F. Y. B. Tech Academic Year 2021-22

ECE1022A: Basics of Electrical and Electronics Engineering

Trimester: II

Assignment 1

Date: 10 Jan 2022 Max. Marks: 25 Submission Date: 17 Jan 2022

Course Outcomes (COs) Covered:

1. Predict the behavior and characteristics of basic electrical and magnetic circuits. (CLII) 2. Identify components/equipment required for any particular application related to electrical and electronics engineering. (CL-II)

Instructions:

1. **Q I is a set of 10 MCQs. Each MCQ carries one mark.**
2. **Q II, Q III, Q IV each carry 5 marks.**
3. **Pls note in Q II, Q III, Q IV, the component values are to be selected based on your division and roll number.**

Q. I Select the answer of the following MCQs.

1) When transistor is used as an amplifier, it operate in the

A. active region

B. breakdown region

C. saturation and cutoff regions

D. linear region

2) Select which statement is incorrect.

A. In a diode, the forward bias narrows the depletion region and produces the voltage drop across a pn junction equal to the barrier potential.

B. If the external reverse-bias voltage is increased to a value called the breakdown voltage, the reverse current will drastically decrease.

C. The extremely small reverse current in a reverse-biased diode is due to the minority carriers from thermally generated electron-hole pairs.

D. The voltage drop across pn junction for a silicon transistor is 0.7 V and for germanium transistor it is 0.3 V

3) If V_{CC} = +15 V, then in the voltage-divider circuit with resistor R_1 is 4.7 k Ω, and R_2 is 1500 Ω, what is the base bias voltage for a transistor in CE configuration?

A 8.70 V

B 4.35 V

C 3.62 V

D 0.7 V

4) Select the correct statement from the following**:**

A In PNP BJT, a collector is heavily doped and base is lightly doped

B In NPN BJT, a collector is lightly doped and base is moderately doped

C In PNP BJT, an emitter is heavily doped and base is lightly doped

D In NPN BJT, an emitter is heavily doped and collector is lightly doped

5) When the collector junction in transistors is reverse biased and the emitter junction is reverse biased, the transistor is said to be operating in the

A. Cut off region

B. Active region

C. Switching mode

D. Saturation region

6) In a BJT of type NPN, the largest current flows

A. In the base

B. In the collector

C. In base and collector

D. In the emitter

7) Select the incorrect statement.

A. Ripple factor should be as small as possible and rectification efficiency should be as large as possible for a good rectifier.

B. PN junction diodes are used in Voltage multipliers and reverse current protection circuits.

C. Zener diodes are used in forward biased condition for an application of voltage regulator.

D. The higher capacitor value in a capacitor filter, improves the ripple factor.

8) What is the current gain for a common-base configuration where $I_E = 4.2$ mA and $I_C = 4.0$ mA?

A. 16.80
B. 1.05
C. 0.20
D. 0.95

9) Which of the following statements is incorrect?

A. The process of giving off light by applying an electrical source of energy is called electroluminescence.
B. The Energy difference between the electrons and the holes corresponds to the energy of visible light.
C. A small exposed surface area on one layer of the semiconducting material permits the photons to be emitted as visible light in a LED.
D. The emitted light tends to be monochromatic and that depends on the band gap and impurities added during the LED construction.

