UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: ELECTRICAL* *ENGINEERING: COMPUTER SYSTEMS*
SUBJECT	:	**ELECTRONICS I**
CODE	:	**EEL1111**
DATE	:	WINTER EXAMINATION 2014 12 JUNE 2015
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40: 60
TOTAL MARKS	:	110
FULL MARKS	:	100

EXAMINER	:	MR NE MABUNDA
MODERATOR	:	MR HP VAN DER WALT 2010
NUMBER OF PAGES	:	7 PAGES

INSTRUCTIONS : ONE POCKET CALCULATOR PER STUDENT.

INSTRUCTIONS TO CANDIDATES

1. MARKS 100 / 100 = 100%. TOTAL MARKS AVAILABLE = 110.

2. ATTEMPT ALL QUESTIONS.

4. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.

5. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND IN PROPORTION.

6. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.

7. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK AND WILL NOT BE MARKED.

8. **NOTE**: - MARKS WILL BE DEDUCTED FOR WORK WHICH IS POORLY PRESENTED.

9. **QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF A QUESTION MUST BE KEPT TOGETHER.**

10. TAKE THE FORWARD BIASED VOLT DROP ACROSS ALL PN JUNCTIONS AS 0,6 VOLTS UNLESS OTHERWISE STATED AT 25°C.

QUESTION 1

Answer Question 1 on the multiple choice answer sheet (Back page of your exam script). **(1 mark per correct answer)**

1.1 Donor doping is a process which

(a) Increase the number of charge carriers
(b) creates holes on the conduction band
(c) causes a release of electrons into valence band
(d) causes a release of electrons into conduction band

1.2 Leakage current in a PN-junction can increased by

(a) application of light to the junction
(b) chemical energy
(c) dropping barrier potential
(d) majority carriers

Question 1 (Continued)

1.3 Fixed voltage present across a reverse biased PN-junction is called a

(a) breakdown voltage
(b) barrier voltage
(c) bias voltage
(d) reverse voltage

1.4 When used in a circuit, a varactor diode is always

(a) forward-biased
(b) connected in series
(c) troubled by overheating
(d) reverse-biased

1.5 A semiconductor device representative of a fixed voltage regulator is called a

(a) Tunnel diode
(b) PIN diode
(c) Schottky diode
(d) Zener diode

1.6 Signal diodes are mostly used in

(a) rectifiers
(b) voltage regulators
(c) radio frequency circuits
(d) amplifiers
(e) protection devices

1.7 The basic reason why a half wave rectifier has approximately half the efficiency of a full wave rectifier is that

(a) it utilizes both half-cycle of the input
(b) its ripple factor is much less
(c) it makes use of a one transformer half cycle
(d) its output frequency is double the line frequency

1.8 The PIV of a full-wave bi-phase rectifier is

(a) 2 Vp
(b) Vp
(c) Vp/2
(d) Vp/3

Question 1 (Continued)

1.9 The DC polarity from the output of a full-wave bridge rectifier may be reversed by reversing the

(a) diode
(b) transformer primary terminals
(c) transformer secondary terminals
(d) it cannot be reversed

1.10 For the operation of an PNP-bipolar transistor, the stated electrodes should have the following polarities with respect to the emitter

(a) collector positive; base negative
(b) collector negative; base positive
(c) collector negative; base negative
(d) collector positive; base positive

1.11 In the case of a bipolar transistor, the current gain (h_{fb}) is

(a) positive and > 1
(b) positive and < 1
(c) negative and > 1
(d) negative and < 1

1.12 Which of the following approximations are often used in electronic transistor circuits?

(a) $I_B \cong I_E$
(b) $I_B \cong I_C$
(c) $I_C \cong I_E$
(d) $I_E \cong I_B + I_C$

1.13 If a change in base current changes the collector current in a linear manner, the transistor amplifier is said to be

(a) saturated
(b) cut-off
(c) in active region
(d) complemented

1.14 If, in a bipolar junction transistor $I_B = 100\ \mu A$ and $I_C = 1$ mA, in what range does the value of its forward current gain β falls?

