

# ACE THE RACE

## CSIR-UGC NET Life Sciences

### Index

#### Unit 1 Molecules and their Interaction relevant to biology

<b>1.A</b>	<b>Structure of atoms, molecules and chemical bonds</b>	<b>1</b>
<b>1.A.1</b>	Structure of atom	<b>1</b>
<b>1.A.2</b>	Structure of molecules and chemical bonds	<b>1</b>
	➤ Covalent bond	
	➤ Ionic bond	
	➤ Polar bond	
	➤ Hydrogen bond	
<b>1.B</b>	<b>Composition, structure and function of biomolecules</b>	<b>3</b>
<b>1.B.1</b>	Carbohydrates	<b>3</b>
	➤ Monosaccharides	
	➤ Disaccharides	
	➤ Polysaccharides	
	➤ Glycoproteins	
	➤ Glycolipids	
<b>1.B.2</b>	Lipids	<b>8</b>
	➤ Fatty acids	
	➤ Waxes	
	➤ Triglycerides (Triacylglycerols)	
	➤ Phosphoglycerides	
	➤ Glycolipids	
	➤ Steroids	
	➤ Eicosanoids	
<b>1.B.3</b>	Proteins	<b>12</b>
	➤ Classification of Proteins	
	➤ General Properties of Proteins	
	➤ Amino acids	
	➤ Classification of amino acids	
	➤ Non-standard	
	➤ Amino acids as acid and a base	
	➤ Titration curve of amino acids	
	➤ Absorption of UV radiations by aromatic amino acids	
<b>1.B.4</b>	Nucleic acid	<b>18</b>
	➤ Nucleotides	
	➤ Purines	
	➤ Pyrimidines	
	➤ Sugar	
	➤ Phosphate	
	➤ Nucleosides	
	➤ Oligonucleotides	
<b>1.B.5</b>	Vitamins	<b>20</b>
	➤ Classification of Vitamins	
	➤ Vitamin metabolism	
<b>1.C</b>	<b>Stabilizing interactions</b>	<b>21</b>
<b>1.C.1</b>	Vander waals forces	<b>21</b>
<b>1.C.2</b>	Electrostatic forces (Salt Bridges)	<b>22</b>

#### Book Map

Index	<i>i-xv</i>
20-Weeks preparation schedule	<i>xvi</i>
16-Weeks preparation schedule	<i>xvii</i>
12-Weeks Preparation schedule	<i>xviii</i>
Unit specific online quiz-Record sheet	<i>xix</i>
Previous year paper and UGC mock NET Record sheet	<i>xxi</i>
<b>Unit 1</b> Molecules and their interaction relevant to biology	<b>1</b>
<b>Unit 2</b> Cellular organization	<b>81</b>
<b>Unit 3</b> Fundamental process	<b>120</b>
<b>Unit 4</b> Cell communication and cell signaling	<b>180</b>
<b>Unit 5</b> Developmental biology	<b>273</b>
<b>Unit 6</b> System physiology-Plant	<b>325</b>
<b>Unit 7</b> System physiology-Animal	<b>397</b>
<b>Unit 8</b> Inheritance biology	<b>482</b>
<b>Unit 9</b> Diversity of life form	<b>536</b>
<b>Unit 10</b> Ecological principles	<b>600</b>
<b>Unit 11</b> Evolution and behavior	<b>643</b>
<b>Unit 12</b> Applied biology	<b>677</b>
<b>Unit 13</b> Methods in biology	<b>720</b>
<b>Unit 14</b> General Aptitude	<b>804</b>
<b>Annexure 1</b> Introduction to Ace The Race-Online	<b>866</b>
<b>Annexure 2</b> Introduction to UGC Mock NET	<b>867</b>
<b>Annexure 3</b> Introduction to Biosmart Classroom	<b>868</b>
<b>1.C.3</b> Dipolar forces (Hydrogen bonds)	<b>22</b>
	➤ General description
	➤ Geometry
	➤ Water
<b>1.C.4</b> Hydrophobic interactions	<b>24</b>
<b>1.D</b> Principles of biophysical chemistry	<b>24</b>
<b>1.D.1</b> pH	<b>24</b>
<b>1.D.2</b> Buffers	<b>25</b>
<b>1.D.3</b> Reaction kinetics	<b>25</b>
<b>1.D.4</b> Thermodynamics	<b>26</b>
<b>1.D.5</b> Colligative properties	<b>26</b>
	• Boiling point elevation
	• Freezing point depression
	• Osmotic pressure
<b>1.E</b> Bioenergetics and glycolysis	<b>27</b>
<b>1.E.1</b> Bioenergetics	<b>27</b>
	➤ Endergonic reactions
	➤ Exergonic reactions
<b>1.E.2</b> Glycolysis	<b>28</b>

➤ Fate of pyruvate			
➤ Glycolysis energetics			
➤ Regulation of glycolysis			
➤ Allosteric regulation of glycolysis			
➤ Hormonal regulation			
<b>1.E.3</b> Oxidative phosphorylation		<b>33</b>	
<b>1.E.4</b> Coupled reaction		<b>33</b>	
<b>1.E.5</b> Group transfer reaction		<b>34</b>	
<b>1.E.6</b> Biological energy transducer		<b>34</b>	
<b>1.F Enzymology</b>		<b>34</b>	
<b>1.F.1</b> Principles of catalysis		<b>34</b>	
<b>1.F.2</b> Enzymes		<b>35</b>	
➤ Nomenclature			
➤ Classification			
<b>1.F.3</b> Enzymes kinetics		<b>36</b>	
➤ Steady state assumption			
➤ Assumptions			
➤ Line weaver burk plot			
➤ Eadie-Hofstee plot			
➤ Hanes wolf equation			
<b>1.F.4</b> Enzyme activity		<b>39</b>	
➤ Factor affecting enzyme activity			
➤ Turn over number			
<b>1.F.5</b> Enzymes Inhibition		<b>40</b>	
➤ Competitive Inhibition			
➤ Non- competitive inhibition			
➤ Uncompetitive inhibition			
<b>1.F.6</b> Enzyme regulation		<b>42</b>	
➤ Allosteric regulation			
➤ Feedback inhibition			
<b>1.F.7</b> Principle of enzyme catalysis		<b>43</b>	
<b>1.F.8</b> Mechanism of enzyme catalysis		<b>44</b>	
<b>1.F.9</b> Isozymes		<b>44</b>	
<b>1.G Conformation of proteins</b>		<b>44</b>	
<b>1.G.1</b> Peptide bond formation		<b>44</b>	
<b>1.G.2</b> Primary structure		<b>45</b>	
<b>1.G.3</b> Secondary structure		<b>45</b>	
<b>1.G.4</b> Tertiary structure		<b>47</b>	
<b>1.G.5</b> Quaternary structure		<b>48</b>	
<b>1.G.6</b> Ramachandran plot		<b>48</b>	
<b>1.G.7</b> Domains		<b>49</b>	
<b>1.G.8</b> Mofits		<b>49</b>	
<b>1.G.9</b> Protein folding		<b>49</b>	
➤ Process of folding of polypeptides			
➤ Molecular chaperons			
<b>1.H Conformation of nucleic acids</b>		<b>51</b>	
<b>1.H.1</b> Structure of DNA		<b>51</b>	
<b>1.H.2</b> Forms of DNA		<b>51</b>	
<b>1.H.3</b> t-RNA		<b>52</b>	
<b>1.H.4</b> Micro RNA		<b>52</b>	
<b>1.I Stability of proteins and nucleic acids</b>		<b>51</b>	
<b>1.I.1</b> Stability of proteins		<b>52</b>	
➤ Factor affecting protein stability			
			• Temperature
			• Detergents
			• pH
	➤ Factor that influenced DNA stability		
	• Hydrogen bonding		
	• Base stacking		
	• Denaturation and melting curve		
	• Denaturation and strand separation		
	• Denaturation by helix destabilizing proteins		
	• Denaturation in Alkali		
	• Factors that affect the $T_m$		
<b>1.I.2</b> Stability of nucleic acids			<b>53</b>
<b>1.J Metabolisms</b>			<b>54</b>
<b>1.J.1</b> Carbohydrates metabolism			<b>54</b>
➤ Gluconeogenesis			
➤ Gluconeogenesis pathway regulation			
➤ Pentose phosphate pathway (PPP)			
➤ Alcoholic Fermentation			
<b>1.J.2</b> Lipids metabolism			<b>58</b>
➤ Cholesterol metabolism			
➤ Biosynthesis of cholesterol			
➤ Steroid hormones and bile acids			
➤ Synthesis and storage of triacylglycerols			
➤ Digestion and absorption of lipids			
• Micelles			
• Chylomicrons			
➤ Biosynthesis of fatty acids and $\beta$ -oxidation			
<b>1.J.3</b> Amino acids metabolism			<b>63</b>
➤ Transamination			
➤ Oxidative deamination			
➤ Non-oxidative deamination			
➤ Urea cycle			
➤ Role of urea cycle			
➤ Reactions of urea cycle			
➤ Regulation of urea cycle			
➤ Fate of carbon skeleton			
<b>1.J.4</b> Nucleotide metabolism			<b>66</b>
➤ Denovo pathway of purines nucleotides			
➤ Purines salvage pathway			
➤ Biosynthesis of pyrimidines (Denovo pathway)			
➤ Primidine salvage pathway			
<b>1.J.5</b> Vitamins metabolism			<b>70</b>
➤ Water soluble Vitamin			
• Vitamin B1 or Thiamine			
• Vitamin B2 or riboflavin			
• Niacin			