10) The parameter h_{ie} stands for input impedance in _____

A. CB arrangement with output shorted

B. CE arrangement with output shorted

C. CC and CB arrangement with output shorted

D. CC arrangement with output shorted

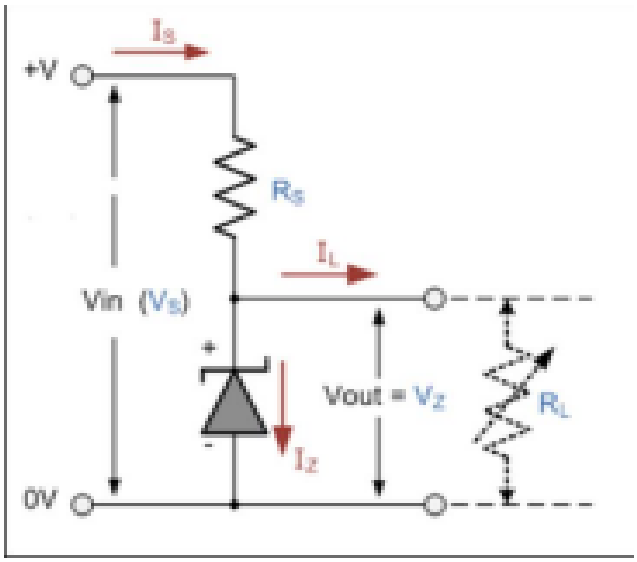
Q. II

A voltage $V(t) = 300 \cos 100\omega t$ is applied to a half wave rectifier with R_L =5KΩ. The rectifier is represented by an ideal diode in series with a resistance of a value equal to the last two digits of roll no. of a student (For example- **1KΩ, 2KΩ ,3KΩ……..65KΩ**)

Find the following:

1. Load Current (I_m)
2. DC Power
3. AC Power
4. Rectifier efficiency
5. Ripple factor

Q.III



A stabilized power supply is required to produce a constant output voltage, Vz

Vz= Addition of last two digits of your Roll number (in volts)

Input DC power supply source value, Vs

Vs= ***Twice the Vz Plus 2 (in volts)***.

The maximum power rating of the Zener diode is Pz

Pz= Your Division number minus 5 (in watts) if your division number is greater than 10 otherwise take Pz=10 watts

(Example) ***Lets take Roll Number 115003*** ***(for div 11)***
Vz= (0+3)= 3 volts
*Vs= (2*3)+2= 8 Volts*
Pz= Division no. 11 > 10 so 11-5=6 Watts

Using the Zener regulator circuit shown below, calculate:

a) The maximum current flowing through the Zener diode.

b) The value of the series resistor, Rs, with no load

c) The load current IL if a load resistor of 1kΩ is connected across theZener diode.

d) The Zener current Iz at full load.

Q IV.

A silicon transistor connected in CE configuration with voltage divider bias is shown in the following figure. V_{CC} =15V,

R_1 is equal to twice of the last two digits of your roll number in KΩ if that two digits are less than 35(roll no.1- roll no. 34) (Ex: for 1110**12**, R_1=2***12**=24KΩ) else the last two digits in KΩ,

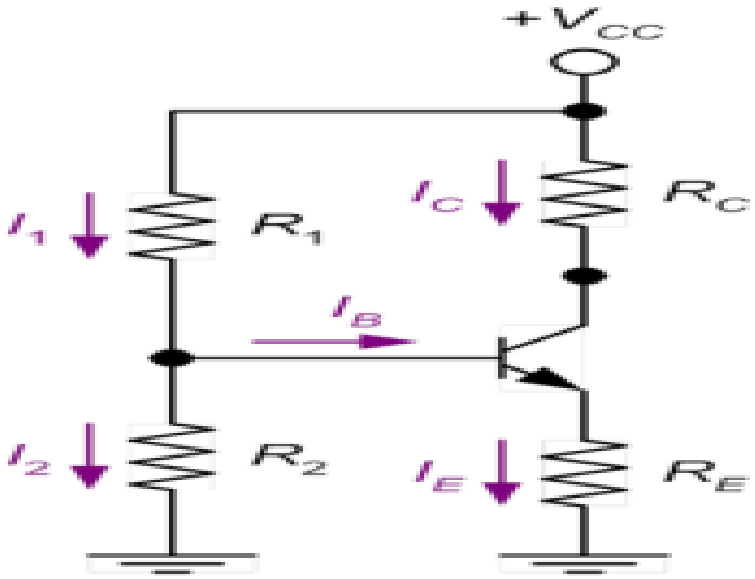
R_2 is equal to thrice of your division number for students with roll number less than 35 (roll no.1-roll no. 34) and twice of your div no. for students with roll no. greater than and equal to 35.

