MAKERERE UNIVERSITY

COLLEGE OF ENGINEERING, DESIGN, ART AND TECHNOLOGY

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

CMP1101: ELECTRONICS 1

CONTINUOUS ASSESSMENT TEST 2

FRIDAY, NOVEMBER 17TH, 2017

TIME: 1 HOUR 30 MINUTES

INSTRUCTIONS:

1. Answer all questions.
2. All questions carry equal points.
3. Select the response(s) that most accurately answer the question.
4. Multiple selections of responses of which one may be incorrect leads to the loss of points allocated to that question.
5. You are allowed the use of written/typed material in this test.
6. All permitted material for this test cannot be shared.
7. No electronic/digital material is permitted during this test.

QUESTION 1: TRUE OR FALSE (*30 points*)

i. P-N junctions are constructed by joining separate semiconductor materials that are appropriately doped with holes and electrons respectively.

ii. The magnitude of current that flows in the forward bias of a semiconductor is equivalent to that which flows in the reverse bias for the same magnitude of bias voltage.

iii. The use of lumped circuit abstraction in a simulation sequence always results in the accurate representation of a given element.

iv. The circuit analysis simplification through the use of Thevenin's equivalent circuits provides more accurate values of circuit currents and voltage drops than attained by the application of Kirchhoff's laws.

v. The frequency at which any given diode is operated affects the diode's ability to maintain conductivity across its p-n junction.

vi. The atomic number of an element in the periodic table is a prediction of the conductivity of the element.

vii. Transistors find wide application in digital electronics because they provide the capability to switch and/or amplify signals as required.

viii. Biasing a semiconductor is defined as the application of a positive voltage that is equal to the bulk voltage.

ix. Conduction in semiconductors is made possible through the movement of electrons and/or holes.

x. Metals and integrated circuits are examples of conductors with positive temperature coefficient.

xi. At equilibrium, the electrons and holes in either the p-type or n-type semiconductor materials of a p-n junction are uniformly distributed.

xii. Since all transistors are current controlled devices, it is necessary to ensure that they only receive current signals at their inputs.
xiii. The size of the p-n junction area in any diode is only useful for aesthetic purpose.
xiv. Due to the added insight derived from the use of load lines in the graphical diode analysis methods, the values of currents and voltages determined are the accurate.
xv. Conduction in semiconductors is made possible through the movement of electrons and/or holes.
xvi. For the operation of only the NPN transistor, the base-emitter junction must be forward biased while the reverse is true for the base collector junction.
xvii. The root mean square value of a given voltage or current is directly proportional to the maximum amplitude that the current or voltage signal can attain at any given time.
xviii. A p-n junction is only non-conductive in the reverse bias.
xix. Small signal diodes are generally not operated in the breakdown region because the amounts of current experienced in the region have no use in electronics.
xx. Tunnel diodes are very similar in operation to the varactors and are thus substitutes of each other.
xxi. The typical i-v characteristics of diodes depict a linear relationship between the current and voltage from the point where the bulk voltage is superseded.
xxii. Since diodes effectively conduct in one direction with the application of an appropriate voltage and block the flow of current in the opposite direction, it therefore follows that all diodes are p-n junctions.
xxiii. Uncontrolled rectifiers are those rectifiers that can only be operated in conjunction with an external switch to determine when the rectifier diodes process the input signal.
xxiv. Smoothing capacitors in rectifiers are primarily intended to operate such that they supply the load in the instances when the output from the diodes falls below a certain value.
xxv. The bridge rectifier is a much superior design of a full-wave rectifier.
xxvi. For the special BJTs, it is not a requirement to have their diodes operating in reverse polarity of each other.
xxvii. In the circuit symbols of BJTs, the NPN and the PNP transistors have the exact opposite representation for the currents and voltages experienced at the transistor terminals.
xxviii. Transistors can be used in electronics where signal switching, amplification and attenuation are required.
xxix. The operation of FETs is not any different from that of BJTs except in biasing requirements.
xxx. The current gain from the common-emitter and common-collector configurations of BJTs is significantly similar to that attained through the use of FETs.

QUESTION 2: TRANSISTORS **(*25 points*)**

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) Figure 1 below 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)

Figure 1: **Electrical characteristics of the diffrent 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 3: DIODE LOGIC **(*25 points*)**

a) Define a logic gates and explain their importance in electronics. (3)

b) Name 4 logic gates and discuss their operational capabilities highlighting their effect on the different signal combinations that they process. (12)

c) Implement the NAND gate using diodes and explain how all combinations of the input signals are processed through the gate. (8)

d) Name two shortcomings that arise from the use of diodes in the implementation of logic gates. (2)