- Vitamin B6: Pyridoxine and pyridoxal phosphate
- Biotin
- Folic acid
- Pantothenic acid and co enzyme A
- Vitamin B12 or cyanocobalamin
- Vitamin C
- Fat soluble vitamins
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K

## Unit 2 Cellular organization

<b>2.A</b>	<b>Membrane structure and function</b>	<b>81</b>
<b>2.A.1</b>	Structure of model membrane	<b>81</b>
	➤ Fluid Mosaic model	
<b>2.A.2</b>	Lipid bilayer and membrane protein diffusion	<b>81</b>
<b>2.A.3</b>	Osmosis, ion channels, active transport, ion pumps	<b>83</b>
	➤ Passive transport	
	➤ Active transport	
	➤ Bulk transport by the plasma membrane	
	• Exocytosis	
	• Phagocytosis	
	• Endocytosis	
<b>2.A.4</b>	Mechanism of sorting and regulation of intracellular transport	<b>90</b>
	➤ Protein targeting	
<b>2.A.5</b>	Electrical properties of cell membranes	<b>92</b>
<b>2.B</b>	<b>Structural organization and function of intracellular organelles</b>	<b>92</b>
<b>2.B.1</b>	Cell wall	<b>93</b>
	➤ Composition of cell wall	
<b>2.B.2</b>	Nucleus	<b>95</b>
<b>2.B.3</b>	Mitochondria	<b>96</b>
<b>2.B.4</b>	Golgi apparatus	<b>97</b>
<b>2.B.5</b>	Lysosomes	<b>98</b>
<b>2.B.6</b>	Endoplasmic reticulum	<b>98</b>
<b>2.B.7</b>	Peroxisomes	<b>99</b>
<b>2.B.8</b>	Plastids	<b>99</b>
<b>2.B.9</b>	Vacuoles	<b>100</b>
<b>2.B.10</b>	Chloroplast	<b>100</b>
<b>2.B.11</b>	Structure & function of cytoskeleton and its role in motility	<b>100</b>
	➤ Structure of cytoskeleton	
	➤ Function of cytoskeleton	
	➤ Mechanism of action	
<b>2.C</b>	<b>Organization of genes and chromosomes</b>	<b>103</b>
<b>2.C.1</b>	Operons	<b>103</b>
	➤ Lac operon	
	➤ Trp operon	
<b>2.C.2</b>	Interrupted genes	<b>106</b>
<b>2.C.3</b>	Gene families	<b>106</b>
<b>2.C.4</b>	Structure of chromatin and chromosomes	<b>106</b>

	➤ Chromosomes	
	➤ Chromatin	
	➤ Chromosomal abnormalities	
	➤ Numerical abnormalities	
	➤ Structural abnormalities	
<b>2.C.5</b>	Unique and repetitive DNA	<b>109</b>
	➤ Repetitive DNA	
	➤ LINES and SINES	
<b>2.D</b>	<b>Cell division and cell cycle</b>	<b>110</b>
<b>2.D.1</b>	The cell cycle	<b>110</b>
	➤ M phase	
	➤ Interphase	
<b>2.D.2</b>	Cell division-mitosis and meiosis	<b>110</b>
	➤ Mitosis consists of four phases	
	➤ Meiosis	
	➤ Meiosis II	
<b>2.D.3</b>	Cell cycle regulation	<b>113</b>
<b>2.D.4</b>	Control of cell cycle	<b>113</b>
<b>2.D.5</b>	Cell cycle check points	<b>114</b>
<b>2.D.6</b>	Checkpoints: Quality control of the cell cycle	<b>115</b>
	➤ DNA damage checkpoints	
	➤ Spindle assembly checkpoints	
<b>2.E</b>	<b>Microbial physiology</b>	<b>115</b>
<b>2.E.1</b>	Growth, yield and characteristics	<b>115</b>
	➤ Growth curve of bacterium	
<b>2.E.2</b>	Stress response	<b>116</b>

## Unit 3 Fundamental processes

<b>3.A</b>	<b>DNA replication, repair and recombination</b>	<b>120</b>
<b>3.A.1</b>	Important rules for DNA replication	<b>120</b>
	➤ Semi conservative replication	
	➤ Replication at origin and replication for	
	➤ Fidelity of DNA replication	
	➤ Accurate replication	
	➤ DNA damage	
<b>3.A.2</b>	Enzymes and protein involved in DNA replication	<b>122</b>
	➤ DNA polymerases	
	➤ DNA binding proteins	
<b>3.A.3</b>	DNA replication process	<b>124</b>
	➤ Initiation	
	➤ Elongation	
	➤ Termination	
<b>3.A.4</b>	Rolling circle mechanism of DNA replication	<b>126</b>
<b>3.A.5</b>	Telomere replication	<b>127</b>
<b>3.A.6</b>	Replication of organelle DNA	<b>127</b>
<b>3.A.7</b>	DNA Recombination	<b>128</b>
	➤ Importance	
	➤ Types of recombination	
	➤ Holliday model for homologous recombination	
	➤ Meselson–Radding recombination	
	➤ Site specific recombination	
	➤ Double strand break model	
<b>3.A.8</b>	DNA Repair	<b>132</b>
	➤ DNA excision repair	

	i. Base excision repair		<b>3.C.7</b>	tRNA-identity	<b>161</b>
	ii. Nucleotide excision repair		<b>3.C.8</b>	Aminoacyl tRNA synthesis	<b>161</b>
	iii. Mismatch repair		<b>3.C.9</b>	Translational Inhibitors	<b>161</b>
	➤ Direct repair		<b>3.C.10</b>	Post-Translational modification of proteins	<b>162</b>
	➤ Recombinational DNA repair				
	➤ SOS repair		<b>3.D</b>	<b>Control of gene expression of transcription and translation level</b>	<b>164</b>
<b>3.A.9</b>	Mutations	<b>134</b>	<b>3.D.1</b>	Gene regulation in Bacteriophage and Viruses	<b>164</b>
	➤ Causes of mutation		<b>3.D.2</b>	Gene regulation in prokaryotes	<b>165</b>
	➤ Types of mutation			➤ Lac operon (inducible operon)	
<b>3.B</b>	<b>RNA synthesis and processing</b>	<b>137</b>		➤ Arabinose operon of <i>E. coli</i> - positive and negative regulation	
<b>3.B.1</b>	Basic structure of RNA	<b>137</b>		➤ Tryptophan operon	
	➤ Different types of RNA		<b>3.D.3</b>	Gene regulation in eukaryotes	<b>170</b>
	• Messenger RNA (mRNA)		<b>3.D.4</b>	Regulation of Gene expression in eukaryotes	<b>171</b>
	• Ribosomal RNA (rRNA)			➤ Gene expression regulation by methylation	
	• Small interfering RNA (SiRNA)			➤ Role of CpG islands in gene regulation	
	• Small nuclear ribonucleic acid (SnRNA)			➤ Transcriptional Regulation through chromosomal packaging	
	• Heterogenous nuclear ribonucleic acid (hnRNA)			➤ Regulation of mRNA stability	
	• Transfer RNA (tRNA)		<b>3.D.5</b>	Role of chromatin in gene expression	<b>172</b>
<b>3.B.2</b>	RNA Polymerases			➤ Covalent histone modification	
	➤ Eukaryotic RNA polymerase	<b>140</b>		➤ Nucleosome remodeling	
<b>3.B.3</b>	RNA machinery		<b>3.D.6</b>	Gene expression regulation at Translational level	<b>173</b>
	➤ Transcription activators and repressor	<b>141</b>		➤ Translational frame shifting	
	➤ Transcription cycle in bacteria			➤ Post translational modification in regulation of protein stability	
	➤ Eukaryotic transcription			➤ Post translational regulation of transcription factors	
<b>3.B.4</b>	Transcription Factors		<b>3.D.7</b>	Gene Silencing	<b>174</b>
<b>3.B.5</b>	RNA processing	<b>144</b>		➤ Antisense technology	
	➤ RNA capping and polyadenylation	<b>145</b>		➤ RNAi technology	
<b>3.B.6</b>	RNA splicing			• siRNA mediated pathway	
	➤ Chemistry of RNA splicing	<b>146</b>		• miRNA mediated RNA interference	
	➤ The splisosome machinery				
	➤ Splicing pathway				
	➤ Alternate splicing				
<b>3.B.7</b>	RNA Editing				
<b>3.B.8</b>	RNA transport	<b>149</b>			
		<b>149</b>			
<b>3.C</b>	<b>Protein synthesis and processing</b>		<b>Unit 4</b>	<b>Cell communication and cell signaling</b>	
<b>3.C.1</b>	Role of RNA	<b>151</b>	<b>4.A</b>	<b>Host parasite interaction</b>	<b>180</b>
	➤ Role of messenger RNA (mRNA)	<b>151</b>	<b>4.A.1</b>	Recognition and entry processes of different pathogens	<b>180</b>
	➤ Role of transfer RNA (tRNA)			➤ Pathogen recognition	
	➤ Role of ribosomal RNA (rRNA)			➤ Bacterial toxins	
<b>3.C.2</b>	Ribosomes			➤ Entry process	
	➤ Characteristics	<b>152</b>	<b>4.A.2</b>	Alteration of host cell behavior by pathogens	<b>183</b>
	➤ Location in the cell			➤ Immune system	
	➤ RNA binding sites in the ribosome		<b>4.A.3</b>	Virus-induced cell transformation	<b>184</b>
	➤ Amino acid activation and attachment to tRNA			➤ Lytic and lysogenic cycles	
<b>3.C.3</b>	Protein synthesis			➤ Detecting viruses; plaque assay	
	➤ Protein synthesis involves three steps	<b>154</b>	<b>4.A.4</b>	Pathogen-induced diseases	<b>186</b>
<b>3.C.4</b>	Proof reading			➤ Diseases caused by pathogens	
	➤ Tanslational proof reading	<b>159</b>	<b>4.A.5</b>	Cell-cell fusion in both normal and abnormal cells	<b>192</b>
<b>3.C.5</b>	Genetic Code			➤ Transformation	
	➤ Other characteristics of genetic code	<b>159</b>		➤ Conjugation	
	➤ Mutations and genetic code			➤ Transduction	
<b>3.C.6</b>	Aminoacylation of tRNA	<b>161</b>	<b>4.B</b>	<b>Cell signaling</b>	<b>194</b>

