Ref. No. : Ex/PG/Nano/T/128A/2018

M.TECH. NANO SCIENCE AND TECHNOLOGY FIRST YEAR SECOND SEMESTER – 2018

(2^{nd} Semester)

NANOSENSORS & NANODEVICES

Time: Three hours Full Marks: 100

Answer any *ten* questions.

1. What is quantum interference based logic gates? What is its operational principle? 2+8

2. What are the different types of biosensor? How they are classified? What is the basic principle to detect bacteria or virus? 2+ 2 + 6

3. What do you mean by Coulomb blockade? How Coulomb blockade control single electron transfer through quantum dot? 2 + 8

4. Draw schematic diagram of single electron transistor. Discuss its basic operational principle and draw I – V characteristic. 4+6

5. What is a transducer? What are the differences between a sensor and an actuator? Draw and explain the block diagram of a typical electronic sensor system. Mention the characteristics of light sensors and temperature sensors. 1+3+3+3

6. What is NEMS? What are the differences between MEMS and ICs? Mention the different steps of microfabrication process. Write the differences between isotropic and anisotropic etching. 2+2+2+4

7. Explain the differences between surface and bulk machining. Explain the different steps to fabricate a Piezoresistive Pressure Sensors with proper diagrams. Mention few applications of MEMS devices. 3+5+2

8. Explain the Hall Effect with proper diagrams and mention its application. Mention the properties and applications of micro fluids. Write about the operation of a sensor used in bio-medical applications. 5+3+2

9. What are optical tweezers? Mention the basic principles of optical tweezers. What is an accelerometer? Draw the diagram of an organic thin film transistor. 2+3+2+3

10. What is effective mass? What are direct band gap and indirect band gap semiconductors? For opto-electronic applications which are the preferred semiconductors and why? What is spintronics? 2+ 6+1+1

11. What are narrow band gap and wide band gap semiconductors and what are their application in devices? Explain the operation of a photodiode. Name the different types of photodiodes. 2+1+5+2

12. Explain the operation of device consisting of metal insulator semiconductor structure, with proper diagrams. What is a CMOS? Mention the applications of transistor as sensor. 5+ 4+1