**BIOLOGY FOR ENGINEERS**

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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 22BEXY02 | Biology for Engineers | Open free elective | 2-1-0 | 3 |

**Course Learning Objectives:**

1. To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
2. The molecular basis of coding and decoding genetic information is universal
3. To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine
4. To convey that without catalysis life would not have existed on earth.
5. How to analyses biological processes at the reductionist level. The fundamental principles of energy transactions are the same in physical and biological world.
6. To make understanding of concept of single cell celled organisms.

**Course Content:**

**Unit – I: Introduction and Classification (7 hours)**

Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Need to study biology? Biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Hierarchy of life forms at phenomenological level. Classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitat- aquatic or terrestrial (e) Molecular taxonomy- three kingdoms classification (Ernst Haeckel proposed). Model organisms: *E. coli*, *S. cerevisiae*, *D. melanogaster*, *C. elegance*, *A. thaliana*, *M. musculus*.

**Unit – II: Genetics and Information Transfer (7 hours)**

Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Single gene disorders in humans. Concept of complementation using human genetics.

DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Wobble hypothesis, Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Unit – III: Biomolecules (5 hours)**

Molecules of life. Monomeric units and polymeric structures. sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Lipids and glycolipids

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**Unit -IV: Macromolecular Analysis (5 hours)**

Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. Proteins as catalysis (ribozyme)

**Unit -V: Enzyme and Metabolism (7 hours)**

Monitoring of enzyme catalyzed reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. RNA catalysis (ribozyme).

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. Glycolysis and Krebs cycle, synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

**Unit -VI: Microbiology (5 hours)**

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions (defined and nondefined media, basal media, enrichment media, fungal media). Growth kinetics.

**Learning Resources**

**Text Book:**

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, ‘*Biology: A global approach*’, Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, ‘*Outlines of Biochemistry*’, John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, ‘*Principles of Biochemistry’*, W.H. Freeman and Company, 2012.

**Reference Books:**

1. L. M. Prescott, J. P. Harley and C. A. Klein, ‘*Microbiology*’, McGraw Hill Higher Education, 2005.
2. G. S. Stent and R. Calendar, ‘*Molecular Genetics’*, Freeman and company, 1978.

**Web Resources:**

1. NPTEL:

[https://nptel.ac.in/courses/121/106/121106008/]( https://nptel.ac.in/courses/121106008/)

**Course Outcomes:** At the end of the course, the student will be able to

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| CO 1 | Describe how biological observations of 18th Century that lead to major  discoveries., Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological |
| CO 2 | Identify DNA as a genetic material in the molecular basis of information transfer, Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring. |
| CO 3 | Understand structure about DNA, RNA, Protein , carbohydrate and lipid |
| CO 4 | Understand hierarch in protein structure and different roles of proteins. |
| CO 5 | Classify enzymes and distinguish between different mechanisms of enzyme action. Apply thermodynamic principles to biological systems. |
| CO 6 | Identify and classify microorganisms. |

**Evaluation pattern for Theory Course Only:**

**Assessment Method**

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| **Assessment Tool** | **Monthly tests** | **End Semester Test** | **Total** |
| Weightage (%) | 40% | 60% | 100% |