KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION SCIENCE

COURSE CODE: PHYS 422

COURSE TITLE: SEMICONDUCTOR DEVICES

STREAM: SESSION VIII

DAY: SATURDAY

TIME: 2.00 – 4.00 P.M.

DATE: 28/11/2009

INSTRUCTIONS:

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

PLEASE TURN OVER

QUESTION 1

(a) Define the following terms:-
  (i) *Recombination* process. (1mark)
  (ii) *Lifetime* of electron- hole-pair. (1mark)

(b) Differentiate between extrinsic and intrinsic semiconductors. (2 marks)

(c) Name the three modes of operation of the bipolar transistor and give the biasing conditions of each. (6 marks)

(d) Explain the ***four*** important properties of the FETs. (8 marks)

(e) Give three reasons why Si and Ge have advantage over other elements in the development of semiconductor devices. (4 marks)

(f) Why is the ripple factor of a power supply an important specification? (2 marks)

QUESTION 2

(a) By show of diagrams describe positive and negative clipper circuits. (6marks)

(b) A certain P-N junction has a leakage current of 10^{-14} A at room temperature of 27^{o} C and 10^{-9} A at 125^{o} C. The diode is forward biased with a constant-current source of 1 mA at room temperature. If the current is assumed to be constant, calculate the junction barrier voltage at room temperature and at 125^{o} C. (6 marks)

QUESTION 3

(a) Determine the quiescent operating point for the circuit of fig. 2 and the sketch the loadline. (7marks)

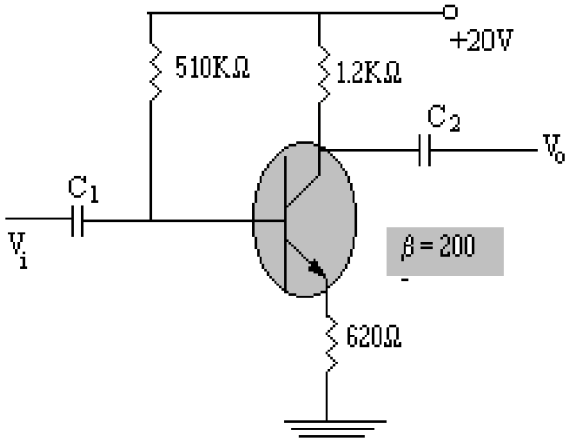

Fig. 2

(b) Show that the stability factor is given by $S = \dfrac{(1+\beta)}{(1-\beta)\dfrac{\Delta I_B}{\Delta I_C}}$ (5 marks)

QUESTION 4

(a) Differentiate between the *enhancement mode* MOSFET and *depletion mode* MOSFET. (2marks)

(b) Design a self-bias circuit such as to operate a JFET 2N5952. Use a 22-V supply and bias the device at I_D = 5mA, V_{DS} = 15V.
The spec. sheet for the 2N5952 shows
I_{GSS} = 200nA
I_{DSS} = 4mA to 8mA (use I_{DSS} = 6mA)
$V_{GS(off)}$ = -1.3V to -3.5V (use V_P = -2.5V) (8marks)

(c) Calculate the stability factor of the circuit in fig. 3. (2 marks)

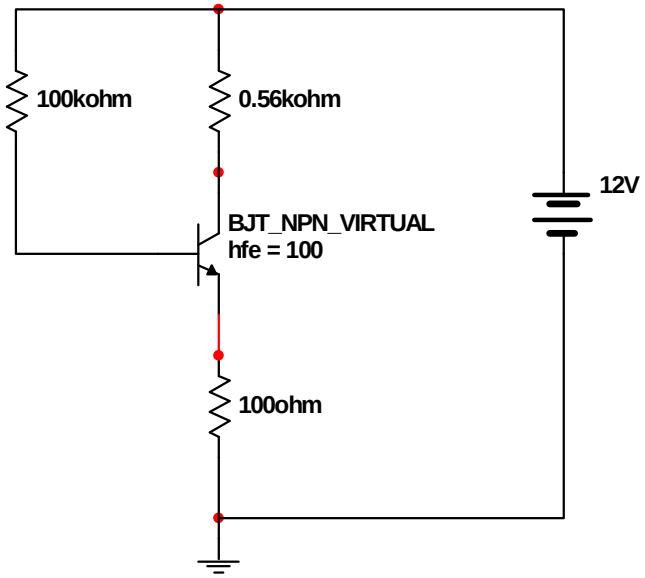

Fig. 3

QUESTION 5

(a) Design a common emitter bias circuit that will conform to the following specifications:

Supply voltage = $12V_{DC}$, β = 400, I_{CQ} = 22mA (6 marks)

(b) If the input voltage of the power supply shown in fig. 4 is 20 V_{ac} and the load resistance is 1 KΩ. Calculate the size of the smoothing capacitor needed, in order for the load voltage to be 25 V_{DC}. (6 marks)

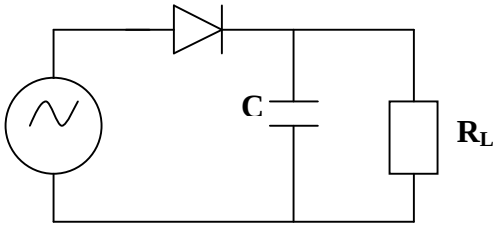

Fig. 4

QUESTION 6

(a) Describe thermal runaway and how it is prevented. (12 marks)