(Example for div 11: For roll no. 1**11**012, R_2=3***11**=33K & for roll no. 1**11**070,

R_2=2***11**=22KΩ). Find the Q-point of the amplifier circuit if Rc=1.5KΩ & R_E=15KΩ &

β = 160

Refer the following circuit diagram below for R1,R2 Rc ,RE and Vcc.


+VCC
I1
R1
IC
RC
IB
I2
R2
IE
RE

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Div. 9.

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BEEE Assignment -1

Q.1. (1) Transistor is used as an amplifier in ~~active~~ active mode

~~Q.2.~~ (2) "If the external reverse bias voltage is increased to a value called the Breakdown voltage Reverse current will decrease."

is False.

Reverse current should drastically Increase.

(3) $V_{cc} = 15\ V$

$R_1 = 4.7\ K\Omega \quad R_2 = 1.5\ K\Omega$

Base Voltage will be,

$$\left(\frac{R_2}{R_1 + R_2}\right) V_{cc} = \left(\frac{1.5}{1.5 + 4.7}\right) 15$$

$$= 3.629\ V$$

~~Q.4.~~ (4) In a PNP BJT, Emitter is heavily doped and Base is lightly doped.

(5) Cut off Region

(6) $I_E = I_c + I_B$

largest current flows in the Emitter

(7) B. "Zener diodes are used is forward Biased condition for voltage regulators"

is false. They are used in reverse Bias.

(8) $I_E = 4.2$ mA

$I_c = 4.0$ mA.

For CB config,

$$\alpha_{DC} = \frac{I_c}{I_E} = \frac{4}{4.2} = \underline{0.9523}$$

(D) option

(9) D. "~~The emitted light tends to be monochromatic and that depends on the band gap and impurities added during the LED construction~~. A small exposed area on one layer of the semiconducting material permits photons to be emitted as visible light in an LED.

(10) h_{ie} Stands for input impedance in CE arrangement with output shorted.

9. (2) Voltage $V(t) = 300 \cos 100(\omega t)$ is applied to half wave Rectifier. with $R_L = 5\ k\Omega$. Diode are Ideal. is series with source Resistance $R_S = 54\ k\Omega$. Find all parameters.

Ans

$V_t = 300 \cos(100\omega t)$ V

$R_L = 5\ k\Omega$

$R_S = 54\ k\Omega$ (Roll NO : 54)

Here, $V_t = 300 \cos 100\omega t$

$V_{max} = 300 = V_{peak}$

As diode is ideal. R_D is ignored.

$R_{total} = R_L + R_S$

$= 54 + 5 = 59\ k\Omega$

So $I_{max_{AC}} = \frac{300}{59} \times 10^{-3}$ A.

$= 5.08 \times 10^{-3}$ A

$= 5.08$ mA

$I_{DC} = \frac{5.08}{\pi} = \frac{I_m}{\pi} = 1.61$ mA

$I_{rms} = \frac{I_M}{2} = 2.54$ mA

Power is load due to DC component of current $= P_{DC} = I_{DL}^2 \times R_L$

$= 1.61^2 \times 5\ K\Omega$

$= 12.9\ W \times 10^{-3}$

Power is dissipated due to AC current,

$P_{AC} = I_{rms}^2 \times (R_L + R_S)$

$= 2.54^2 \times (59000) \times 10^{-6}$

$= 380.64\ W \times 10^{-3}$

Efficiency of Rectifier $= \frac{P_{DC}}{P_{AC}} = \eta$

$\eta = \frac{12.9 \times 10^{-3}}{380.6 \times 10^{-3}} = \underline{3.39\ \%}$

Ripple factor :

