UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY **[BEng Tech]** IN ELECTRICAL ENGINEERING. B6ELEQ & B6ELXQ
SUBJECT	:	**ELECTRONIC CIRCUITS IB**
CODE	:	**ELCELB1**
DATE		SUPPLEMENTARY EXAMINATION 2020 9 JANUARY 2020
DURATION	:	3 HOURS: 11:30 TO 14:30
CALCULATION CRITERIA	:	40 [SEMESTER]: 60 [EXAM]
TOTAL MARKS	:	100

EXAMINER	:	MR HP VAN DER WALT
MODERATOR	:	MR PJJ VAN ZYL
NUMBER OF PAGES	:	6 PAGES, 1 ANNEXTURE
INSTRUCTIONS	:	ONE POCKET CALCULATOR PER STUDENT. **THE QUESTION PAPER AND ANSWER SHEETS MUST BE HANDED IN TOGETHER WITH THE SCRIPT**

INSTRUCTIONS TO CANDIDATES:

1. READ INSTRUCTIONS CAREFULLY
2. ATTEMPT ALL QUESTIONS.
3. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.
4. ALL DIAGRAMS AND SKETCHES MUST BE SKETCH NEATLY AND IN PROPORTION.
5. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.
6. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK AND WILL NOT BE MARKED.
7. NOTE:- MARKS WILL BE DEDUCTED FOR WORK WHICH IS POORLY PRESENTED.
8. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF A QUESTION MUST BE KEPT TOGETHER.
9. QUESTION 1 MUST BE ANSWERED ON THE ANSWER SHEET PROVIDED (**ANNEXURE 1)** AT THE BACK OF YOUR QUESTION PAPER.

QUESTION 1 – MULTIPLE CHOICE QUESTIONS

A) Choose the letter that represents the correct answer and indicate this answer on the multiple choice answer sheet provided.
B) **NOTE**:- only one answer is **100% correct**.
C) Each question has a value of 2 marks.

QUESTION 1

- MULTIPLE CHOICE

Choose ***the most correct answer*** *and mark an* **X** *over the corresponding letter on your answer sheet at the back of your exam answer script. (Rough work can be done at the back of the exam answer script).*

1.1 Input resistance of a common-base amplifier is

a) very low
b) very high
c) the same as common-emitter
d) the same as common-collector

1.2 A certain class A amplifier has a current gain of 75 and a voltage gain of 50. The total power gain is

a) 75
b) 125
c) 3750
d) 50

1.3 A class A amplifier is biased with a centered Q-point at $V_{CEQ} = 5\,V$ *and* $I_{CEQ} = 10\ mA.$ The maximum output power is

a) 25 mW
b) 50 mW
c) 10 mW
d) 37.5 mW

1.4 The JFET is

a) a unipolar device
b) a voltage-controlled device
c) answers a) and b)
d) answers a) and c)

1.5 The channel of a JFET is between the

a) gate and drain
b) drain and source
c) gate and source
d) input and output

1.6 A certain JFET data sheet gives $V_{GS(off)} = -4\,V$. The pinch-off voltage, Vp,

a) cannot be determined
b) is -4 V
c) depends on V_{GS}
d) is +4 V

1.7 The JFET in Question 1.6

a) is an *n* channel
b) is a *p* channel
c) can be either
d) pn junction

1.8 A MOSFET differs from a JFET mainly because

a) of the power rating
b) the MOSFET has two gates
c) the JFET has a pn junction
d) MOSFETs do not have a physical channel

1.9 Electrons that move from any shell or energy level into the m1 shell must lose a large amount of energy in order to move from their energy state to a much lower energy state.

The light emitted is:

a) ultra-violet light or Lyman- series
b) infrared -light or Paschen -series
c) visible-light or Balmer-series

1.10 Electrons that move from any shell or energy level into the m2 shell must lose a large amount of energy in order to move from their energy state to a lower energy state.

