

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF

EENG 292: PHYSICAL ELECTRONICS II

STREAMS:

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 08/04/2020

8.30 A.M. – 10.30 A.M.

INSTRUCTIONS:

1.
 - (a) What is a Schottky Diode? (1 mark)
 - (b) Systems using high-concentration photovoltaic (HCPV) have the potential to become competitive in the near future. Explain. (2 marks)
 - (c) A 430-nm violet light is incident on a calcium photo electrode with a work function of 2.71 eV. Find the energy of the incident photons and the maximum kinetic energy of ejected electrons. (4 marks)
 - (d) Imagine a normal incidence light is passing into a diamond crystal having an index of refraction $n = 2.41$. Find the percentage of light that is reflected. (3 marks)
 - (e) State the advantage and disadvantages of avalanche photodiode. (3 marks)
 - (f) Discuss the Unique Characteristics of the beam of Laser Light produced by the Laser diode. (4 marks)
 - (g) List and explain performance parameters of a photodiode. (3 marks)
 - (h) Explain the operation of a MESFET both in *Enhancement mode and Depletion mode*. (5 marks)
 - (i) List and explain five application of LEDs. (5 marks)
2.
 - (a) The metal-semiconductor (MS) contact is an important component in the performance of most semiconductor devices in the solid state.

- (i) Show the equilibrium energy band diagram for a metal to an p-type semiconductor where (4 marks)
- (a) $\Phi_m < \Phi_s$ and
- (b) $\Phi_m < \Phi_s$
- (ii) Find the expression of the barrier height Φ_B of the rectifying p-type contact. (4 marks)
- (iii) When a MS contact is formed for $\Phi_m = \chi$, under what conditions will the contact behaves as the Ohmic contact, and under what conditions will the contact behaves as the rectifying?
- (b) Discuss the principle of operation and design of a QDIP. (7 marks)
- (c) What is the minimum wavelength absorbed by Ge, for which $E_g = 0.67$ eV? (3 marks)
3. (a) With the aid of a well labelled diagrams explain the operation of Schottky Diode. (8 marks)
- (b) Briefly describe how a High Electron Mobility Transistor (HEMT) operate. (4 marks)
- (c) Discuss four types of Thin-Film solar cells that are commercially used in several technologies. (8 marks)
4. (a) Using a figure for illustrate explain the operation of a PIN photodiode. (10 marks)
- (b) The Schottky photodiode is unique as a photodetector as it is able to operate in two photo-detection modes. Explain. (4 marks)
- (c) State three Applications of HEMT. (3 marks)
- (d) Why is Quantum well infrared photodetector (QWIP) important? (3 marks)
5. (a) Explain the working of a photo-detector and give example of photodetectors. (5 marks)
- (b) State and describe at least 3 types of semiconductor laser. (3 marks)
- (c) With the help of a well labelled diagram explain the principles of photoelectric emission in semi-conductors. (6 marks)
- (d) With a well labelled diagram discuss the construction of a LED. (6 marks)
-