<b>4.B.1</b>	Hormones and their receptors	<b>198</b>	<b>4.D.7</b>	Tumor suppressor gene	<b>222</b>
	➤ Hormones			➤ The p53 gene	
	➤ Receptors		<b>4.D.8</b>	Cancer and the cell cycle	<b>223</b>
<b>4.B.2</b>	Cell surface receptors	<b>199</b>		➤ The cell cycle	
	➤ Steroid receptors		<b>4.D.9</b>	Virus-induced cancer	<b>225</b>
	➤ Nitric oxide (NO) receptors			➤ Human papillomavirus	
	➤ Cytokine receptors			➤ Hepatitis	
	➤ Ion gated channel receptors			➤ Epstein Barr virus (EBV)	
	➤ Enzyme-linked receptors			➤ Human immune deficiency virus (HIV)	
	➤ Receptors Tyrosine Kinases (RTKs)		<b>4.D.10</b>	Metastasis	<b>226</b>
	➤ JAK-STAT Pathways		<b>4.D.11</b>	Interaction of cancer cells with normal cells	<b>226</b>
<b>4.B.3</b>	Signaling through G-protein coupled receptors	<b>201</b>	<b>4.D.12</b>	Apoptosis	<b>226</b>
<b>4.B.4</b>	Signal transduction pathways	<b>201</b>		➤ Apoptosis Mediated by an Intracellular	
	➤ P13 kinase pathways			➤ Proteolytic Cascade	
<b>4.B.5</b>	Second messengers	<b>203</b>		➤ Procaspases are activated by binding to	
<b>4.B.6</b>	Regulation of signaling pathways	<b>206</b>		➤ Adaptor proteins	
	➤ Endocytosis			➤ Bcl-2 family proteins and IAP protein are the	
	➤ Phosphorylation and Dephosphorylation			➤ main Intracellular regulator of the cell Death	
<b>4.B.7</b>	Bacterial and plant two-component system	<b>206</b>		➤ Program	
<b>4.B.8</b>	Light signaling in plants	<b>206</b>	<b>4.D.13</b>	Therapeutic interventions of uncontrolled cell	<b>229</b>
<b>4.B.9</b>	Bacterial chemotaxis	<b>207</b>		growth	
<b>4.B.10</b>	Quorum sensing	<b>207</b>		➤ Granulomatous inflammation	
	➤ Intraspecies Communication-Gram negative			➤ ANCA-induced necrotising vasculitis	
	➤ bacteria		<b>4.E</b>	<b>Innate and adaptive immune system</b>	<b>230</b>
	➤ Intraspecies Communication-Gram positive		<b>4.E.1</b>	Cells and molecules involved in innate and	<b>230</b>
	➤ bacteria			adaptive immunity	
	➤ Interspecies Communication-Bacterial Crosstalk			➤ Innate immunity	
	➤ Quorum sensing pathway			➤ Adaptive immunity	
				➤ Humoral and cell mediated immunity	
<b>4.C</b>	<b>Cellular communication</b>	<b>209</b>	<b>4.E.2</b>	Cells and organs of immune system	<b>233</b>
<b>4.C.1</b>	Regulation of hematopoiesis	<b>209</b>		➤ Lymphoid cells	
<b>4.C.2</b>	General principles of cell communication	<b>210</b>		➤ Macrophages	
	i. Reception			➤ Granulocytes	
	ii. Transduction			➤ Neutrophils	
	iii. Response			➤ Mast cells	
<b>4.C.3</b>	Cell adhesion and roles of different adhesion	<b>211</b>		➤ Dendritic cells	
	molecules			➤ Follicular dendritic cells	
	➤ Cell adhesion molecules		<b>4.E.3</b>	Lymphoid organs	<b>235</b>
<b>4.C.4</b>	Gap junctions	<b>212</b>		➤ Primary lymphoid organs	
	➤ Cell junctions			➤ Secondary lymphoid organs	
<b>4.C.5</b>	Extracellular matrix	<b>214</b>		➤ Other lymphoid tissues	
	➤ Plant cell walls		<b>4.E.4</b>	Antigens, antigenicity and immunogenicity	<b>236</b>
	➤ Extra cellular matrix of animals			➤ Antigens	
	➤ Adhesion proteins			➤ Three type of antigenic determinants	
<b>4.C.6</b>	Neurotransmission and its regulation	<b>217</b>		➤ Properties of the immunogen	
	➤ Process of Neurotransmission			➤ Susceptibility to antigen processing &	
	➤ Regulation of synaptic transmission			➤ presentation	
				➤ Adjuvants	
<b>4.D</b>	<b>Cancer</b>	<b>218</b>	<b>4.E.5</b>	B and T-cell epitopes	<b>237</b>
<b>4.D.1</b>	Genetic rearrangements in progenitor cells	<b>218</b>		➤ B-cell epitopes	
<b>4.D.2</b>	Types of cancer	<b>218</b>		➤ T-cell epitopes requires peptides from antigen	
<b>4.D.3</b>	Tumors	<b>219</b>		➤ Superantigens	
	➤ Benign tumors		<b>4.E.6</b>	Structure and function of antibody molecules	<b>239</b>
	➤ Malignant tumors			➤ Basic structure of Antibody	
<b>4.D.4</b>	Transition of normal cell to cancer cell	<b>220</b>		➤ Antigenic determinants of Immunoglobulin	
<b>4.D.5</b>	Properties of cancer cell	<b>220</b>		➤ Constant & variable region of Light chain	
<b>4.D.6</b>	Oncogenes	<b>221</b>		➤ Properties of different classes of	
	➤ Introduction to Photo-oncogenes			➤ immunoglobulins	



4.E.7	Generation of antibody diversity	238	4.E.22	Immune response to parasitic diseases (Malaria)	262
	➤ Organization of genes in light chains		4.E.23	Immune response to viral HIV infections	262
	➤ Combinatorial V (D) J joining		4.E.24	Congenital and acquired immunodeficiencies	262
	➤ Combinatorial joining of H and L chain		4.E.25	Failures of host defense mechanisms	263
4.E.8	Monoclonal antibodies	240	4.E.26	Vaccines	264
	➤ Hybridoma cells			➤ Active vaccination	
	➤ Production of monoclonal antibody			➤ Passive vaccination	
4.E.9	Antibody engineering	241		➤ Herd immunity	
	➤ Immunotoxins		<b>Unit 5 Developmental biology</b>		
	➤ Chimeric antibodies		5.A	<b>Basic concept of development</b>	273
	➤ Humanized antibodies		5.A.1	Potency and cell fate	273
	➤ Hetroconjugates or Bispecific antibodies			➤ Simplified development hierarchy in vertebrates	
	➤ Clonal selection theory			➤ Simplified development hierarchy in flowering plants	
4.E.10	Antigen-antibody interactions	241	5.A.2	Commitment	274
	➤ Affinity			➤ Levels of developmental commitment	
	➤ Avidity			➤ Stages of developmental commitment	
	➤ Specificity			➤ Mechanisms of developmental commitment	
	➤ Cross-reactivity		5.A.3	Specification	275
	➤ Precipitation reactions			➤ Mosaic development or autonomous specification	
4.E.11	Kinetics of antibody response	242		➤ Regulative development or Conditional specification	
	➤ Primary immune response		5.A.4	Induction	277
	➤ Secondary immune response			➤ Ranges and types of induction	
	➤ Specificity of 1° and 2° responses			➤ Types of induction on the basis of choice available to responding cell	
4.E.12	Major Histocompatibility complex (MHC molecules)	243		➤ Lateral inhibition	
	➤ Class I MHC molecules			➤ Community effect	
	➤ Class II MHC molecules		5.A.5	Competence	278
4.E.13	Antigen processing and presentation	245	5.A.6	Determination	278
	➤ Antigen presenting cells (APCs)		5.A.7	Differentiation	279
	➤ Antigen processing and presentation pathways		5.A.8	Morphogenetic gradients	279
4.E.14	Activation and differentiation of B and T cells	246	5.A.9	Cell fate (Fate Maps)	279
	➤ B-cell		5.A.10	Cell lineages	279
	➤ T-cell		5.A.11	Stem cells	279
4.E.15	B and T-cell receptors	248		➤ Kinds of stem cells	
	➤ Generation of T-cell receptor diversity			➤ Types of stem cell	
	➤ T-cell receptor complex; TCR-CD3			➤ Identification of stem cell	
	➤ Coreceptors			➤ Stems cells are important from a medical perspective	
	➤ Thymic selection			➤ Stem cell controversy	
	➤ Humoral immune response		5.A.12	Genomic equivalence	283
	➤ Cell mediated immune response		5.A.13	Cytoplasmic determinants	284
4.E.16	Primary and secondary immune modulation	254	5.A.14	Imprinting	284
4.E.17	The complement system	254	5.A.15	Mutants	284
	➤ Complement components		5.A.16	Transgenics in analysis of developmen	284
	➤ Toll-like receptors				
4.E.18	Cell-mediated effector functions	256	5.B	<b>Gametogenesis, fertilization and early development</b>	284
	➤ Cytokines		5.B.1	Production of gametes	284
	➤ Function of cytokines			➤ Spermatogenesis	
	➤ Inflammation			➤ Oogenesis	
4.E.19	Hypersensitivity	258		➤ Fertilization	
	➤ Type I hypersensitive reactions			➤ Physical and chemical events of fertilization	
	➤ Type II hypersensitive reactions				
	➤ Type III hypersensitive reactions				
	➤ Type IV hypersensitive reactions				
4.E.20	Autoimmunity	260			
	➤ Organ specific autoimmune diseases				
	➤ Systemic auto immune diseases				
4.E.21	Immune response to parasitic infections (Tuberculosis)	262			