$r = \sqrt{\left(\left(\frac{I_{rms}}{I_{DC}}\right)^2 - 1\right)}$

$= \sqrt{\left(\frac{2.54}{1.61}\right)^2 - 1}$

$= \sqrt{1.488} = \underline{1.22}$

Load current $(I_m) = I_{DC} = 1.61\ mA$

DC Power $P_{DC} = 12.9\ mW$

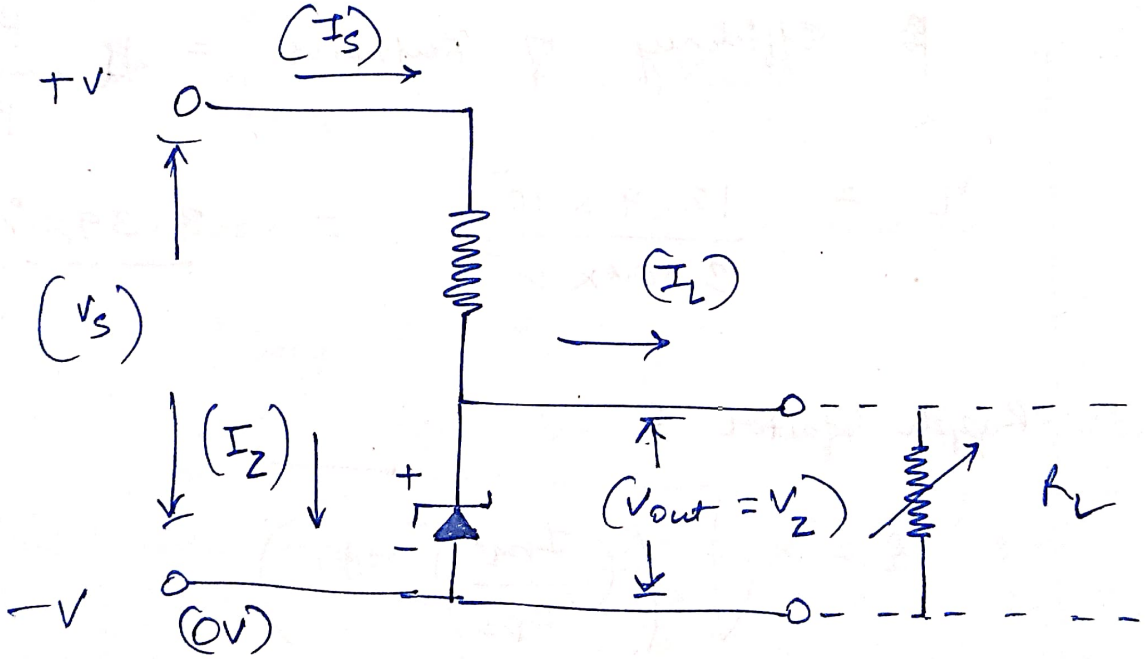
AC Power $P_{AC} = 380.64\ mW$

Rectifier efficiency $\eta = 3.39\ \%$

Ripple factor $r = 1.22$

Q(3). Using Zener Regulation circuit shown Below, calculate →

1. Max current through diode.
2. The value of the series resistor R_s with No load.
3. Load current I_L if a load Resistor of ~~1KΩ~~ 1 KΩ is connected across Zener diode
4. Zener current I_Z at full load.



$5 + 4 = 9\,V$

$\therefore V_Z = $ ~~54 (V)~~ [Roll No. 54]

$V_S = 2 \cdot (V_Z) + 2 = 18 + 2 = 20\,V$ ~~10 V.~~

$\therefore P_{Z_{max}} =$ ~~P_Z V_Z~~ [Div < 10]

$=$ ~~I_Z V_Z~~ [P = ~~V~~ / 10]

~~10 W~~ 10 W

(1) Maximum current through Zener Diode

$$I_{Z_{max}} = \frac{P_{max}}{Voltage} = \frac{10}{9} = 1.11\ A$$

(2) Value of R_S with NO load

$$R_S = \frac{V_S - V_Z}{I_{Z\,max}} = \frac{20 - 9}{1.11}$$

$$= 9.909\ \Omega$$

(3) Load current if I_L is $1\ k\Omega$

$$I_L = \frac{V_Z}{R_L} = \frac{9}{1000} = 9\ mA$$

(4) I_Z at full load,

$$I_Z = I_S - I_L$$

$$= I_{Z_{max}} - I_L = 1110 - 9$$

$$= 1101\ mA$$

Q.4. CE config voltage divider Bias circuit is shown.

