FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

PENSTER 1/2014

EEE413 – ANALOGUE ELECTRONICS 1A

SOLUTION

ID Number: _____

Section A **Multiple Choice** **[30 Marks]**

Circle the letter of your **Best** choice

1	**A**	B	C	D
2	A	B	**C**	D
3	A	B	**C**	D
4	A	B	**C**	D
5	A	B	C	**D**
6	A	**B**	C	D
7	A	B	**C**	D
8	A	**B**	C	D
9	**A**	B	C	D
10	A	**B**	C	D
11	A	B	C	**D**
12	A	B	**C**	D
13	A	**B**	C	D
14	A	**B**	C	D
15	**A**	B	C	D
16	A	**B**	C	D
17	A	B	C	**D**
18	A	B	**C**	D
19	A	B	**C**	D
20	A	B	C	**D**
21	A	**B**	C	D
22	A	B	**C**	D
23	A	B	**C**	D
24	A	B	C	**D**
25	**A**	B	C	D
26	A	B	**C**	D
27	A	**B**	C	D
28	**A**	B	C	D
29	**A**	B	C	D
30	**A**	B	C	D

NB: Attach this sheet with the answer booklet.

Question 1 **Operational Amplifier (OP-AMPS)** **[20 Marks]**

a. Complete the table given below about the four main properties of real and ideal op-amp.

Properties	Ideal	Real
A_d	**Infinity**	**200,000**
CMRR	**Infinity**	**90dB**
R_{in}	**Infinity**	**2MΩ**
R_{out}	**0Ω**	**75Ω**

(4 marks)

b. CMRR = 20 Log Ad/Ac dB
= 20 Log 2000/0.2dB
= 80dB (3 marks)

c. .

I. Av = Vout/ Vin = -Rf/Rin
= 100kΩ/10kΩ
= 10 or 20dB (2 marks)

ii Gain = -Rf/Rin

A_1 = -10kΩ/1kΩ
= -10

A_2 = -10kΩ/2kΩ
= -5

Vout = - (10(2mV) + 5 (5mV) = **- 45mV** (2 marks)

d. 1 – ii
2 – i
3 – iv
4 – iii (1 mark each = 4 marks)

e. $I_E = V_{EE} – 0.7V/R_E$
= 9 – 0.7/3.9kΩ
= **2.515mA** (2 marks)

$I_C = I_E/2$
= 2.515mA/2
= **1.2576mA** (1 mark)

$V_C = V_{CC} - I_C R_C$
$= 9 - (1.25 \times 10^3)(3.9 \times 10^3)$
$=$ **4.095V** (2 marks)

Question 2 **BJT** **[20 Marks]**

a. i) low; heavily
ii) lower
iii) high; lightly (1 mark each = 5 marks)

b. NPN PNP

(2 marks)

c.
i) Base Bias
ii) Emitter Bias
iii) Voltage Divider Bias
iv) Collector – Feedback Bias (Any Three) (3 marks)

d.
i. $V_{BE} = 0.7V$ (1 mark)

ii. $I_B = (V_{BB} - V_{BE})/R_B$
$= (5V - 0.7V)/3.9 \times 10^3$
$= 1.103mA$ (2 marks)

iii. $I_C = \beta I_B$
$= 50 \times 1.103mA$
$= 55.12mA$ (2 marks)

iv. $I_E = I_B + I_C$
$= 1.103mA + 55.128mA$
$= 56.23mA$ (1 mark)

v. $V_{CE} = V_{CC} - I_C R_C$
$= 15 - (55.128 \times 10^{-3})(180)$
$= 5.07V$ (2 marks)

vi. $V_{CB} = V_{CE} - V_{BE}$

$= 5.07 - 0.7$

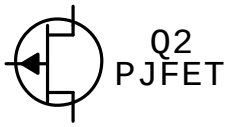
$= 4.37V$ (2 marks)

Question 3 **FET** **[20 Marks]**

a.

JFET

N – Channel



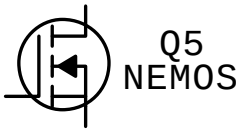
P- Channel (2 marks)

DE – MOSFET

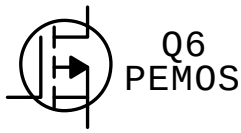
N – Channel

P – Channel (2 marks)

E – MOSFET



N – Channel



P- Channel (2 marks)

b. $R_{in} = IV_{GS}/I_{GSS}I$

$= 20/2 \times 10^{-9}$

$= 10{,}000M\Omega$ (3 marks)

c. i) The device has a negative VGS (off), therefore is a P – Channel MOSFET.
(1 mark)

ii) $I_D = I_{DSS} X \left(1 - \frac{Vgs}{Vgs(off)}\right)^2$

$I_D = 18 \text{ x}10\text{-}3X \left(1 - \frac{-3}{-8}\right)^2$

I_D = 11.25mA (3 marks)

iii) $I_D = I_{DSS} X \left(1 - \frac{Vgs}{Vgs(off)}\right)^2$

$I_D = 18 \text{ x}10\text{-}3X \left(1 - \frac{3}{-8}\right)^2$

I_D = 24.75mA (3 marks)

d. $V_S = I_D X R_S$

$= (5 X 10^{-3}) (470)$

= **2.35V** (1 mark)

$V_D = V_{DD} – I_D R_D$

$= 15 – (5 X 10^{-3})(1 X 10^3)$

= 10V (1 mark)

$V_{DS} = V_D – V_S$

$= 10 – 2.35$

= **7.65V**. (1 mark)

Since V_G = OV

$V_{GS} = V_G – V_S$

$= 0 – 2.35V$

= **-2.35V** (1 mark)

Question 4 **POWER AMPLIFIER** **[10 Marks]**

a. Used as the final stage of communication receivers or transmitters to provide signal power to speakers or transmitting antenna. (2 marks)

b. $T = 1/200 \times 10^3$
$= 5\mu S$ (1 mark)

$P_D(avg) = (t_{on}/T)V_{CE}(sat)\ I_C\ (sat)$
$= (1/5) \times 0.2 \times 100 \times 10^{-3}$
$= 4mW.$ (3 marks)

c. i) Heat sinks are made from aluminium with a matt black finish (1 mark)

ii) To remove access heart from components so as to keep the internal temperature to a safe level. (1 mark)

iii) To create maximum surface area so that more heat can be dissipated. (2 marks)