The light emitted is:

a) ultra-violet light or Lyman- series
b) infrared -light or Paschen -series
c) visible-light or Balmer-series

1.11 A transistor is a:

a) voltage controlled device
b) current controlled device
c) voltage and current controlled device
d) voltage and current controlled device

1.12 Electrons that move from any shell or energy level into the m3 shell must lose a large amount of energy in order to move from their energy state to a slightly lower energy state.

The light emitted is:

a) ultra-violet light or Lyman- series
b) infrared -light or Paschen -series
c) visible-light or Balmer-series
d) black (no) light

1.13 The h22 hybrid parameter is defined as the

(a) open-circuit output admittance
(b) open-circuit reverse voltage ratio
(c) short-circuit forward current ratio
(d) short-circuit input impedance

1.14 The hybrid parameter that is represented by the name hf_ is

(a) h11
(b) h12
(c) h21
(d) h22

1.15 The h12 hybrid parameter is defined as the

(a) open-circuit output admittance
(b) open-circuit reverse voltage ratio
(c) short-circuit forward current ratio
(d) short-circuit input impedance

[30]

QUESTION 2

2.1 Design and sketch a basic voltage (shunt) regulator circuit with a terminal voltage of 6.2 Volt to supply 0 - 200 mA of current to a load resistor. A 6,2 volt 10 watt Zener diode is available for the design. Take I_z min as 20% of I_z max. Vin is a 10 – 14 Volt saw-tooth signal. (5)

2.1.2 Determine a suitable value for the series-limiting resistor. (5)

2.2.2 Having found a resistor value determine whether it will keep the Zener current within its maximum and minimum limits. (2)

2.1.3 Calculate the resistor's power rating. (2)

2.2 Create a comprehensive schematic diagram of the LM317 adjustable voltage regulator. (4)

2.3 Compare 3 drawbacks of a conventional linear power supply when compared to a SMPS. (3)

2.4 Make a schematic drawing of a step-down configuration SMPS and explain its operation in point form. (7)

[28]

QUESTION 3

3.1 Given the single-stage common-emitter circuit in Figure 1 below, take that the reactance's and all capacitors are negligible for all mid-frequencies and given the following information relating to the transistor:

Sketch the circuit's small signal h-parameter model. (4)

Derive from first principles equations and values for the following:

3.2	Input impedance Zin	(2)
3.3	Output impedance Zout	(2)
3.4	Voltage gain Av	(3)
3.5	Current gain Ai	(3)
3.6	Power gain Ap	(2)

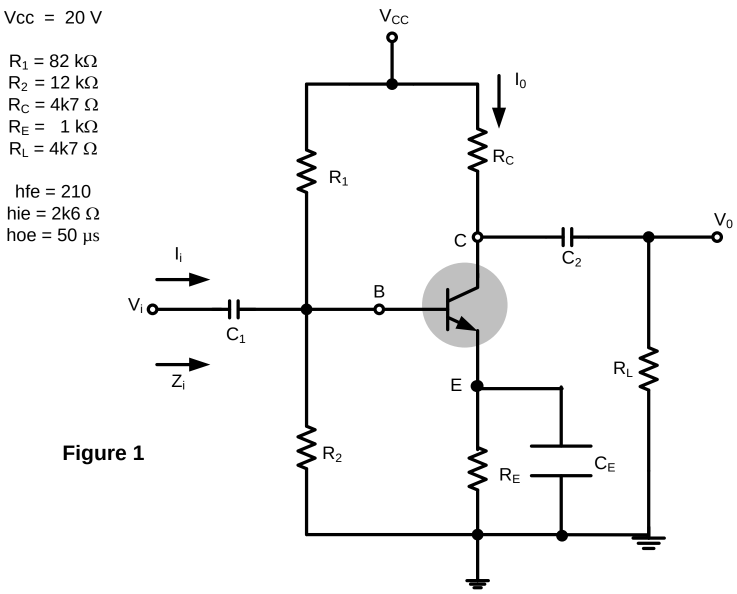

Figure 1

4.0 Deduce from first principles equations for Zin, Zout, Av and Ai for Figure 2. Show all relevant diagrams.

Perform a dc analysis on the amplifier circuit to find the value of re. Determine values for Zin, Zout and Av.