<b>5.B.2</b>	Embryo sac development	<b>288</b>	<b>5.D</b>	<b>Morphogenesis and organogenesis &amp; organogenesis in plants (SAM)</b>	<b>308</b>
	➤ Growth of pollen tube		<b>5.D.1</b>	Organization of shoot and root apical meristem	<b>308</b>
	➤ Entry of pollen tube into ovule			➤ Organization of shoot apical meristem	
<b>5.B.3</b>	Double fertilization	<b>289</b>		➤ Tunica corpus organization or layer concept	
<b>5.B.4</b>	Zygote formation	<b>289</b>		➤ Zonal organization	
<b>5.B.5</b>	Cleavage	<b>289</b>		➤ Genes involved in shoot apical meristem development	
	➤ Planes of cleavage			➤ Organization of root apical meristem	
	➤ Patterns of cleavage			➤ Plant development	
<b>5.B.6</b>	Blastula formation	<b>290</b>		➤ Types of germination	
	➤ Gastrulation			➤ Development of seedlings	
	➤ Process			➤ Environmental influences to which seedlings respond	
<b>5.B.7</b>	Establishment of symmetry in plants	<b>291</b>		➤ Embryogenesis in <i>Arabidopsis</i>	
	➤ Meristematic Plant Development			➤ Transition to germinations	
	➤ Types of Phyllotaxis		<b>5.D.2</b>	Shoot and root development	<b>313</b>
<b>5.B.8</b>	Development of seedling	<b>293</b>	<b>5.D.3</b>	Leaf development	<b>313</b>
<b>5.B.9</b>	Transition to germination	<b>293</b>	<b>5.D.4</b>	Phyllotaxy	<b>314</b>
<b>5.C</b>	<b>Morphogenesis and organogenesis in animals</b>	<b>293</b>	<b>5.D.5</b>	Transition to flowering	<b>314</b>
<b>5.C.1</b>	Cell aggregation	<b>293</b>		➤ The florigen concept	
<b>5.C.2</b>	Differentiation	<b>294</b>		➤ The nutrient diversion hypothesis	
	➤ Culmination			➤ Multifactorial control model	
<b>5.C.3</b>	Axes and pattern formation in drosophila	<b>294</b>	<b>5.D.6</b>	Floral meristems and floral development in <i>arabidopsis</i> and <i>antirrhinum</i>	<b>315</b>
	First zygotic genes to be expressed along the A/P axis are called GAP genes			➤ ABC model	
<b>5.C.4</b>	Axes and pattern formation in amphibian	<b>295</b>		➤ ABCDE model	
	➤ Positioning the blastopore		<b>5.E</b>	<b>Programmed cell death, aging and senescence</b>	<b>316</b>
<b>5.C.5</b>	Axes and pattern formation in chick	<b>298</b>	<b>5.E.1</b>	Programmed cell death	<b>316</b>
	➤ Early stages, blastoderm formation and early polarity			➤ Apoptosis	
	➤ The blastoderm stage			➤ Apoptosis associated gene or protein	
	➤ Cell interactions leading to primitive streak formation		<b>5.E.2</b>	Aging	<b>318</b>
	➤ Primitive streak formation and elongation			➤ Mechanism of cell aging	
	➤ Hensen's node		<b>5.E.3</b>	Senescence	<b>319</b>
	➤ Establishment and subdivision of embryonic endoderm and mesoderm			➤ Mechanism of senescence	
	➤ Ending gastrulation and regression of the primitive streak		<b>Unit 6 System physiology-Plant</b>		
	➤ The tail bud		<b>6.A</b>	<b>Photosynthesis</b>	<b>325</b>
<b>5.C.6</b>	Organogenesis-vulva formation in <i>caenorhabditiselegans</i>	<b>302</b>	<b>6.A.1</b>	Light-harvesting complexes	<b>325</b>
<b>5.C.7</b>	Eye lens induction	<b>303</b>		➤ Photosynthetic pigments	
<b>5.C.8</b>	Limb development and regeneration in verterates	<b>303</b>		➤ Spectra-absorption and action Photosynthetic Units (PSU)	
	➤ Limb regeneration		<b>6.A.2</b>	Mechanism of electron transport	<b>326</b>
<b>5.C.9</b>	Differentiation of neurons	<b>304</b>		➤ Cyclic photophosphorylation	
	➤ Induces			➤ Non-cyclic photophosphorylation	
	➤ Regional specificity and induction		<b>6.A.3</b>	Photoprotective mechanisms	<b>328</b>
<b>5.C.10</b>	Post embryonic development	<b>305</b>	<b>6.A.4</b>	Carbon dioxide fixation	<b>328</b>
<b>5.C.11</b>	Environmental regulation of normal development	<b>306</b>		➤ The Calvin cycle	
				➤ The C4 cycle	
<b>5.C.12</b>	Sex determination	<b>306</b>		➤ Crassulacean Acid Metabolism (CAM) pathway	
	➤ Chromosomal sex determination		<b>6.B</b>	<b>Respiration and photorespiration</b>	<b>331</b>
	➤ Sex determination in humans		<b>6.B.1</b>	Citric acid cycle/Krebs cycle	<b>331</b>
	➤ Sex chromosome and dosage compensation in organisms		<b>6.B.2</b>	Plant mitochondrial electron transport and ATP synthesis	<b>332</b>
	➤ Sex determination in Drosophila				
	➤ Sex switch gene concept in Drosophila				