$V_{CC} = 15V$

$R_1 = 54\ k\Omega$

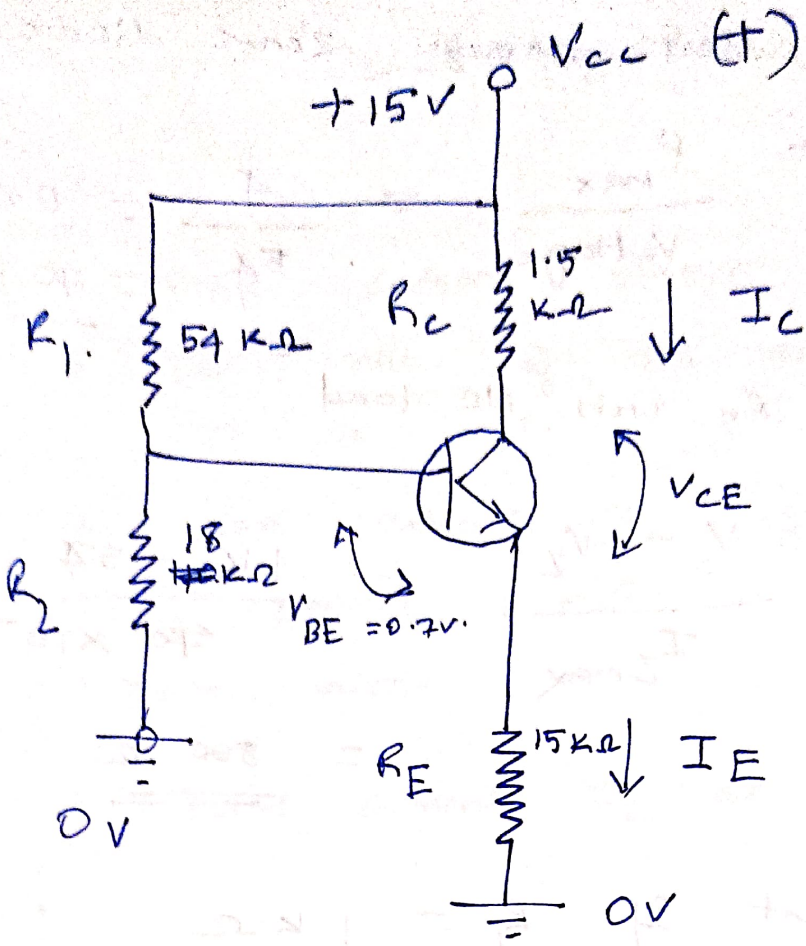
$R_2 = 9 \times 2 = 18\ k\Omega$

$R_C = 1.5\ k\Omega$

$R_E = 1.5\ k\Omega$

$\beta = 160$

Find Q point.



$$V_{BB} = V_{cc}\left(\frac{R_2}{R_1+R_2}\right) = 15\left(\frac{18}{54+18}\right)$$

$$= 15\left(\frac{18K}{18K+54K}\right) = 3.75V$$

$$V_E = V_{BB} - 0.7 = 3.75 - 0.7\ V$$

$$= 3.05V$$

$$I_{EQ} = \frac{V_E}{R_E} \quad \text{so} \quad I_E = \frac{V_E}{R_E} = \frac{3.05}{15000} = 0.20\,mA$$

But $I_C \approx I_E = 0.20\,mA = I_{CQ}$.

$$V_{CE} = V_{cc} - I_C R_C = 15 - (0.20)(1.5\times10^3)\times10^{-3}$$

$$= 15 - 0.3 = 14.7V$$

$$V_{CE} = V_c - V_E$$

$$= 14.7\,V - 3.05\,V$$

$$= 11.65\,V$$

So Q point $= (I_c, V_{CE})$

$= (0.20\,mA, 11.65\,V)$