<u>Note:</u>
Use common base h-parameters and not common emitter h-parameters.
(14)

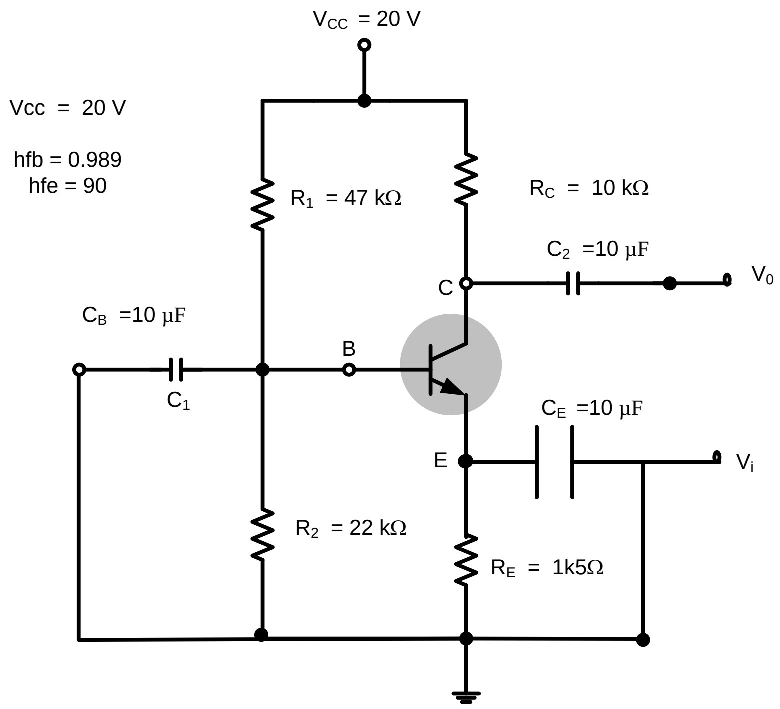

Figure 2

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QUESTION 4

4.1 Derive equations for Zin and Av from for the circuit in Figure 3 below.. Justify your calculations using relevant equivalent small signal diagrams.. Use the sheet of graph paper to determine I_{DQ} and V_{GSQ} graphically. I_{DSS} = 8 mA and Vp =-4 V

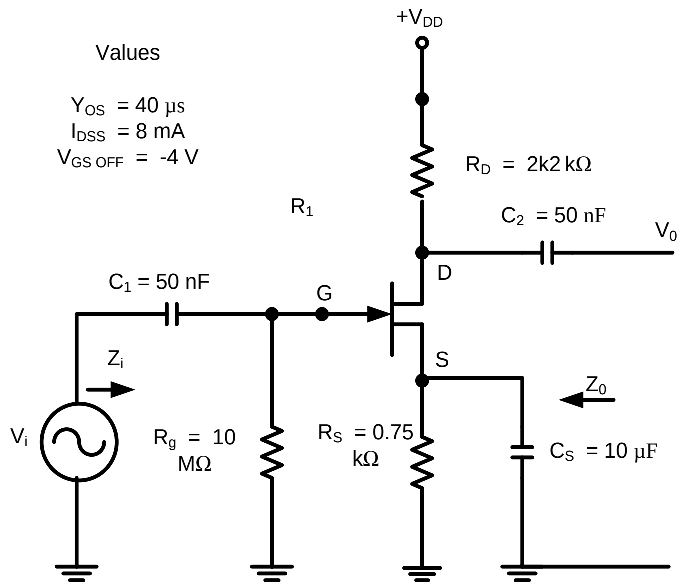

Figure 3

(16)
[18]

(To be handed in with your examination script) **ANNEXURE 1**

Surname & Initials	Student N°										Lab List N°

QUESTION No1 ANSWER SHEET

Use a pen and make a cross in the applicable block.

NOTE :- Only one choice may be indicated per question.

QUESTION 1	ANSWERS	ANSWERS	ANSWERS	ANSWERS	ANSWERS
	A	B	C	D	E
1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E
13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E