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# B.M.S. College of Engineering, Bengaluru-560019

**Autonomous Institute Affiliated to VTU**

## January / February 2025 Semester End Main Examinations

**Programme: B.E.** **Semester: V**

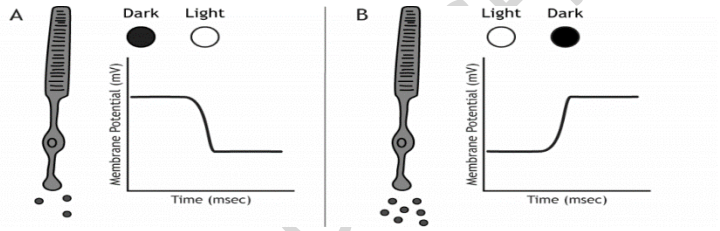
**Branch: BIOTECHNOLOGY** **Duration: 3 hrs.**

**Course Code: 23BT5PESTN / 22BT5PESTN** **Max Marks: 100**

**Course: Signal Transduction**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

**Important Note:** Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

| | | | UNIT - I | *CO* | *PO* | Marks |
|---|---|---|---|---|---|---|
| 1 | a) | | Discuss the polarization state of Photoreceptors in response to when moving from light to dark or vice versa in the below given image.   | *CO1* | *PO 1* | **8** |
| | b) | | Tropicamide is an alkaloid atropine-derived anticholinergic drug and a non-selective antagonist of muscarinic acetylcholine (mACh) receptors. Apart from routine eye testing, it is given as topical application during cataract surgery for pupil dilation. Discuss the possible signalling mechanism involved in the process? | *CO1* | *PO 1* | **7** |
| | c) | | The concentrations of salts of $K^+$ and $Na^+$ in saline used for frog and mammalian experiments outside and inside the cell are 5mMand 140mM for $K^+$ and 140 and 14 for $Na^+$. Calculate the equilibrium potential and interpret the results. | *CO1* | *PO1* | **5** |
| | | | **OR** | | | |
| 2 | a) | | Mention with one line reason, to which type of action the following falls (Reflex/Non reflex):<br>1.Digestion of food<br>2. Sudden exposure to bight light<br>3. Knee jerk due to hit on patella<br>4. Yawning when we see someone else yawning | *CO1* | *PO1* | **8** |

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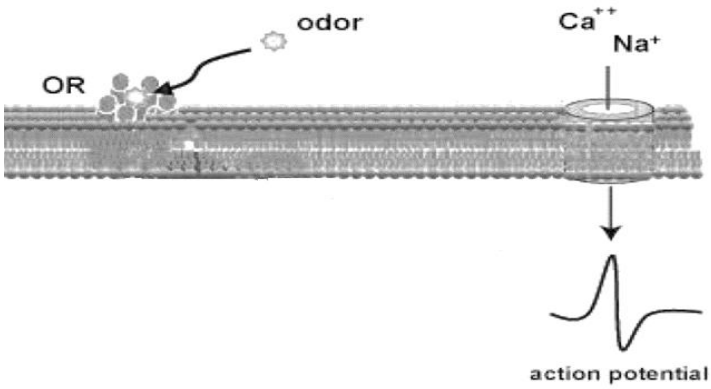
| | | b) | Odour sensing is located in the different parts of the brain and based on the types, signalling responses are sent for identifcation. Justify the statement using the below image as reference.<br>  <br> | *CO1* | *PO1* | **7** |
| | | c) | The squid axon placed in seawater has concentrations of ions such as $K^+$ and $Ca^{++}$ in seawater outside and inside the cell, wherein 20mMand 400mM is for $K^+$ and 440mM and 50mM for $Ca^{++}$. What is the equilibrium potential? How does it effects the movement of ions in and out of axon? | *CO1* | *PO1* | **5** |
| | | | **UNIT - II** | | | |
| | 3 | a) | Ryanodine receptors (RyRs) are located in the sarcoplasmic reticulum membrane and are responsible for the release of Ca2+ from intracellular stores during excitation-contraction coupling in both cardiac and skeletal muscle. Discuss the signaling mechanism involved. | *CO2* | *PO 2* | **8** |
| | | b) | Identify the receptor/ receptors class for the following ligands in signaling mechanism:<br>1. Insulin<br>2. Epinephrine<br>3. Estrogen<br>4. Growth factors | *CO2* | *PO 2* | **12** |
| | | | **OR** | | | |
| | 4 | a) | IGF binds and interacts through IGFR /IRS and switches on several downstream pathways. Discuss the pathway and the various types of responses through the signaling | *CO2* | *PO 2* | **8** |
| | | b) | Deliberate on a signaling pathway involving the following types of ligands/Signals/ Second messengers/Intermediate of the pathway.<br>1. Ca<br>2. NO<br>3. Ethylene<br>4.DAG | *CO2* | *PO 2* | **12** |

