Q1. Explain the concept of cybernetics in ecosystems

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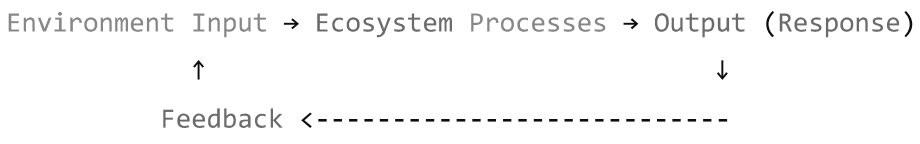
a) Define cybernetics and its relevance to ecology. (3 marks)

Answer:
Cybernetics is the scientific study of control and communication in systems, both living and non-living. In ecology, cybernetics refers to how ecosystems maintain stability and adapt to changes through feedback mechanisms, energy flows, and information exchange among components.

Relevance to ecology:

- Helps in understanding **self-regulation** of ecosystems.
- Explains how ecosystems respond to **disturbances** (e.g., pollution, climate change).
- Provides a framework for **modeling ecological balance** using feedback loops.

Schematic diagram:



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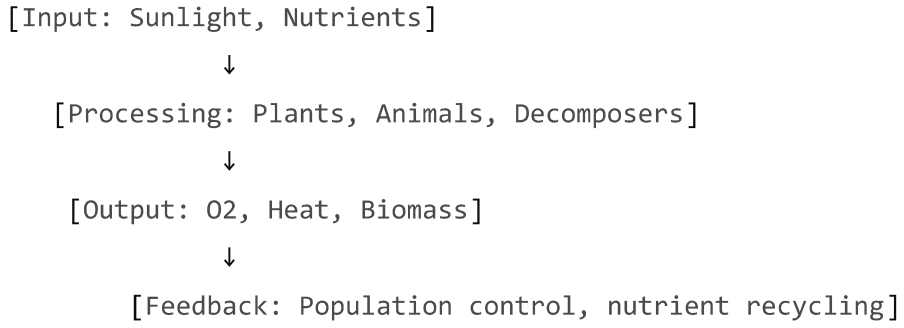
b) Describe the components of a cybernetic ecosystem with examples. (4 marks)

Answer:
A cybernetic ecosystem consists of the following components:

1. **Input –** Energy or materials entering the system.
   - Example: Solar radiation, rainfall, nutrients.
2. **Processing unit –** Biotic and abiotic interactions that transform inputs.
   - Example: Photosynthesis by plants, nutrient cycling by decomposers.
3. **Output –** Energy or matter released back.
   - Example: Oxygen, heat loss, organic waste.
4. **Feedback mechanism –** Regulatory processes ensuring system stability.
   - Example: Predator–prey population control.

Schematic diagram:



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c) Discuss the significance of feedback mechanisms in ecosystem regulation. (3 marks)

Answer:
Feedback mechanisms are crucial for maintaining ecological balance:

- **Negative feedback**: Restores balance by counteracting changes.
  - Example: Increase in herbivores → more predation → herbivore population decreases → balance restored.
- **Positive feedback**: Amplifies changes, may lead to instability.
  - Example: Melting of polar ice reduces albedo → increases warming → accelerates ice melt.

Significance:

- Maintains **homeostasis** of ecosystems.
- Regulates **population dynamics** and **energy flow**.
- Helps ecosystems **adapt to environmental change**.

Schematic diagram: