Modular Biosensors

Prelims – *Current events of national and international importance| Science & Technology.*

Why in News?

Recently, Researchers from Imperial College London and Zhejiang University developed genetically engineered bacteria, a step towards building cheap and programmable bioelectronic devices.

- **Biosensors –** Analytical devices that consist of a combination of biological detecting elements, like a sensor system and a transducer.
- It can be defined as self-sufficient integrated devices that can provide specific qualitative or semi-quantitative analytical information.
- It uses a biological recognition element that is in direct spatial contact with a transduction element.
- **Whole Cell biosensors –** It is analytical devices that utilize living microorganisms to detect and quantify specific biological or chemical substances.
- It leverages the natural biological response of cells to changes in their environment, converting biochemical signals into measurable electrical signals.
- It can maintain and repair itself & operate inside contaminated samples.
- **Issues with Traditional biosensors –** It is based on enzymes, are often fragile, costly and have a slow response time in complex environments.
- **Modular biosensor –** It could sense the presence of specific compounds and convert that into an electrical signal, which is compatible with low-cost electronics.
- **Source organisms –** The term used genetically engineered **Escherichia coli (E coli) bacteria** as containers to host the biosensor modules. These microbes hosted 3 biosensor modules.
    - **Sensing module –** It detected a target chemical through specific molecular regulators.
    - **Information Processing Module –** It amplified or processed the

signal.
    - **Output module –** It produced phenazines, nitrogen-containing organic molecules that can be measured using an electrochemical technique called voltammetry.
- **Two sensors are built by researchers**
    - **1st sensors - Arabinose** – A simple plant sugar often used in lab media.
    - A sample containing the sugar came in contact with the bacteria, and the cells started producing phenazine-1-carboxylic acid.
    - When this molecule touched the electrode, the latter produced a current that rose with the sugar level.
    - The signal appeared in roughly 2 hours.
    - **2nd sensor – Mercury ions –** These ions are present only in trace quantities in real-world water.
    - The mercury bound with a protein called MerR, triggering the production of a polymerase that pushed the phenazine production pathway into overdrive.
    - 25 nanomoles of mercury, which is below the WHO safety limit, produced a readable current within 3 hours.
- **Logic gate—**The 'AND' logic gate inside *E. coli*, produced a signal only when two specific molecules were present together.
- It is established a proof of concept of a living, electronically integrated biosensor capable of detecting compounds in its surroundings, processing the signals, and supplying data.

Reference

The Hindu| Modular Biosensor