**KABARAK**  **UNIVERSITY**

# EXAMINATIONS

## 2008/2009 ACADEMIC YEAR

## FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

**COURSE CODE:** **PHYS 120**

**COURSE TITLE:** **BASIC ELECTRONICS**

**STREAM:** **Y1S2**

**DAY:** **FRIDAY**

**TIME:** **9.00 – 11.00 A.M**

**DATE:** **27/03/2009**

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**INSTRUCTIONS**

Answer **QUESTION 1** and **ANY OTHER TWO**

*You may need the following constants:*

Electronic charge e = $^{-}1.6 \times 10^{-19}$C.

$\pi = 3.14$

Boltzmann constant k = $1.38 \times 10^{-23}$ j/K

Constant of material for Germanium $\eta_{Ge} = 1$

1 electron volt =$1.6 \times 10^{-19}$ Joules

**PLEASE TURN OVER**

**Question 1 (30 marks)**

(a) Give any FOUR advantages of associated with the use of semiconductor devices over their vacuum based counterparts in electronics industry. (2 marks)

(b) Explain why increase in temperature leads to increase in conductivity in semiconductors while the opposite happens in metals. (2 marks)

(c) Explain the term ENERGY GAP as applied in semiconductors. (1 mark)

(d) Starting with pure silicon material, describe how a p-type semiconductor can be achieved. (3 marks)

(e) A diode whose threshold voltage is 0.7 V is connected in a circuit with a voltage source of 3 V. Estimate the barrier potential when the diode is

(I) Reverse biased (1 mark)
(II) Forward biased (1 mark)

(f) Determine current *I* in the circuit below (Fig. 1) if

(I) the diode is ideal (2 marks)
(II) $V_{th}$ = 0.4 V, diode forward resistance = 20 Ω. (2 marks)

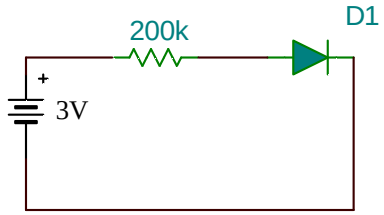



Fig. 1

(g) State THREE factors that the $\beta_{dc}$ depends on. (3 marks)

(h) Draw transistor circuits to illustrate the following bias modes:

(I) voltage divider bias (2 marks)
(II) collector feedback bias (2 marks)

(i) Give any THREE differences between a JFET and a BJT. (3 mks)

(j) Give FOUR advantages of employing negative feedback schemes in amplifiers. (4 marks)

(k) Sketch the drain curves for a small signal E-MOSFET. (2 Marks)

**Question 2 (20 marks)**

(a) Compare the I/V characteristic curves of a Si and Germanium diodes (5 marks)

(b) (i) Describe the operation of a bridge rectifier (5 marks)

(ii) A bridge rectifier uses four identical diodes of forward resistance of 5 Ω each. It is supplied from a transformer with an output of 20 V(rms) and secondary winding of 10 Ω. Calculate,

I. the dc load current $I_{dc}$ (2 marks)
II. Dc output voltage $V_{dc}$ (2 marks)

(iii) Sketch and explain the output of the rectifier when a filter capacitor is connected across the load. (2, 2 marks)

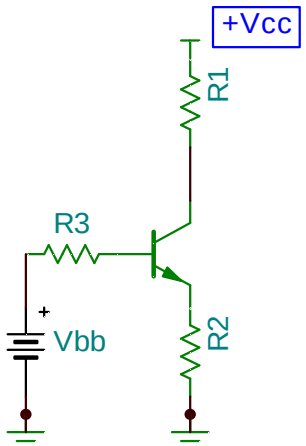
**Question 3 (20 marks)**

(a) (i) Draw a circuit of an n type E-MOSFET with positive $V_{gs}$ bias. (2 marks)

(ii) Explain how the $V_{gs}$ bias regulates charge motion in the E-MOSFET. (3 marks)

(b) (i) State THREE factors that the DC transistor gain $\beta_{dc}$ depends on. (3 marks)

((ii) For the circuit shown below, $R_1$= 3k, $R_2$= 500 Ohms, $R_3$= 200k, β =100, $V_{BE}$ = 0.7 V, $V_{bb}$= 5V and $V_{CC}$ = 10 V.




(i) Find the transistor currents $I_B$, $I_C$ and $I_E$. (7 marks)

(ii) Determine $V_{CB}$ (2 marks)

(iii) Draw the load-line and estimate the Q point (3 marks)

**Question 4 (20 marks)**

(a) (i) State TWO golden rules which idealize the op-amp behavior. (2 marks)

(ii) Show that the gain for an inverting amplifier is of the form

$$Gain = \frac{-R_2}{R_1}$$

where $R_1$ and $R_2$ are input and feedback resistors respectively. (4 marks)

(iii) Draw a circuit of an op-amp integrator and deduce the voltage output expression in integral form. (6 marks)

(b) Show that the gain of an amplifier with negative feedback depends only on the intrinsic gain *A* and the feedback factor$\beta$, hence calculate the closed loop gain if A=100 and $\beta = 0.1$ (6, 2 marks)