	➤ Electron Transport Chain				➤ Factor affecting the stomatal movement		
	➤ Oxidative Phosphorylation				➤ Mechanism of stomatal movement		
<b>6.B.3</b>	Alternate oxidase	<b>335</b>		<b>6.E.5</b>	Photoperiodism		<b>354</b>
<b>6.B.4</b>	Photorespiratory pathway	<b>336</b>		<b>6.E.6</b>	Biological clocks in plants		<b>355</b>
<b>6.C</b>	<b>Nitrogen metabolism</b>	<b>337</b>		<b>6.F</b>	<b>Solute transport and photo assimilate translocation</b>		<b>355</b>
<b>6.C.1</b>	Nitrate assimilation	<b>337</b>		<b>6.F.1</b>	Uptake transport		<b>355</b>
	➤ Nitrogen fixation				➤ Diffusion		
<b>6.C.2</b>	Ammonium assimilation	<b>338</b>			➤ Osmosis		
<b>6.C.3</b>	Amino acid biosynthesis	<b>339</b>			➤ Hypotonic, Hypertonic and Isotonic Solutions		
					➤ Diffusion pressure deficit (DPD)		
					➤ Water Potential		
<b>6.D</b>	<b>Plant hormones</b>	<b>340</b>		<b>6.F.2</b>	Translocation of water, ions, solutes and macromolecules from soil, cells across membrane, through xylem and phloem.		<b>356</b>
<b>6.D.1</b>	Auxins	<b>340</b>		<b>6.F.3</b>	Ascent of sap		<b>358</b>
	➤ Biosynthesis and metabolism			<b>6.F.4</b>	Transpiration		<b>359</b>
	➤ Role of auxins				➤ Types of transpiration		
	➤ Transport			<b>6.F.5</b>	Mechanism of loading and unloading of photo assimilates.		<b>359</b>
	➤ Physiological effects				➤ Phloem loading		
<b>6.D.2</b>	Cytokinins	<b>342</b>			➤ Phloem unloading and transition from source to sink		
	➤ Biosynthesis and metabolism			<b>6.G</b>	<b>Secondary metabolites</b>		<b>361</b>
	➤ Role of cytokinins			<b>6.G.1</b>	Biosynthesis and role of terpenes		<b>362</b>
	➤ Physiological effects			<b>6.G.2</b>	Biosynthesis and role of phenols		<b>364</b>
<b>6.D.3</b>	Gibberellins	<b>343</b>		<b>6.G.3</b>	Biosynthesis and role of nitrogenous compounds		<b>366</b>
	➤ Biosynthesis and metabolism			<b>6.H</b>	<b>Stress physiology</b>		<b>367</b>
	➤ Role of gibberellins			<b>6.H.1</b>	Responses of plants and mechanism of resistance to biotic stresses		<b>368</b>
	➤ Transport				➤ Biotic stress		
	➤ Physiological effects				➤ Infection		
<b>6.D.4</b>	Ethylene	<b>346</b>			➤ Herbivory		
	➤ Biosynthesis and metabolism				➤ Defense hypothesis		
	➤ Role of ethylene				➤ Competition		
	➤ Transport				➤ Defense mechanism		
	➤ Physiological effects			<b>6.H.2</b>	Responses of plants and mechanism of tolerance to abiotic stresses		<b>375</b>
<b>6.D.5</b>	Abscisic acid	<b>347</b>			➤ Temperature stress		
	➤ Biosynthesis and metabolism				➤ Water stress		
	➤ Role of abscisic acid (ABA)				➤ Radiation stress		
	➤ Transport				➤ Chemical stress		
	➤ Physiological effects				➤ Mechanical stress		
					➤ Other abiotic stresses		
<b>6.E</b>	<b>Sensory photobiology</b>	<b>349</b>		<b>Unit 7 System physiology-Animal</b>			
<b>6.E.1</b>	Structure, function and mechanism of action of Phytochromes	<b>349</b>		<b>7.A</b>	<b>Blood and circulation</b>		<b>397</b>
	➤ Structure			<b>7.A.1</b>	Blood corpuscles		<b>397</b>
	➤ Functions of phytochromes						
	➤ Mechanism of action						
<b>6.E.2</b>	Structure, function and mechanism of action of Cryptochromes	<b>350</b>					
	➤ Structure of chrytochromes						
	➤ Functions of chrytochromes						
<b>6.E.3</b>	Structure, function and mechanism of action of Phototropins	<b>352</b>					
	➤ Structure						
	➤ Functions of phototropins						
	➤ Mechanism of action						
<b>6.E.4</b>	Stomatal movements	<b>353</b>					
	➤ Stomatal transpiration						



7.A.2	Haemopoiesis and formed elements	397	7.D.2	Action potential	431
	➤ Composition of blood			➤ Neuron signaling	
	➤ Blood types			➤ Conduction	
7.A.3	Plasma function	403	7.D.3	Gross neuroanatomy of the brain and spinal cord	431
	➤ Plasma proteins			➤ Brain	
	➤ Functions of plasma proteins			➤ Spinal cord	
7.A.4	Blood volumes	404		➤ Meninges	
7.A.5	Blood volume regulation	404		➤ Cerebrospinal fluid	
7.A.6	Blood group	405		➤ Sense organs	
7.A.7	Hemoglobin	405	7.D.4	Central and peripheral nervous system	434
	➤ Hemoglobin structure			➤ Nervous system physiology	
	➤ Hemoglobin function			➤ Central nervous system	
	➤ Abnormal hemoglobin			➤ Peripheral nervous system	
	➤ RBC Life span and circulation			➤ Action potentials	
	➤ Hemoglobin conservation and recycling			➤ Synapses	
	➤ Iron			➤ Myelination	
7.A.8	Immunity	407		➤ Reflexes	
7.A.9	Hemoglobin	407		➤ Functions of cranial nerves	
				➤ Sensory physiology	
4.B	<b>Cardiovascular system</b>	411	7.D.5	Neural control of muscle tone and posture	438
4.B.1	Comparative anatomy of heart structure	411		➤ Maintenance of upright posture and balance	
	➤ The heart			➤ Brainstem control of posture	
	➤ Working of heart and circulatory system			➤ Decerebrate rigidity (Mid Collicular Transaction)	
	➤ Functions of the cardiovascular system				
	➤ Problem with the cardiovascular system				
7.B.2	Myogenic heart	414	7.E	<b>Sense organs</b>	439
7.B.3	Specialized tissue	416	7.E.1	Sight/Vision	439
7.B.4	ECG-its principle and significance	416	7.E.2	Hearing	440
7.B.5	Neural and Chemical regulation	418	7.E.3	Tactile response	441
	➤ Cardiac cycle				
	➤ Heart as a pump				
	➤ Blood pressure				
7.C	<b>Respiratory system</b>	419	7.F	<b>Excretory system</b>	442
7.C.1	Comparison of respiration in different species	420	7.F.1	Comparative physiology of excretion	442
	➤ Evolution of respiratory system		7.F.2	Comparative physiology of Kidney	443
	➤ The respiratory system			➤ Nephron	
	➤ Control of kidney function			➤ Comparative physiology of urine formation	444
7.C.2	Anatomical considerations	421		➤ Comparative physiology of urine concentration	445
	➤ The respiratory system			➤ Comparative physiology of waste elimination	446
7.C.3	Transport of gases	424		➤ Comparative physiology of micturition	447
	➤ Mechanism of respiration			➤ Regulation of water balance	448
	➤ External respiration			➤ Blood Volume	450
	➤ Respiratory volumes			➤ Regulation of blood pressure	451
7.C.4	Exchange of gases	425		➤ Regulation of fluid and electrolyte balance	451
	➤ Bohr's effect			➤ Regulation of acid-base balance	452
	➤ Hambergaur effect			➤ Respiratory acidosis	
	➤ Haldane effect			➤ Metabolic acidosis	
7.C.5	Waste elimination	426		➤ Alkakosis	
7.C.6	Neural and chemical regulation of respiration	426	7.G	<b>Thermoregulation</b>	454
	➤ Regulation of respiration		7.G.1	Comfort zone	454
	➤ Ventral group of neurons			➤ Working of thermoregulation	
	➤ Thermo regulatory system		7.G.2	Body temperature	455
				➤ Physical	
				➤ Chemical	
				➤ Neural regulation	
7.D	<b>Nervous system</b>	429	7.G.3	Acclimatization	458
7.D.1	Neurons	429			
	➤ Myelin Sheath				
	➤ Neuroglia				
	➤ Functions of neurons				
	➤ Structure of neurons				

<b>7H</b>	<b>Stress and adaptation</b>	<b>459</b>	<b>8.B</b>	<b>Concept of gene</b>	<b>483</b>
<b>7.H.1</b>	Stress and adaptation	459	<b>8.B.1</b>	Allele	484
	➤ Stress		<b>8.B.2</b>	Multiple alleles	484
	➤ Stressors		<b>8.B.3</b>	Pseudoallele	484
	➤ Flight or fight response			➤ Chromosomal theory of inheritance	
	➤ The stress response		<b>8.C</b>	<b>Extension of Mendelian principles</b>	<b>485</b>
	➤ Role of hypothalamus-pituitary-adrenal(HPA) axis in stress		<b>8.C.1</b>	Co-dominance	485
	➤ Role of locus coeruleus in stress		<b>8.C.2</b>	Incomplete dominance	485
	➤ Importance of the connections in the brain in stress		<b>8.C.3</b>	Gene interaction	486
	➤ Physiology of stress			➤ Intragenic interaction	
	➤ Role of the parasympathetic nervous system(PNS)			➤ Non-allelic or intergenic interaction	
	➤ Adaptation			➤ Dominant epistasis	
				➤ Recessive epistasis	
<b>7.I</b>	<b>Digestive system</b>	<b>464</b>		➤ Dominant recessive epistasis	
<b>7.I.1</b>	Digestion	464		➤ Duplicate genes	
	➤ Digestive system anatomy		<b>8.C.4</b>	➤ Additive or polymeric genes	
	➤ Digestive system physiology		<b>8.C.5</b>	Pleiotropic Gene	489
<b>7.I.2</b>	Absorption and transport of nutrients	466	<b>8.C.6</b>	Genomic Imprinting	490
<b>7.I.3</b>	Energy balance	467	<b>8.C.7</b>	Penetrance and Expressivity	490
<b>7.I.4</b>	Basal Metabolic Rate(BMR)	468	<b>8.C.8</b>	Phenocopy	490
<b>7.J</b>	<b>Endocrinology and reproduction</b>	<b>468</b>	<b>8.C.8</b>	Linkage & Crossing Over	491
<b>7.J.1</b>	Endocrine glands	468		➤ Gene mapping	
	➤ Hormones secreted by pituitary glands		<b>8.C.9</b>	Sex linkage	493
	➤ Thyroid gland			➤ Sex chromosomes	
	➤ Parathyroid glands			➤ Sex linkage	
	➤ Adrenal glands			➤ Characteristics of sex linkage inheritance	
	➤ Pancreas			➤ Colour blindness	
<b>7.J.2</b>	Basic mechanism of hormone actions	471	<b>8.C.10</b>	Sex influenced and sex limited genes	495
	➤ Non steroid hormones		<b>8.D</b>	<b>Gene mapping methods</b>	<b>495</b>
<b>7.J.3</b>	Hormones and diseases	472	<b>8.D.1</b>	Linkage maps	495
	➤ Hormones			➤ Creating map	
	➤ Diseases		<b>8.D.2</b>	Tetrad analysis	498
<b>7.J.4</b>	Reproductive processes	474		➤ Nomenclature conventions	
	➤ Women's reproductive system		<b>8.D.3</b>	Mapping with molecular markers	499
	➤ Men's reproductive system		<b>8.D.4</b>	Somatic hybrid mapping	500
	➤ Best time for conception		<b>8.D.5</b>	Mapping populations	500
	➤ Pregnancy		<b>8.E</b>	<b>Extra chromosomal inheritance</b>	<b>501</b>
<b>7.J.5</b>	Neuroendocrine regulation	476	<b>8.E.1</b>	Inheritance of mitochondrial and chloroplast gene	502
	➤ Hypophysiotropic hormones		<b>8.E.2</b>	Inheritance of faulty mitochondrial genes- Maternal inheritance	502
	➤ Somatostatin			➤ Chloroplast DNA	
	➤ Corticotrophin releasing hormone			➤ Maternal inheritance	
	➤ Growth hormone releasing hormone			➤ Maternal effects in drosophila	
	➤ Prolactin inhibitory factor		<b>8.F</b>	<b>Microbial genetics</b>	<b>504</b>
	➤ Endogenous opioids peptides		<b>8.F.1</b>	Method of genetic transfers	504
	➤ Central nervous system rhythms and neuroendocrine function			➤ Transformation	
				➤ Conjugation	
				➤ Transduction	
				➤ Sex-duction	
<b>Unit 8</b>	<b>Inheritance biology</b>		<b>8.F.2</b>	Mapping genes by interrupted mating	508
<b>8.A</b>	<b>Mendelian principles</b>	<b>482</b>	<b>8.F.3</b>	Fine structure analysis of genes	508
<b>8.A.1</b>	Law of dominance	482	<b>8.G</b>	<b>Human genetics</b>	<b>509</b>
<b>8.A.2</b>	Law of segregation	482			
<b>8.A.3</b>	Law of independent assortment	482			
<b>8.A.4</b>	Deviation from Mendelian Inheritance	483			