(a) 0.1 to 1.0
(b) 1.01 to 10
(c) 10.1 to 100
(d) 100.1 to 1000

Question 1 (Continued)

1.15 For a PNP transistor connected in a circuit, an increase in the negative base voltage will

(a) decrease I_C = only
(b) decrease I_E = only
(c) increase both I_C and I_E
(d) leakage current.

1.16 A common emitter amplifier is characterized by a

(a) low voltage gain
(b) moderate power gain
(c) signal phase reversal
(d) very high output impedance

1.17 In a Class B amplifier, conduction extends between 0 to 180° since the Q-point is

(a) located on the load line
(b) located near the saturation point
(c) centred on the load line
(d) located at or near the cut-off point

1.18 The maximum overall percentage efficiency of a Class C amplifier is

(a) 50
(b) 25
(c) 78.5
(d) 70

1.19 When the drain-source voltage (V_{DS}) of a JFET device in a circuit reaches the pinch-off value (V_P), the drain current I_D tends to

(a) a low value
(b) zero
(c) be saturated
(d) be reversed

1.20 An enhancement MOSFET differs from a JFET in the sense that it does not have a

(a) continues channel
(b) gate
(c) PN-junction
(d) substrate

[20]

QUESTION 2

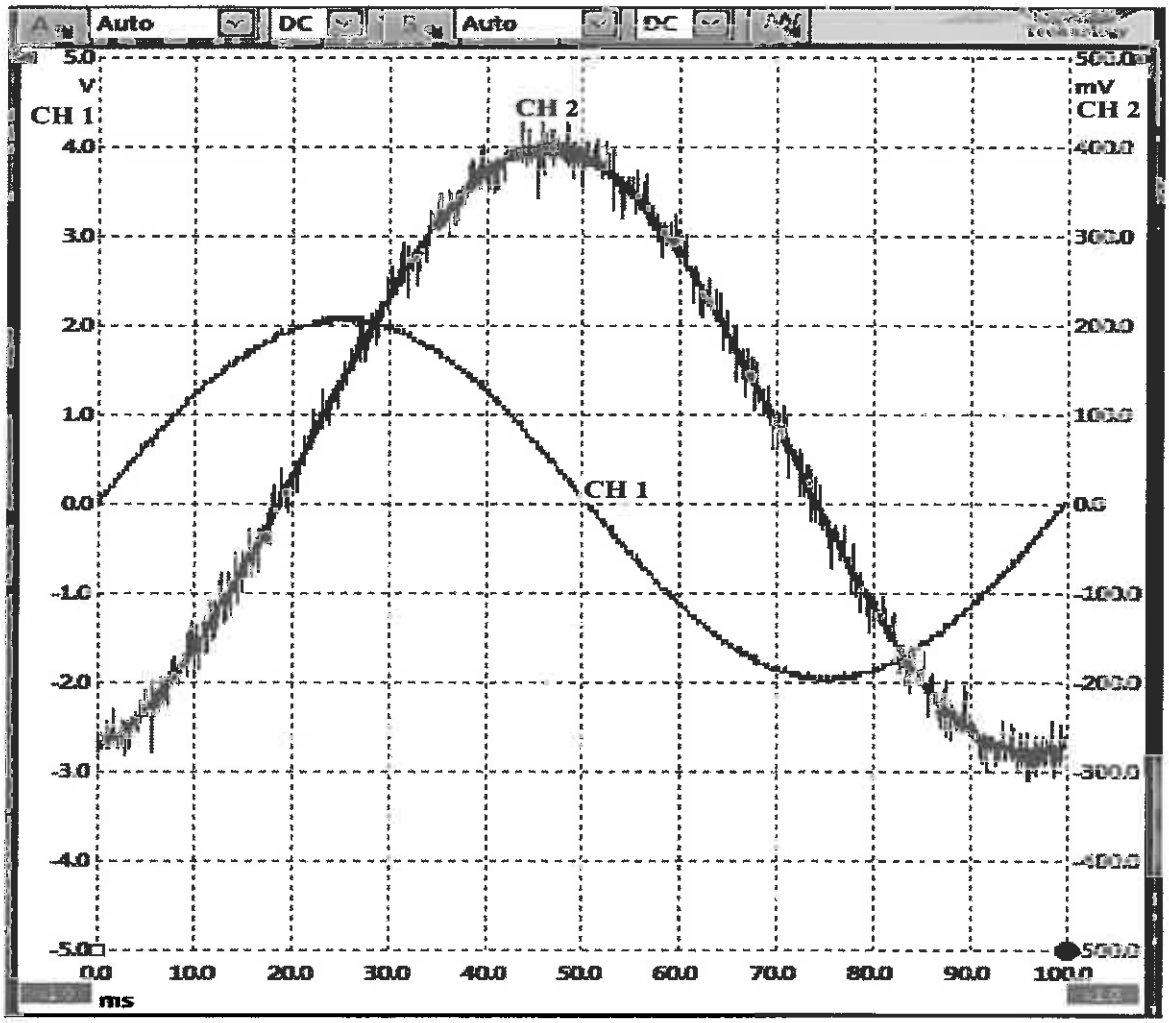

Figure 1

2.1 Refer to Figure 1 above to:

2.1.1	determine the peak voltages for both signals,	(4)
2.1.2	calculate frequency of the signals,	(2)
2.1.3	determine the phase difference (in degrees) between the two signals,	(3)
2.1.4	calculate the voltage loss between the two signals.	(3)
2.1.5	If all channels are set to DC mode, how will the DC offset of 1 V affect each signal?	(4)
2.1.6	Both time per division and volt per division are now doubled, how will these two signals be affected? Relate to the number cycles observed and number of divisions that are covered vertically or horizontally.	(5)

2.2 With the aid of circuit diagrams, explain how you could make use of an oscilloscope to measure current flowing through a 100 Ω resistor. (4)

