THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

MAIN EXAMINATION

JANUARY – APRIL 2020 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND LIBRARY SCIENCE

REGULAR PROGRAMME

CMT 200: SEMICONDUCTOR THEORY

Date: APRIL 2020	Duration: 2 Hours
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) i) Explain the term integrated circuit. **(2 marks)**

ii) Differentiate between active and passive components giving an example in each case. **(4 marks)**

iii) Why is the temperature coefficient of resistance of a semiconductor negative? **(2 marks)**

b) Using the concept of energy-band diagram, explain why some materials behave as conductors, some as insulators and some as semiconductors. **(6 marks)**

c) The intrinsic concentration of free electrons for silicon at room temperature is 1.5×10^{16} per m^3. The mobilities of free electrons and holes are $0.13 m^2/Vs$ and $0.05 m^2/Vs$, respectively. The atomic density in silicon is 5×10^{28} per m^3. If it is doped with antimony with the concentration of 1 antimony atom per 2×10^8 silicon atoms, determine the conductivity of this intrinsic semiconductor. **(6 marks**)

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d) Explain why a pentavalent impurity is known as donor type and trivalent as acceptor type. **(4 marks)**

e) The atomic number of Silver is 47. Determine its orbital distribution of electrons. **(2 marks)**

f) Determine the resistivity of a sample of N-type germanium at 300K with donor density of $N_D = 10^{20}/m^3$; all donors are assumed ionized. Given that $\mu_n = 0.38m^2/Vs$. **(4 marks)**

Q2. a) State four types of diodes, draw their circuit symbols and their applications. **(8 marks)**

b) Describe Full wave rectification. **(8 marks)**

b) Explain the difference between static and dynamic resistances of a diode. **(4 marks)**

Q3. a) Draw a block diagram of a dc power supply and state the function of each block. **(8 marks)**

b) Name any three types of thyristors, draw their circuit symbols and explain their applications. **(9 marks)**

c) State the diode equation indicating the symbols used. **(3 marks)**

Q4. a) Use appropriate diagrams to differentiate enhancement mode MOSFETS and depletion mode MOSFETS. **(12 marks)**

b) The figure below shows a voltage – amplifier.
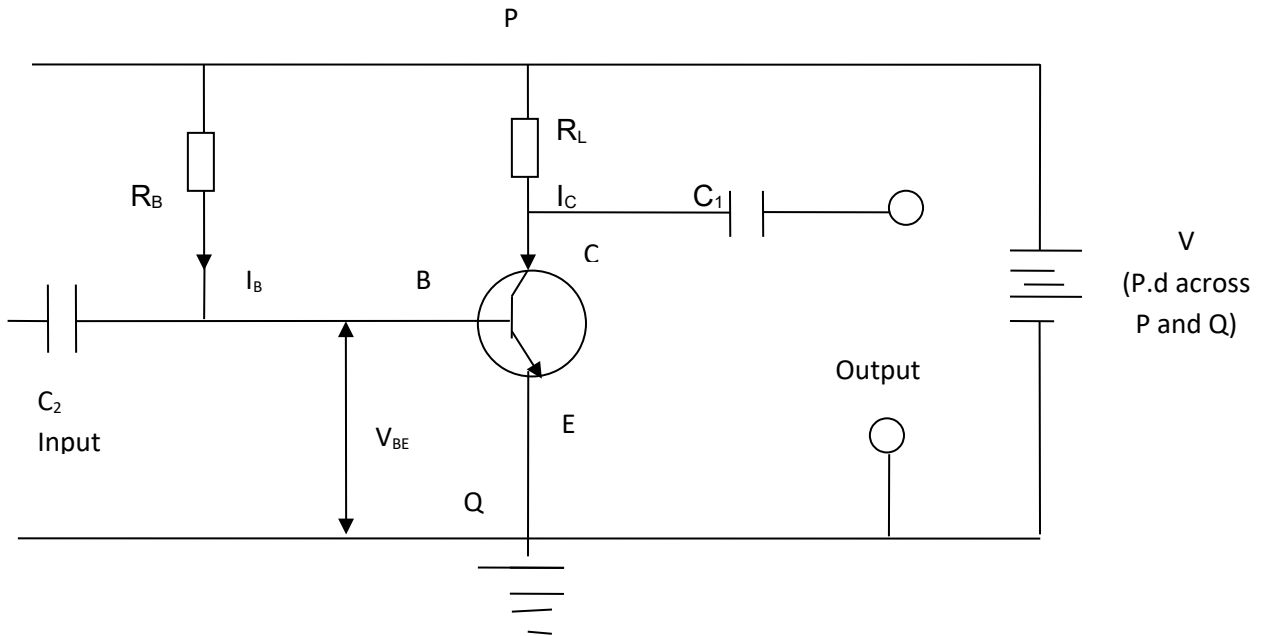
Given that $I_c = 1.5 \times 10^{-3}A$, $V_{CE} = 6V$, $V = 10V$, $V_{BE} = 0.6$, $I_B = 1.5 \times 10^{-5}A$, then,

i) State the functions of the capacitors C_1 and C_2 in the circuit. **(4 marks)**

ii) Calculate the values of R_L and R_B. (**4 marks**)

Q5. a) Differentiate bipolar transistors and field effect transistors. **(8 marks)**

b) State the three amplifier configurations and briefly describe their applications. **(12 marks)**

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