UNIVERSITY OF GHANA

SCHOOL OF ENGINEERING SCIENCES

BSc. (ENG) FIRST SEMESTER EXAMINATIONS: 2014/2015

MTEN 311: SOLID STATE TECHNOLOGY (3 Credits)

Answer All Questions **Time Allowed: 2.5 Hours**

SECTION A: 30 MARKS

1. State Gordon Moore's law and its significance to modern day electronics? *2Marks*

2. Explain the distinction between classical physics and the Quantum Mechanics in terms of Heisenberg Uncertainty principles. *3Marks*

3. Why are semiconductors the principal materials used in modern day electronic gadgets? *2Marks*

4. Describe the phenomenon of superconductivity. *3Marks*

5. In your own words explain the wave-particle duality. *2Marks*

6. Describe and explain the Meissner Effect in superconductivity. *3Marks*

7. Explain the distinction between classical physics interpretation of a physical system as against Schrodinger interpretation with regards to quantum tunneling. *3Marks*

8. What are the four (4) most typical methods for adjusting the conductivity of semiconductors? *2Marks*

9. Describe the MOS Capacitor and its three (3) regimes of operation using a p-type semiconductor. *6Marks*

10.
   a. What is the single most important characteristic of a PN junction? *2Marks*
   b. Describe the equilibrium, forward and reverse bias states of the PN junction. *2Marks*

Examiner: Dr. Johnson Kwame Efavi

Section B: 40 Marks

1. Solar (or photovoltaic) cells convert the sun's energy into electricity. Whether they're adorning your calculator or orbiting our planet on satellites, they rely on the photoelectric effect. Explain with diagrams the fundamental basis for the operation of a solid state Solar Cell. *10Marks*

2. A **LASER** is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation and are different from other light sources. *10Marks*
   (a) Explain the four most important characteristics of a laser beam
   (b) Using schematic diagrams explain the fundamental principles underlying LASER operation.

3. The purpose of a fuel cell is to produce an electrical current from a chemical reaction that can be directed outside the cell to do work, such as powering an electric motor or illuminating a light bulb or a city. Describe the fundamental basis of a fuel cell operation using schematic diagrams. *10Marks*

4. A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it and it can be used for a number of application such as lightning, signals, data communications, indicator signs etc. Describe the principles underpinning LED operation. *10Marks*

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