<b>8.G.1</b>	Pedigree analysis	<b>509</b>	<b>9.C.2</b>	Plant Kingdom	<b>566</b>
	➤ Expected patterns of various types of inheritance in pedigrees		<b>9.C.3</b>	Classification of plants	<b>566</b>
<b>8.G.2</b>	Low Score for linkage testing	<b>510</b>	<b>9.C.4</b>	Generalized life cycle of thallophytes	<b>569</b>
<b>8.G.3</b>	Karyotypes	<b>511</b>	<b>9.C.5</b>	Animal classification	<b>578</b>
<b>8.G.4</b>	Autosomal and genetic disorders	<b>513</b>	<b>9.C.6</b>	Classification of microorganisms	<b>587</b>
			<b>9.C.7</b>	Evolutionary relationships among taxa	<b>589</b>
<b>8.H</b>	<b>Quantitative genetics</b>	<b>513</b>	<b>9.D</b>	<b>Natural history of Indian subcontinent</b>	<b>590</b>
<b>8.H.1</b>	Polygenic inheritance	<b>513</b>	<b>9.D.1</b>	Major habitat types of the subcontinent	<b>590</b>
<b>8.H.2</b>	Heritability and its measurements	<b>514</b>	<b>9.D.2</b>	Geographic origin and migration of species	<b>592</b>
	➤ Types of heritability		<b>9.D.3</b>	Common Indian mammals and birds	<b>592</b>
<b>8.H.3</b>	QTL mapping	<b>515</b>	<b>9.D.4</b>	Seasonality and phenology of the sub-continent	<b>593</b>
<b>8.I</b>	<b>Mutation</b>	<b>516</b>	<b>9.E</b>	<b>Organisms of health and agriculture importance</b>	<b>594</b>
<b>8.I.1</b>	Types of mutations	<b>516</b>	<b>9.E.1</b>	Seasonality and phenology of the sub-continent	<b>594</b>
<b>8.I.2</b>	Causes of mutations	<b>517</b>	<b>9.E.2</b>	Animal and Human Parasites and Pathogens	<b>594</b>
<b>8.I.3</b>	Mutation detection methods	<b>517</b>	<b>9.F</b>	<b>Organisms of conservation concern</b>	<b>595</b>
<b>8.I.4</b>	Mutant types	<b>520</b>	<b>9.F.1</b>	Rare, endangered species	
<b>8.I.5</b>	Germinal versus Somatic mutants	<b>520</b>	<b>9.F.2</b>	Conservation strategies	
<b>8.I.6</b>	Insertional mutagenesis	<b>521</b>			
	➤ Signature tagged mutagenesis				
	➤ Virus insertion mutagenesis				
	➤ Insertional inactivation				
<b>8.J</b>	<b>Structural and numerical alteration of chromosomes</b>	<b>524</b>			
<b>8.J.1</b>	Deletion	<b>524</b>			
<b>8.J.2</b>	Duplication	<b>524</b>			
<b>8.J.3</b>	Inversion	<b>525</b>			
<b>8.J.4</b>	Translocation	<b>526</b>			
<b>8.J.5</b>	Ploidy and their genetic implications	<b>526</b>			
<b>8.K</b>	<b>Recombination</b>	<b>527</b>			
<b>8.K.1</b>	Homologous recombination	<b>528</b>			
<b>8.K.2</b>	Double stranded break repair by non-homologous end joining	<b>530</b>			
<b>8.K.3</b>	Transposons (mobile DNA elements)	<b>530</b>			
<b>Unit 9 Diversity of life forms</b>			<b>Unit 10 Ecological principle</b>		
<b>9.A</b>	<b>Principles and methods of taxonomy</b>	<b>536</b>	<b>10.A</b>	<b>The environment</b>	<b>600</b>
<b>9.A.1</b>	Concepts of species and hierarchical taxa	<b>536</b>	<b>10.A.1</b>	Physical environment/Abiotic environment	<b>600</b>
	➤ Biological species concept			➤ Atmosphere	
	➤ Subspecies			➤ Light	
	➤ Hierarchical taxa			➤ Temperature	
<b>9.A.2</b>	Biological Nomenclature	<b>536</b>		➤ Water	
				➤ Wind	
<b>9.B</b>	<b>Levels of structural organization</b>	<b>543</b>		➤ Soil	
<b>9.B.1</b>	Unicellular Organisms	<b>543</b>	<b>10.A.2</b>	Biotic environment	<b>604</b>
<b>9.B.2</b>	Multicellular Organism	<b>545</b>	<b>10.A.3</b>	Biotic and Abiotic interactions	<b>604</b>
<b>9.B.3</b>	Organs and system of animals	<b>551</b>	<b>10.B</b>	<b>Habitat and niche</b>	<b>604</b>
<b>9.B.4</b>	Comparative anatomy	<b>560</b>	<b>10.B.1</b>	Concept of habitat and niche	<b>604</b>
<b>9.B.5</b>	Adaptive radiation and modification	<b>563</b>		➤ Habitat	
				➤ Niche	
<b>9.C</b>	<b>Outline classification of plants, animals and microorganisms</b>	<b>563</b>	<b>10.B.2</b>	Niche width and overlap	<b>604</b>
<b>9.C.1</b>	Important criteria used for classification in each taxon	<b>563</b>	<b>10.B.3</b>	Fundamental and realized niche	<b>605</b>
			<b>10.B.4</b>	Resource partitioning	<b>605</b>
			<b>10.B.5</b>	Character displacement	<b>605</b>
			<b>10.C</b>	<b>Population ecology</b>	<b>605</b>
			<b>10.C.1</b>	Characteristics of a population	<b>605</b>
			<b>10.C.2</b>	Population Growth Curves	<b>608</b>
			<b>10.C.3</b>	Population regulation	<b>608</b>
			<b>10.C.4</b>	Life history strategies-r and K selection	<b>609</b>
			<b>10.C.5</b>	Concept of Metapopulation	<b>609</b>
			<b>10.C.6</b>	Demes	<b>609</b>
			<b>10.C.7</b>	Interdemic selections or extinctions	<b>610</b>
			<b>10.C.8</b>	Dispersal	<b>610</b>
			<b>10.C.9</b>	Age structured populations	<b>610</b>
			<b>10.D</b>	<b>Species interactions</b>	<b>610</b>