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| | | | **UNIT - III** | | | |
| | 5 | a) | Signalling by cytokine receptors depends upon their association with the *Janus* kinases which couple ligand binding to tyrosine phosphorylation of signalling proteins recruited to cytokine receptor complex such as STAT. Design the pathway and elaborate on the statement. Discuss the class of cytokine receptor which signals through JAK-STAT. | *CO3* | *PO 3,5,12* | **8** |
| | | b) | With a suitable figure, explain the nuclear receptor and their responses for which ligands are not yet discovered. | *CO2* | *PO 2* | **5** |
| | | c) | The crosstalk between different signaling pathways intricately exist in a complex cell. With at least 2 different downstream signaling pathways design a network that can lead to activation of targeted genes. | *CO3* | *PO 3,5,12* | **7** |
| | | | **OR** | | | |
| | 6 | a) | Discuss type I category of Nuclear receptor and their signaling mechanism. | *CO2* | *PO 2* | **5** |
| | | b) | A signaling pathway can converge to and diverge from a common pathway. With a suitable example design pathway in each and show how the different downstream signaling leads to activation of genes. | *CO3* | *PO 3,5,12* | **8** |
| | | c) | Categorize different types of cytokine receptor and discuss their role in cells signaling. | *CO2* | *PO 2* | **7** |
| | | | **UNIT - IV** | | | |
| | 7 | a) | How does G2/M transition checkpoints prevent the damaged DNA from entering into newly formed daughter cells? Design the network that involves switching ON/OFF of target genes with respect to DNA damage. | *CO 3* | *PO 3,5,12* | **12** |
| | | b) | Proteolysis regulates the components of cell cycle at regular interval. Justify the statement with example. | *CO2* | *PO 2* | **8** |
| | | | **OR** | | | |
| | 8 | a) | Discuss and design signaling pathways that describes the transition checkpoint G1/S in a mammalian cell overexposed to UV light. | *CO3* | *PO 3,5,12* | **12** |
| | | b) | Deliberate on the role of Cip/Kip and INK in the regulation of cell cycle. | *CO2* | *PO 2* | **8** |
| | | | **UNIT - V** | | | |
| | 9 | a) | Tumor suppressor gene signaling regulates cell division and other cellular functions to prevent cancer. Once mutated, cells can grow out of control leading to cancer. Validate the statement with an example showing the signaling mechanism involved. | *CO3* | *PO 3,5,12* | **10** |

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| | | b) | With suitable figures discuss the mechanism involved in signaling pathway inactive in postnatal tissues except adult central nervous system, skin and hair. | *CO 2* | *PO 2* | **10** |
| | | | **OR** | | | |
| | 10 | a) | In canonical Wnt/β-catenin pathway, catenin binds to TCF to upregulate genes for cell differentiation. Discuss and add a note on its importance in colo -rectal cancer. | *CO3* | *PO 3,5,1 2* | **10** |
| | | b) | NF-κB, an inducible transcription factor play crucial role in inflammation development and its progression. Discuss. | *CO 2* | *PO 2* | **10** |

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