[25]

QUESTION 3

3.1 A diode has a forward voltage drop of 0,55 V at 10 °C. Determine the forward voltage drop at 90 °C, assuming that the heat affects the forward voltage drop at a rate of 2 mV/°C? (5)

3.2 Sketch onto scale three neatly labelled graphs to illustrate how the temperature changes the reverse saturation current of a silicon diode. Assume a reverse saturation current of 10 µA at 20 °C. (5)

3.3 Sketch a circuit to represent the seven segment display and then describe how you can use it to display the number '7'. (5)

[15]

QUESTION 4

4.1 An unregulated power supply uses a step down transformer and four (4) diodes. The average current is 15 mA delivered to a load of 1 kΩ. The supply to the primary of the transformer is 230 Vrms at 50 Hz and the forward voltage drop of each diode is 0,6 V.

4.1.1 Sketch the circuit diagram. (4)
4.1.2 Determine the turn's ratio of the transformer (8)
4.1.3 What should the minimum PIV rating of each diode be? (1)
4.1.4 With the aid of waveforms, drawn to scale, illustrate the output that is expected if one diode is burned and result onto an open circuit (3)

4.2

4.2.1 With the aid of neatly labeled circuit diagram and waveforms, explain the operation of the half wave rectifier. (7)

4.2.2 Is it practical to use the half rectifier? Support your answer. (2)

[25]

QUESTION 5

Design a common-emitter Class-A amplifier utilizing a voltage divider biasing arrangement and an emitter resistor for stability. The supply voltage is -30 V and the transistor to be used is a **PNP**. Include a circuit which illustrates connections and values for all calculated resistors. Let:

I_{CQ} = 15 mA
β = 50
V_{BE} = -0,6 V
V_{RE} = $V_{cc}/10$ **[15]**

QUESTION 6

By means of neat labeled drawing, explain in point form how a N channel enhancement MOSFET functions. **[10]**

TOTAL MARKS = 110
FULL MARKS = 100