Ref No.: Ex/PG/Nano/T/128A/2024

M.TECH. IN NANO SCIENCE AND TECHNOLOGY FIRST YEAR SECOND SEMESTER – 2024

SUBJECT: NANOSENSOR AND NANODEVICES

Full Marks: 100 **Time: 3 Hours**

Answer any five questions

Marks: 20X5=100

1. Explain the characteristics of nanoensors. Write about the differences between sensors, actuators and transducers. Describe about the working principles of temperature sensor and gas sensor. Explain the structures of two main types of Pressure Sensors.

4+6+4+6

2. Explain the formation of depletion region in a PN junction diode. How photons are detected using a photodiode? How Carbon Nanotubes can be used in photodiodes? Explain the structure and operation of PN photodiode and Avalanche photodiode with proper diagrams. 4+6+4+6

3. Write about the three types of heterojunctions with band diagrams. Explain the energy band diagrams of a Schottky diode. How Schottky barrier diode can be used as a sensor? Draw and explain the band diagrams of a Metal-n type semiconductor Ohmic contact under different biasing conditions. 4+6+4+6

4. Write about the three major steps related to microfabrication technologies. Explain the differences between bulk and surface micromachining. How surface micromachining can be used to make cantilever like structures in MEMS devices-explain the steps with proper diagrams. Describe the fabrication process of a piezoresistive MEMS pressure sensor.

4+6+4+6

5. What the differences between enhancement and depletion mode MOSFET. Explain the current-voltage characteristics of MOSFET with proper diagrams. Explain the pinch off condition from the I-V characteristics of MOSFET. Explain the operation of a CMOS inverter. 4+6+4+6

6. How solar cells are used to convert light energy into electrical energy? Calculate the maximum power that can be delivered to a load through a solar cell. Explain conversion efficiency and fill factor (FF) of a solar cell. Write about structures of Tandem solar cells and Thin Film solar cells. 4+6+4+6

7. How a MOS Capacitor is used to store photoelectrons in a Charged Coupled Device (CCD)? How charge coupling is done in a CCD? Explain the basic principle of operation of a Resonant Tunneling Diode (RTD). Draw the structures and explain the working principles of different types of molecular transistors. 6+4+4+6