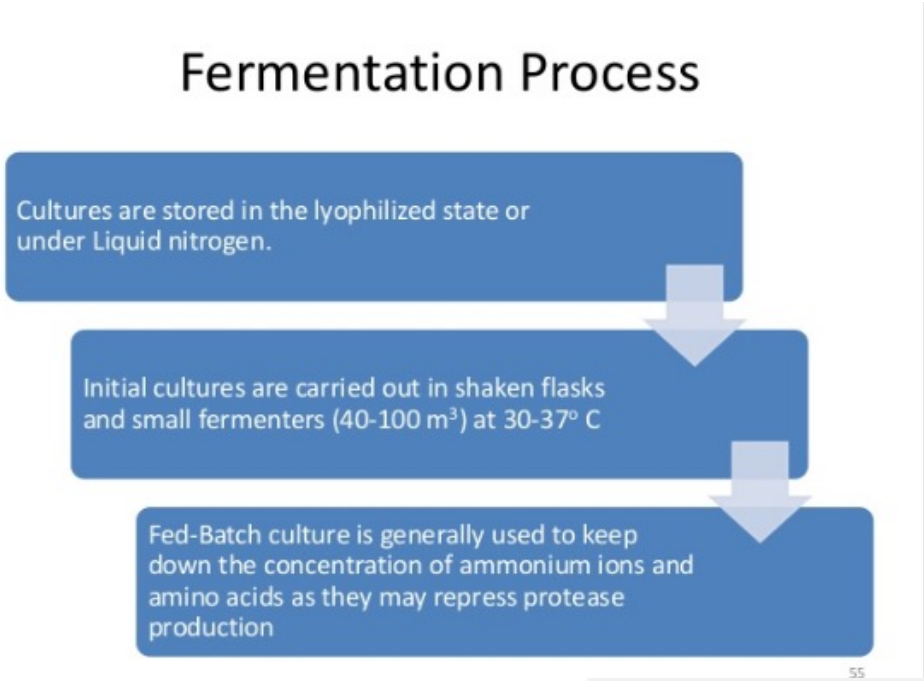
PROTEASE



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PROTEASE

Applications

- Textile industry to remove proteinaceous sizing.
- Silk industry to liberate silk fibers from naturally occurring proteinaceous material in which they are embedded.
- Tenderizing of Meat
- Used in detergent and food industries.

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CONCLUSION

Till we have discuss

- Enzymes
- classification of enzymes
- Properties of enzymes
- Protease
- Types of protease
- Application of protease

ASSESSMENT PATTERN

Assessment Pattern	Total Marks
1st Hourly Test	36
2nd Hourly Test	36
Surprise Test	12
Assignment (3)	10
Quiz	4
End Semester Examination	60

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THANK YOU

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