KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2010/2011 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: PHYS 120

COURSE TITLE: BASIC ELECTRONICS

STREAM: SESSION III

DAY: MONDAY

TIME: 9.00 – 11.00 A.M.

DATE: 11/04/2011

INSTRUCTIONS:

- *Answer Question **ONE** and any other **TWO** Questions. Question One carries **30marks** while each of the other Two Questions carry **20marks**.*

PLEASE TURN OVER

QUESTION 1 (30 marks)

a) Define the following terms (4mks)
i). Electron shells
ii). Valence electrons
iii). Ionization
iv). Energy gap

b) Compare the conductivity of semiconductor atom and conductor atom (2mks)

c) i) Define what is meant by covalent bond. (1mk)
ii) Explain how an n-type semiconductor can be achieved. (3mks)

d) Explain what is meant by the following. (2mks)
i). Barrier potential
ii). Depletion layer

e) i) Explain what is meant by biasing an electronic device. (1mk)
ii) State and explain two biasing techniques used with semiconductor diodes. (3mks)

f) Differentiate between elemental semiconductors and compound semiconductors. State two examples of each. (4mks)

g) Differentiate between the following and state one example of each. (3mks)
i). Acceptor and donor atoms
ii). Extrinsic and intrinsic semiconductors

h) A potential of 5V is applied across a diode whose barrier potential is 0.7V. If a current of $150\mu A$ flows through the diode when a $8k\Omega$ limit resistor is used, find the forward dynamic resistance of the diode.
(3mks)

i) Sketch a basic circuit of an operational amplifier differentiator and derive its transfer function. (4mks)

QUESTION 2 (20 marks)

a) i) Differentiate between half wave and full wave rectification. (2mks)
ii) Draw a circuit diagram of a full wave rectifier and describe how it operates. (5mks)

b) I) Define the following transistor parameters. (2mks)
i). Alpha DC
ii). Hybrid (h_{FE})

II) State and explain the three main operating regions of a transistor. (6mks)

c) i) Sketch a schematic diagram of an operational amplifier integrator circuit (2mks)

ii) Derive the transfer function of an operational amplifier integrator circuit (3mks)

QUESTION 3 (20 marks)

a) i) What are field effect transistors. (1mk)

ii) Sketch a circuit diagram showing how junction field effect transistors are biased. (3mks)

iii) The data sheet of a certain JFET indicates that $I_{DSS} = 4mA$ and $V_P = -6V$. Find the drain current for $V_{GS} = -2V$. (4mks)

b) i) State two special characteristics of operational amplifiers. (2mks)

ii) Sketch a schematic diagram of an inverting operational amplifier and derive its closed-loop gain (A_{vf}). (5mks)

c) i) What is an oscillator? (1mk)

ii) Sketch a labeled clock pulse output of astable multivibrator. (2mks)

d) A transistor has the following $V_{CC} = 12V$, $I_B = 50\mu A$, and $\beta = 100$. Sketch its load line. (2mks)

QUESTION 4 (20 marks)

a) Explain why for good conductors, increase in temperature leads to decrease in conductivity while for semiconductors, the opposite is true (2mks)

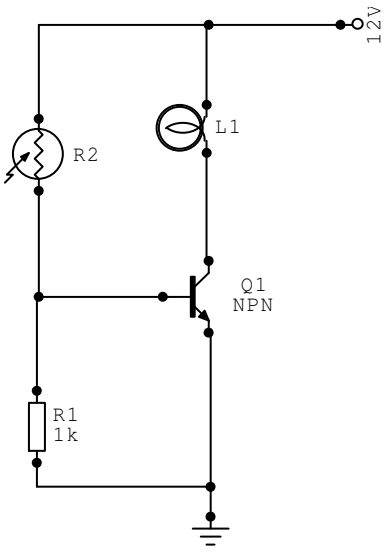
b) What is the major difference between?

