

SECTION A**MULTIPLE CHOICE****[10 MARKS]**

Choose the appropriate answer from each question by writing the alphabet beside the question number in your answer booklet:

1. Junction Field Effect Transistors (JFET) contain how many diodes?
 - A) 1
 - B) 3
 - C) 2
 - D) 4

2. A "U" shaped, opposite-polarity material built near a JFET-channel center is called the:
 - A) drain
 - B) heat sink
 - C) gate
 - D) block

3. The ratio between differential gain and common-mode gain is called:
 - A) differential – mode rejection
 - B) amplitude
 - C) phase
 - D) common mode rejection

4. What is the input impedance of a common-gate configured JFET?
 - A) low
 - B) very low
 - C) very high
 - D) high

5. With the positive probe on an NPN base, an ohmmeter reading between the other transistor terminals should be:
 - A) infinite
 - B) open
 - C) high resistance
 - D) low resistance









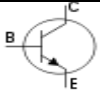

6. To operate properly, a transistor's base-emitter junction must be forward biased with reverse bias applied to which junction?
- A) base collector
 - B) collector-emitter
 - C) collector base
 - D) base-emitter
7. In an averaging amplifier, the input resistances are
- A) less than the feedback resistance
 - B) equal to the feedback resistance
 - C) unequal
 - D) greater than the feedback resistance
8. An ideal operational amplifier has
- A) infinite output impedance
 - B) zero input impedance
 - C) infinite bandwidth
 - D) All of the above
9. The major difference between ground and virtual ground is that virtual ground is only a:
- A) difference reference
 - B) current reference
 - C) power reference
 - D) voltage reference
10. Another name for a unity gain amplifier is
- A) single ended
 - B) voltage follower
 - C) difference amplifier
 - D) comparator

SECTION B**[15 MARKS]**

Write either true or false for the correct answer.

1. The voltage follower or unity gain buffer is a special and very useful type of Non inverting amplifier circuit that is commonly used in electronics.
2. Op Amps have almost infinite gain, high input impedance, and low output impedance.
3. Darlington pair is a compound structure consisting of two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one.
4. The three bipolar transistor circuit configurations are common-base, common-emitter, and emitter-follower.
5. In a BJT, the collector current is approximately equal to the base current.
6. Current gain in a transistor is inversely proportional to collector current.
7. The polarity of V_{BE} is such that it reverse biases the base-emitter junction.
8. An operational amplifier contains a differential amplifier, a voltage amplifier, and an output amplifier.
9. The ideal output impedance for an operational amplifier is 0Ω .
10. A voltage-follower op-amp has the output connected directly to the inverting input.
11. In an n-type 8JFET, current will flow when a positive voltage is applied to the drain and a negative voltage is applied to the source.
12. An enhancement-type MOSFET or E-MOSFET can be turned on when the channel is depleted.
13. 10. A D-MOSFET cannot be biased using zero biasing.
14. The heart of the CRO is a cathode-ray tube.
15. Intensity regulates the brightness of the spot or trace in Cathode Ray Tube.

SECTION C**MATCHING****(10 MARKS)****Match the symbols with their appropriate name.**

	Symbols		Name
1.		A.	Capacitor
2.		B.	Zener Diode
3.		C.	P-Channel JFET
4.		D.	PNP Transistor
5.		E.	Variable Resistor
6.		F.	NPN Transistor
7.		G.	Op - Amp
8.		H.	AC Voltage Source
9.		I.	Earth (Ground)
10		J.	N-Channel JFET

SECTION D

[65 MARKS]

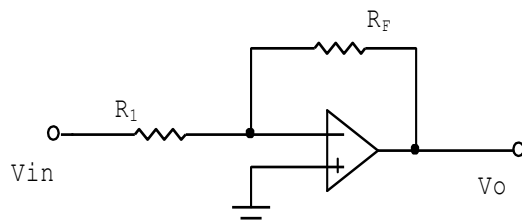
QUESTION 1

- a) Draw the circuit symbols for NPN and PNP transistors. **(3 marks)**
- b) Complete the table given below about the four main properties of real and ideal op-amp.

Properties	Ideal	Real
A_d		
CMRR		
R_{in}		
R_{out}		

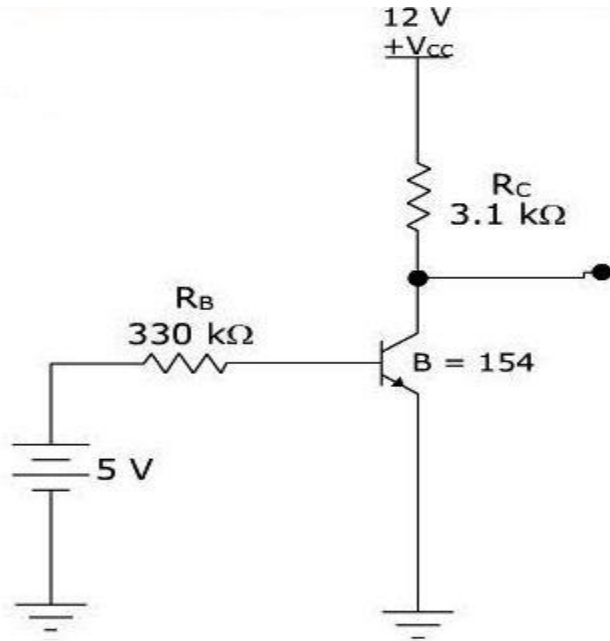
(4 marks)

- c) An op-amp circuit is shown below:



- i). Derive the expression of the voltage gain using (a) above. **(2 marks)**
- ii) Determine the voltage gain if the values of resistors $R_1=20k\Omega$ and $R_F = 100k\Omega$? **(2 marks)**
- d) A certain amplifier has a differential gain voltage of 9000 and a common mode gain of 0.25 Determine the CMRR and express it in dB. **(3 marks)**
- e) Determine β_{DC} , I_E and α_{DC} for a transistor where $I_B= 100\mu A$ and $I_C = 3.65mA$. **(6 marks)**

f) A silicon transistor having $\beta = 154$ is shown below:



For the circuit show above, determine the following:

- i) I_B
- ii) I_C
- iii) I_E
- iv) V_{CE}
- v) V_{CB}

(2 marks)

(2 marks)

(2 marks)

(2 marks)

(2 marks)

g) From the transistor data sheet shown below, determine the:

TYPE	CASE	POL MAT	V_{CE}	V_{CB}	I_C mA	V_{CES} @ I_C mA	H_{fe} @ I_C mA	P(TOT) mW	USE	EQUIVALENT
BD140	TO-126	PS	80	100	1.5A	0.5@500	40@250	8W	G.P. o/p	40410
BC107	TO-18	NS	45	50	100	0.25@10	110@450	300	G.P.S.S. amp	BC207, BC147, BC182
BC559	TO-92 VAR 1	PS	30	30	100	0.65@100	125@800	500	G.P.S.S. amp	BC159
2N3055	TO-3	NS	60	70	15 A	1.1@4A	20@70 4A	115W	G.P. power	BDY 20
TIP 3055	TOP-3	NS	70	100	15 A	1.1@4A	20@ 4A	90W	Power output	MJE 3055

- i) Current gain of BC147 and what current can this transistor operate from? **(1 mark)**
- ii) Material used in all transistors? **(1 mark)**
- iii) Abbreviation of G.P.S.S. from the table. **(1 mark)**
- iv) Power dissipation of BC159? **(1 mark)**
- v) Package of BC207? **(1 mark)**
- vi) Polarity of the BC559 transistor? **(1 mark)**

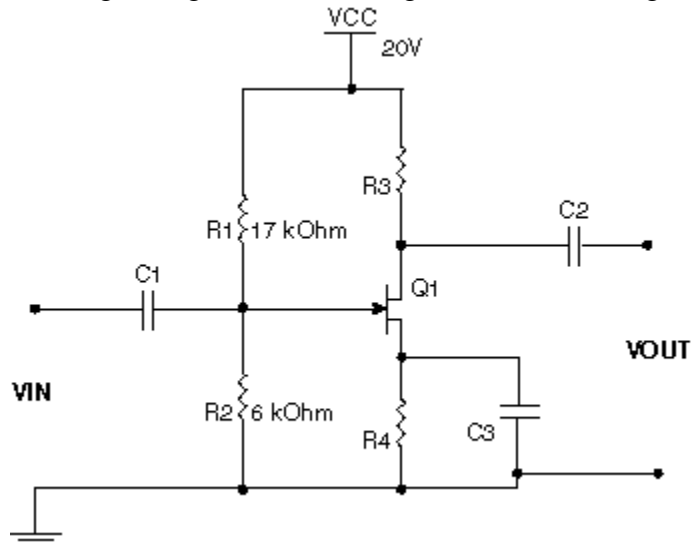
QUESTION 2

- a) If $V_{CC} = +20\text{ V}$, voltage-divider resistor R_1 is $4.7\text{ k}\Omega$, and R_2 is 1500Ω , what is the base bias voltage? **(3 marks)**
- b) What is the current gain for a common-base configuration where $I_E = 4.4\text{ mA}$ and $I_C = 4.0\text{ mA}$? **(2marks)**
- c) There are two main types of Field Effect Transistor (FET). The JFET and MOSFET. For each type of FET, draw the standard symbol, for n-channel and p-channel and label the terminals. **(6 marks)**
- d) For a certain D-MOSFET, $I_{DSS} = 12\text{mA}$ and $V_{GS}(\text{off}) = -8\text{V}$.
- i). Is this an n-channel or a p-channel? **(1 mark)**
 - ii). Calculate I_D at $V_{GS} = -3\text{V}$ **(2 marks)**
 - iii). Calculate I_D at $V_{GS} = +3\text{V}$ **(2 marks)**
- e) A certain JFET has an I_{GSS} of 2nA for $V_{GS} = -10\text{V}$. Determine the input resistance? **(3 marks)**

QUESTION 3

a) Using voltage-divider biasing, what is the voltage at the gate V_{GS} ?

(2 marks)



b) Power amplifiers can be grouped into classes. Write down the efficiency for following classes.

- i) Class A
- ii) Class B
- iii) Class C

(3 marks)

c) A class C amplifier is driven by a 300 kHz signal. The transistor is on for $1\mu\text{s}$, and the amplifier is operating over 100 percent of its load line.

If $I_{C(sat)} = 100\text{mA}$ and $V_{CE(sat)} = 0.3\text{V}$, what is the average power dissipation?

(4 marks)

d) i) A class A amplifier has a current gain of 70 and voltage gain of 50. Calculate the Power gain?

(2 marks)

ii) A class A amplifier is biased with a centered Q-point at $V_{CEQ} = 5\text{V}$ and $I_{CEQ} = 15\text{mA}$.

Calculate maximum output power?

(2 marks)

e) State an application of power amplifiers.

(1 mark)

f) (i) What is heat sink?

(1 mark)

(ii) Why do most heat sinks have a matt black finish?

(1 mark)

(iii) Why are the heat sinks mostly fin shaped?

(1 mark)

THE END