<b>10.D.1</b>	Types of interaction	<b>610</b>	<b>11.A.1</b>	Lamarckism-theory of inheritance of acquired characters	<b>643</b>
<b>10.D.2</b>	Interspecific competition	<b>611</b>	<b>11.A.2</b>	Darwin-concepts of variation, adaptation, struggle, fitness and natural selection	<b>644</b>
<b>10.D.3</b>	Herbivory	<b>612</b>	<b>11.A.3</b>	Mendelism and spontaneity of mutations	<b>645</b>
<b>10.B.4</b>	Carnivory	<b>612</b>	<b>11.A.4</b>	Evolutionary synthesis	<b>645</b>
<b>10.D.5</b>	Pollination	<b>612</b>	<b>11.B</b>	<b>Origin of cells and unicellular evolution</b>	<b>646</b>
<b>10.D.6</b>	Symbiosis	<b>613</b>	<b>11.B.1</b>	Abiotic synthesis of organic monomers and polymers	<b>646</b>
<b>10.E</b>	<b>Community ecology</b>	<b>613</b>	<b>11.B.2</b>	Oparin Haldane concept	<b>647</b>
<b>10.E.1</b>	Nature of communities	<b>613</b>	<b>11.B.3</b>	Experiment of miller	<b>647</b>
<b>10.E.2</b>	Community structure and attributes	<b>614</b>	<b>11.B.4</b>	Origin of basic biological molecules	<b>648</b>
<b>10.E.3</b>	Levels of species diversity and its measurement	<b>614</b>	<b>11.B.5</b>	Formation of molecular aggregates	<b>648</b>
	➤ Simpson's diversity Index		<b>11.B.6</b>	Evolution of prokaryotes	<b>649</b>
	➤ Shannon diversity index		<b>11.B.7</b>	Origin of eukaryotic cells	<b>650</b>
<b>10.F</b>	<b>Ecological succession</b>	<b>615</b>	<b>11.B.8</b>	Evolution of unicellular eukaryotes	<b>651</b>
<b>10.F.1</b>	Types of ecological succession	<b>615</b>	<b>11.B.9</b>	Anaerobic metabolism	<b>651</b>
<b>10.F.2</b>	Mechanisms and changes involved in succession	<b>615</b>	<b>11.B.10</b>	Photosynthesis	<b>651</b>
<b>10.F.3</b>	Changes involved in succession	<b>617</b>	<b>11.B.11</b>	Aerobic metabolism	<b>651</b>
<b>10.F.4</b>	Concept of Climax	<b>617</b>	<b>11.C</b>	<b>Paleontology and evolutionary history</b>	<b>651</b>
<b>10.G</b>	<b>Ecosystem ecology</b>	<b>617</b>	<b>11.C.1</b>	Evolutionary time scale: eras, periods and epochs	<b>651</b>
<b>10.G.1</b>	Ecosystem structure	<b>617</b>	<b>11.C.2</b>	Major events in the evolutionary time scale	<b>652</b>
<b>10.G.2</b>	Ecosystem functions	<b>618</b>	<b>11.C.3</b>	Origin of unicellular and multicellular organisms	<b>653</b>
<b>10.G.3</b>	Energy Flow	<b>618</b>	<b>11.C.4</b>	Major groups of plants and animals	<b>653</b>
<b>10.G.4</b>	Nutrient Cycling	<b>620</b>	<b>11.C.5</b>	Stages in Primate Evolution Including Homo	<b>653</b>
<b>10.G.5</b>	Primary production	<b>622</b>	<b>11.D</b>	<b>Molecular evolution</b>	<b>654</b>
<b>10.G.6</b>	Decomposition	<b>622</b>	<b>11.D.1</b>	Concept of neutral evolution	<b>654</b>
<b>10.G.7</b>	Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine)	<b>622</b>	<b>11.D.2</b>	Molecular divergence and molecular clocks	<b>655</b>
	➤ Terrestrial Ecosystem		<b>11.D.3</b>	Molecular tools in phylogeny	<b>655</b>
	➤ Aquatic Ecosystems		<b>11.D.4</b>	Origin of new genes in proteins	<b>656</b>
<b>10.H</b>	<b>Biogeography</b>	<b>625</b>	<b>11.D.5</b>	Gene duplication and divergence	<b>657</b>
<b>10.H.1</b>	Major terrestrial biomes	<b>625</b>	<b>11.E</b>	<b>The mechanisms</b>	<b>657</b>
<b>10.H.2</b>	Theory of Island biogeography	<b>626</b>	<b>11.E.1</b>	Population genetics-populations, gene pool, gene frequency	<b>657</b>
<b>10.H.3</b>	Biogeographical zones of India	<b>627</b>	<b>11.E.2</b>	Hardy-weinberg law	<b>658</b>
<b>10.I</b>	<b>Applied ecology</b>	<b>628</b>	<b>11.E.3</b>	Concept and rate of change in gene frequency through natural selection	<b>659</b>
<b>10.I.1</b>	Environmental pollution	<b>629</b>	<b>11.E.4</b>	Migration and random genetic drift	<b>660</b>
<b>10.I.2</b>	Global environmental change	<b>633</b>	<b>11.E.5</b>	Adaptive radiation and modification	<b>661</b>
<b>10.I.3</b>	Biodiversity-status, monitoring and documentation	<b>634</b>	<b>11.E.6</b>	Isolating mechanisms	<b>662</b>
<b>10.I.4</b>	Major drivers of biodiversity changes	<b>635</b>	<b>11.E.7</b>	Speciation	<b>662</b>
<b>10.I.5</b>	Biodiversity management approach	<b>636</b>	<b>11.E.8</b>	Convergent evolution	<b>663</b>
<b>10.J</b>	<b>Conservation Biology</b>	<b>637</b>	<b>11.E.9</b>	Sexual selection	<b>664</b>
<b>10.J.1</b>	Principles of conservation biology	<b>637</b>	<b>11.E.10</b>	Co-evolution	<b>664</b>
<b>10.J.2</b>	Major Approaches to management explained in applied ecology	<b>637</b>	<b>10.F</b>	<b>Brain behavior and evolution</b>	<b>664</b>
<b>10.J.3</b>	Indian case studies on conservation/management strategy (Project Tiger, Biosphere Reserves)	<b>637</b>	<b>10.F.1</b>	Approaches and method in study of behavior	<b>664</b>
	➤ Project Tiger		<b>10.F.2</b>	Proximate and ultimate causation	<b>665</b>
	➤ Biosphere reserves		<b>11.E.3</b>	Altruism and evolution-group selection	<b>666</b>
<b>Unit 11 Evolution and behavior</b>			<b>11.E.4</b>	Evolution group selection and kin selection	<b>667</b>
<b>11.A</b>	<b>Emergence of evolutionary thoughts</b>	<b>643</b>	<b>11.E.5</b>	Reciprocal altruism	<b>667</b>
			<b>11.E.6</b>	Neutral basis of learning	<b>667</b>
			<b>11.E.7</b>	Memory	<b>668</b>

11.E.8	Cognition	668
11.E.9	Sleep and arousal	668
11.F.10	Biological clock	668
11.F.11	Development of behavior	669
11.F.12	Social communication	669
11.F.13	Social Dominance	669
11.F.14	Use of space and territoriality	669
11.F.15	Mating system	670
11.F.16	Parental investment and reproductive success	671
11.F.17	Parental care	671
11.F.18	Aggressive behavior	671
11.F.19	Habit selection and optimality on foraging	672
11.F.20	Migration	672
11.F.21	Orientation and navigation	672
11.F.22	Domestication and behavior changes	673

**Unit 12 Applied biology**

12.A	<b>Microbial fermentation and production of small and macro molecules</b>	677
12.B	<b>Application of immunological principles</b>	685
12.B.1	Tissue and cell culture method for plant and animals	685
	➤ Animal tissue Culture	
	➤ Primary culture	
	➤ Plant tissue culture	
	➤ Laboratory for plant Tissue Culture	
	➤ Callus and Suspension culture	
12.C	<b>Transgenic animals and plants, molecular approaches to diagnosis and strain identification</b>	698
12.C.1	Transgenic animals and plants	698
12.C.2	Molecular approaches to diagnosis and strain identification	703
12.D	<b>Genomics and its application to health and agriculture, including gene therapy</b>	703
12.D.1	Genomics and Its Applications in Agriculture	703
	➤ Application of genomics in agriculture	
	➤ Applications of genomics in healthcare	
12.E	<b>Bioresource and uses of biodiversity</b>	705
12.E.1	Bioresources and uses of biodiversity	705
	➤ Genetically modified products like genetically modified food, diseases and insect resistant varieties	
	➤ Agriculture	
12.F	<b>Breeding in plants and animals, including marker-assisted selection</b>	707
12.F.1	Breeding in plants and animals	707
	➤ Molecular Breeding	
	➤ Marker assisted selection	
12.G	<b>Bioremediation and phytoremediation</b>	709
12.G.1	Bioremediation and Phytoremediation	709

12.H	<b>Biosensors</b>	712
12.H.1	Biosensors	712

**Unit 13 Methods in biology**

13.A	<b>Molecular biology and recombination DNA methods</b>	720
13.A.1	Isolation and purification of RNA and DNA	720
13.A.2	Different separation methods	721
	➤ HPLC (High Performance Length Chromatography)	
	➤ Ion Exchange chromatography (IEC)	
	➤ Affinity chromatography	
	➤ Paper chromatography	
	➤ TLC (Thin Layer Chromatography)	
	➤ Gel-filtration chromatography or size exclusion chromatography	
13.A.3	Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis	725
	➤ Agarose gel electrophoresis	
	➤ Two dimensional gel electrophoresis	
	• Isoelectric focusing	
	• Polyacrylamide gel electrophoresis	
13.A.4	Isoelectric focusing gels	727
13.A.5	Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic system and expression of recombinant proteins using bacterial, animal and plant vectors	728
	➤ Cloning vectors	
	➤ <i>E.coli</i> Plasmid	
	➤ F-gene	
	➤ Vectors	
	➤ Plasmid	
	➤ Artificial Chromosomes	
	➤ Selection	
	➤ PAC (P1 Artificial Chromosome)	
	➤ Bacterial Artificial Chromosome (BAC)	
	➤ Isolation and Screening	
13.A.6	Isolation of specific nucleic acid sequences	734
	➤ Polymerase chain reaction	
	➤ Inverse PCR	
	➤ RT-PCR (Reverse Transcription-PCR)	
	➤ Thermal Cycle Sequencing PCR	
	➤ Touchdown PCR	
	➤ Hot start PCR	
13.A.7	Generation of genomic and cDNA libraries	735
	➤ Gene Libraries	
	• Genomic Libraries	
	• cDNA Libraries	
13.A.8	In vitro mutagenesis and deletion techniques	739
	➤ In vitro mutagenesis	
	➤ Oligonucleotides directed mutagenesis	
13.A.9	Gene knockout in bacterial and eukaryotic organisms	739
	➤ Knockout mouse	
	➤ Names of reporter genes	
13.A.10	Protein sequencing methods	740



