MAKERERE UNIVERSITY

College of Engineering, Design, Art and Technology

School of Engineering, Design, Art and Technology

Electrical and Computer engineering

Continuous Assessment Test 2

CMP 1101: ELECTRONICS 1 **DATE: Friday, November 2nd, 2018**

TIME: 8:00 AM – 12:00 PM

INSTRUCTIONS:

1. Attempt all questions.
2. Your complete solution to the test must be clear, legible and submitted electronically in 1 file.
3. Your file name should be of the format: SURNAME-FirstName-CAT2.

QUESTION 1: (*30 Points*)

Consider the logic function Z, described by the following truth table to answer the questions that follow.

A	B	C	Z (A, B, C)
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

a) What is a truth table and what is its significance in electronics? (5)

b) Using only 2-input NAND gates and inverters, show how to implement the function Z. (10)

c) Implement the above function Z, with any appropriate 3-input gate supported by any other gate as you see fit. (10)

d) Fill in the truth table for the following digital circuit. (5)
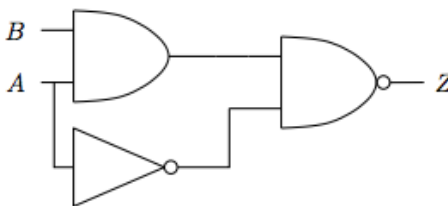
QUESTION 2:   (*30 Points*)

A full-wave bridge rectifier with capacitor smoothing is supplied with a sinusoidal a.c voltage $v_s(t)$ = 26sin(100t) volts as shown in the circuit below.

$v_s(t) = 26\sin(100\pi t)$ Volts — Bridge Rectifier — C 4700μF — R 200Ω — v_o
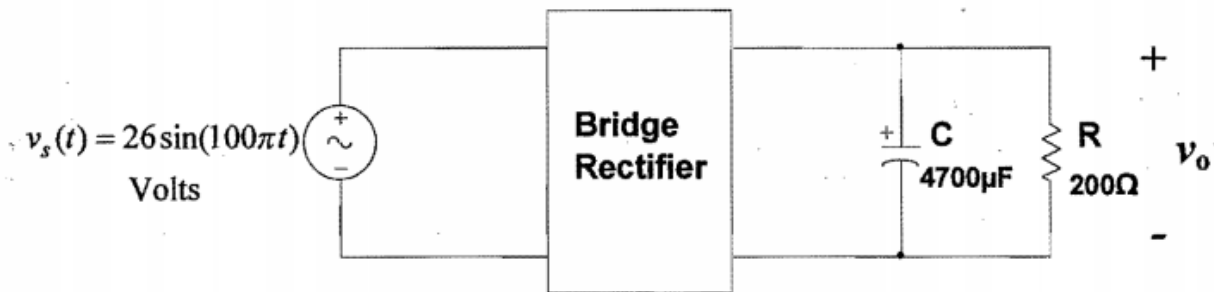
a) Draw the complete circuit including the diode arrangement for the block labeled "bridge rectifier".   (3)

b) Neglecting the voltage drops across diodes, determine the following quantities.

   i) The peak-to-peak magnitude of the output voltage.   (5)

   ii) The average value of the load current in R.   (5)

   iii) The peak inverse voltage in the diode.   (5)

   iv) Discuss the effect of variations in the capacitor rating in the rectifier's operation (5)

c) A nonlinear resistor having terminal voltage V_{NR} and terminal current i_{NR} is connected to an external network as shown below. The terminal characteristics of the nonlinear resistor are given in the attached graph.
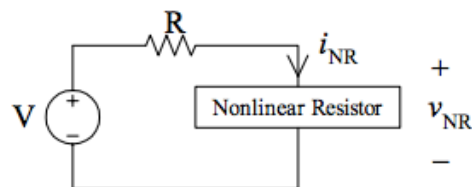
   i) Assuming that V = 2V and R = 4Ω in the external network. Using the graphical terminal characteristics of nonlinear resistors, determine V_{NR} and i_{NR}.   (7)

QUESTION 3:   (*25 marks*)

Transistors find wide application in electronics today and have been credited for the accelerated growth in the provision of low cost communication to many parts of the world.

a) What is a transistor?   (2)

b) Name two broad classifications of transistors and discuss two main differences between them.   (4)

c) For any of the BJT transistor sub categories, explain with appropriate illustrations its principle of operation highlighting how the switching and amplification functions are achieved.   (10)

d) The following figure represents a comparison between the different BJT configurations with their associated electrical characteristics. Based on the input impedance, output impedance and current gain, which of the configurations presents itself as the ideal candidate for use in switching and amplification applications. (9)

Electrical characteristics of the different BJT configurations.

Characteristic	Common Base	Common Emitter	Common Collector
Input Impedance	Low	Medium	High
Output Impedance	Very High	High	Low
Phase Angle	0°	180°	0°
Voltage Gain	High	Medium	Low
Current Gain	Low	Medium	High
Power Gain	Low	Very High	Medium

QUESTION 4: (*15 marks*)

A silicon semiconductor material at T = 300K is doped with Arsenic atoms to a concentration of $2 \times 10^{15} cm^{-3}$ and with Baron atoms to a concentration of $1.2 \times 10^{15} cm^{-3}$

a) With supporting reasons, determine whether the semiconductive material produced is p-type or n-type. (5)

b) Determine the values of the equilibrium concentrations of the holes and electrons in the material. (6)

c) At zero bias, 20% of the total space charge region is in the p region and the built in potential is 0.71V. Determine the concentrations of the of the acceptor atoms. (4)

Note:

Any assumption made in attempting this question must be clearly stated.