i). bipolar and unipolar device (2mks)

ii). minority and majority charge carriers (2mks)

c) Draw a circuit symbol for a semiconductor diode and explain why it acts as a rectifier. (2mks)

d) Consider the given circuit



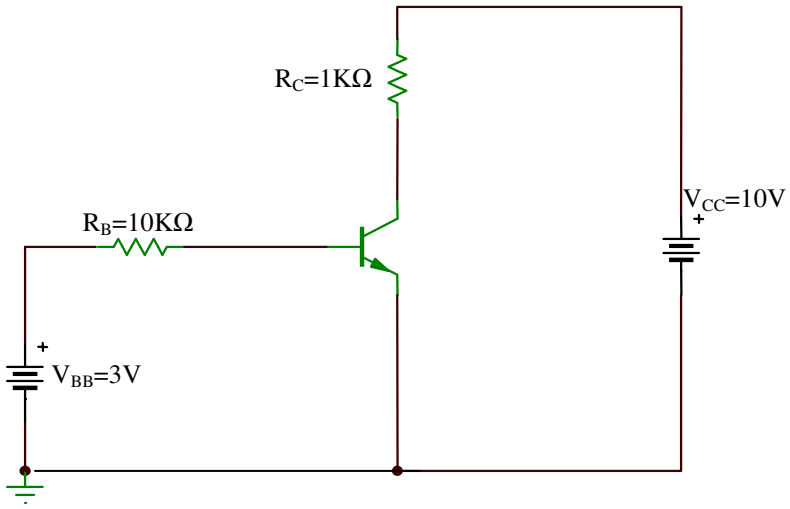
i). Explain how the circuit works (2mks)

ii). State one practical use of this circuit (1mk)

e) i) State and explain two configurations of operational amplifiers. (2mks)

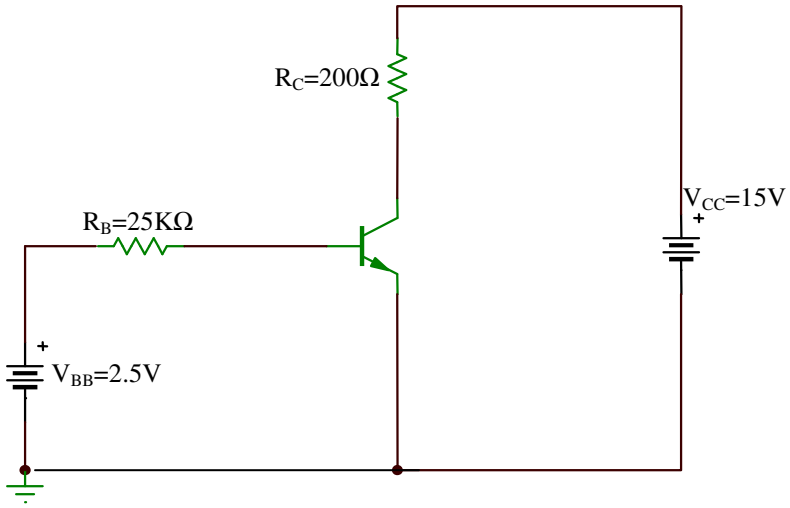
ii) Sketch a basic circuit of operational amplifier comparator and explain how it operates. (3mks)

f) Determine the operating region of the transistor in the given circuit. Given that for this transistor $V_{CE(sat)} = 0.2V$ and $\beta_{DC} = 50$ (4mks)



QUESTION 5 (20 marks)

a) Consider the given transistor circuit



Given that for this transistor, $V_{BE} = 0.7V$ and $\beta_{DC} = 250$, determine for the circuit;

i). Base current I_B (3mks)
ii). Collector current (I_C) (3mks)
iii). Collector-emitter voltage (V_{CE}) (3mks)
iv). Collector-base voltage (V_{CB}) (2mks)

b) A certain clock oscillator produces an output square wave with $t_{high} = 4\mu s$ and $t_{low} = 6\mu s$. Calculate the clock frequency duty cycle. (4mks)

c) A differentiator has a feedback resistor $R = 25k\Omega$ and input capacitance $C = 0.02\mu F$. Calculate;

i). It's cut off frequency. (3mks)
ii). It's maximum linear operating frequency. (2mks)