➤ The Edman degradation reaction			
<b>13.A.11</b> Detection of post translational modification of proteins	<b>741</b>	<b>13.C.8</b> Surface Plasmon resonance	<b>767</b>
<b>13.A.12</b> DNA sequencing methods	<b>741</b>	<b>13.D</b> <b>Statistical Methods</b>	<b>768</b>
➤ Maxam and Gilbert method of sequencing		<b>13.D.1</b> Measures of central tendency and dispersal	<b>768</b>
➤ Sangar method of DNA sequencing		➤ Measure of central tendency	
<b>13.A.13</b> Strategies for genome sequencing	<b>743</b>	➤ Dispersion	
<b>13.A.14</b> Methods for analysis of gene expression at RNA and protein level, large scale expression such as microarray based techniques	<b>743</b>	➤ Range	
➤ Microarray based technology		➤ Quartile deviation	
<b>13.A.15</b> Isolation, separation and analysis of carbohydrate and lipid molecules	<b>744</b>	➤ Mean deviation	
➤ Isolation		➤ Standard deviation	
➤ Separation and analysis methods		➤ Skewness	
➤ Analysis of Lipids		➤ Method of testing skewness	
➤ Chemical Techniques		➤ Difference methods of measuring	
<b>13.A.16</b> RFLP	<b>747</b>	➤ Kurtosis	
➤ RFLP		<b>13.D.2</b> Probability distribution	<b>775</b>
➤ RFLP Method		➤ Normal distribution	
<b>13.A.17</b> RAPD	<b>748</b>	➤ Standard normal distribution	
➤ RAPD-Random amplified polymorphic DNA		➤ Binomial distribution	
<b>13.A.18</b> AFLP	<b>748</b>	➤ Poisson distribution	
➤ Amplified Fragment Length Polymorphism (AFLP)		<b>13.D.3</b> Sampling distribution	<b>776</b>
<b>13.B</b> <b>Histochemical and immunotechniques</b>	<b>749</b>	<b>13.D.4</b> Parametric and non parametric statistics	<b>776</b>
<b>13.B.1</b> Radioimmunoassay (RIA)	<b>749</b>	➤ Hypothesis testing	
<b>13.B.2</b> Enzyme Linked Immuno Sorbant Assay (ELISA)	<b>750</b>	➤ Test static	
<b>13.B.3</b> Western Blotting	<b>751</b>	<b>13.D.5</b> Confidence intervals	<b>779</b>
<b>13.B.4</b> Immuno-precipitation	<b>752</b>	<b>13.D.6</b> Levels of significance and errors	<b>779</b>
<b>13.B.5</b> immunofluorescence Microscopy	<b>752</b>	<b>13.D.7</b> Correlation and Regression	<b>780</b>
<b>13.B.6</b> Flow Cytometry	<b>752</b>	<b>13.D.8</b> t-distribution	<b>781</b>
<b>13.B.7</b> Fish (Fluorescent in situ hybridization)	<b>752</b>	<b>13.D.9</b> Analysis of variance	<b>783</b>
<b>13.C</b> <b>Biophysical methods</b>	<b>753</b>	<b>13.D.10</b> Chi square test	<b>783</b>
<b>13.C.1</b> Molecular analysis using UV/visible spectroscopy	<b>753</b>	<b>13.D.11</b> Basic introductions to multivariate statistics	<b>784</b>
<b>13.C.2</b> Fluorescence	<b>756</b>	<b>13.E</b> <b>Radiolabeling techniques</b>	<b>785</b>
➤ Spectroscopy/Spectrofluorimetry		<b>13.E.1</b> Detection and measurement of different types of radioisotope normally use in biology	<b>785</b>
➤ Phenomenon of fluorescence		➤ Natural types of radioactivity	
<b>13.C.3</b> Circular Dichroism Spectroscopy	<b>757</b>	➤ Radioactivity measurement	
<b>13.C.4</b> ESR and NMR spectroscopy	<b>758</b>	➤ Radioactive half-life	
➤ NMR-Nuclear Magnetic Resonance		➤ Radioactive decay chain	
➤ Principle of Electron Spin Resonance		<b>13.E.2</b> Incorporation of Radioisotopes in Biological Tissues and cells	<b>788</b>
➤ Application of ESR Spectroscopy		<b>13.E.3</b> Safety Guidelines	<b>790</b>
<b>13.C.5</b> Molecular structure determination using x-ray diffraction and NMR	<b>762</b>	<b>13.F</b> <b>Microscopic techniques</b>	<b>790</b>
➤ Nuclear Magnetic Resonance (NMR)		<b>13.F.1</b> Microscopy	<b>790</b>
➤ Molecular structure determination by NMR		<b>13.F.2</b> Different fixation and staining techniques for EM	<b>794</b>
➤ Quantitative analysis		<b>13.F.3</b> Freeze-etch and freeze-fracture methods for EM	<b>795</b>
<b>13.C.6</b> Molecular analysis using light scattering	<b>764</b>	<b>13.F.4</b> Image processing methods in microscopy	<b>796</b>
➤ Static Light scattering (SLS)		<b>13.G</b> <b>Electrophysiological methods</b>	<b>796</b>
➤ Dynamic Light scattering		<b>13.G.1</b> Single neuron recording	<b>796</b>
➤ Mass spectrometer		<b>13.G.2</b> Patch clamping Technique	<b>796</b>
➤ Instrumentation		<b>13.G.3</b> ECG-Electrocardiogram	<b>797</b>
<b>13.C.7</b> Types of mass spectrometer	<b>766</b>	<b>13.G.4</b> Brain activity recording	<b>798</b>
➤ Tandem mass spectrometry		<b>13.G.5</b> Lesions and stimulations of brain	<b>798</b>
➤ Gas chromatography		<b>13.G.6</b> Pharmacologic Testing	<b>799</b>
		<b>13.G.7</b> Positron Emission Tomographic Scanning (PET)	<b>799</b>
		<b>13.G.8</b> Magnetic Resonance Imaging (MRI)	<b>799</b>

<b>13.G.9</b>	Functional MRI (fMRI)	<b>800</b>
<b>13.G.10</b>	Computed Tomographic Scanning (CT Scan)	<b>800</b>

**Unit 14 General Aptitude**

<b>14.A</b>	<b>Logical Reasoning</b>	<b>804</b>
<b>14.A.1</b>	Deductive logic	<b>806</b>
<b>14.A.2</b>	Syllogism	<b>808</b>
<b>14.A.2</b>	Inductive logic	<b>809</b>
<b>14.A.4</b>	Logical Venn diagrams	<b>810</b>
<b>14.B</b>	<b>Data Interpretation and Analysis</b>	<b>811</b>
<b>14.B.1</b>	Measure of central tendency	<b>812</b>
<b>14.B.2</b>	Measures of dispersion	<b>815</b>
<b>14.B.3</b>	Data analysis	<b>815</b>
<b>14.C</b>	<b>Numerical Ability</b>	<b>817</b>
<b>14.C.1</b>	Number and Simplification	<b>817</b>
<b>14.C.2</b>	H.C.F. and L.C.M	<b>820</b>
<b>14.C.3</b>	Average	<b>821</b>
<b>14.C.4</b>	Percentage	<b>822</b>
<b>14.C.5</b>	Profit and Loss	<b>822</b>
<b>14.C.6</b>	Simple Interest	<b>823</b>
<b>14.C.7</b>	Compound Interest	<b>824</b>
<b>14.C.8</b>	Ratio and Proportion	<b>825</b>
<b>14.C.9</b>	Alligation or Mixture	<b>826</b>
<b>14.C.10</b>	Time and Work	<b>828</b>
<b>14.C.11</b>	Quadratic Equations	<b>829</b>
<b>14.C.12</b>	Logarithms	<b>830</b>
<b>14.C.13</b>	Permutations and Combinations	<b>831</b>
<b>14.C.14</b>	Probability	<b>835</b>
<b>14.D</b>	<b>Numerical Reasoning</b>	<b>843</b>
<b>14.D.1</b>	Series formation	<b>843</b>
<b>14.D.2</b>	Distance and direction	<b>844</b>
<b>14.D.3</b>	Schedule day/Date/Time	<b>845</b>
<b>14.E</b>	<b>Quantitative Comparison</b>	<b>846</b>
<b>14.F</b>	<b>Progression</b>	<b>848</b>
<b>14.G</b>	<b>Puzzles</b>	<b>849</b>
<b>14.H</b>	<b>Geometry</b>	<b>851</b>