MILITARY COLLEGE OF SIGNALS

MID TERM EXAM

COURSE – BESE 15 (A&B)

SUBJECT –ELECTRONIC CIRCUITS & DEVICES

INSTRUCTOR: Lt Col Saleem(Retd)

Time: 1:30 Hours

MAX Marks: 30

Note: **Attempt all questions. Be specific and to the point. All questions carry equal marks. Draw neat and clean diagrams.**

Question No-1

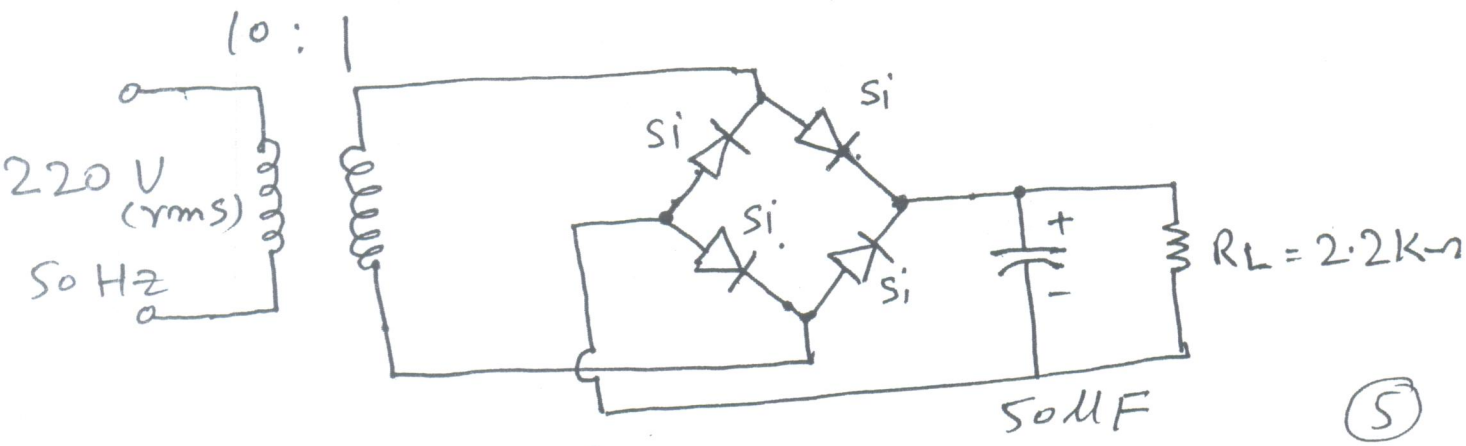
a. Show diagramatically the complete Diode model in Forward and Reverse bias (5)

b. Draw Energy diagram which should Explain the formation of PN Junction and depletion region at the instant of Junction formation and at equilibrium. (3)

c. Enumerate and sketch the Transistor configuration (2)

Question No-2

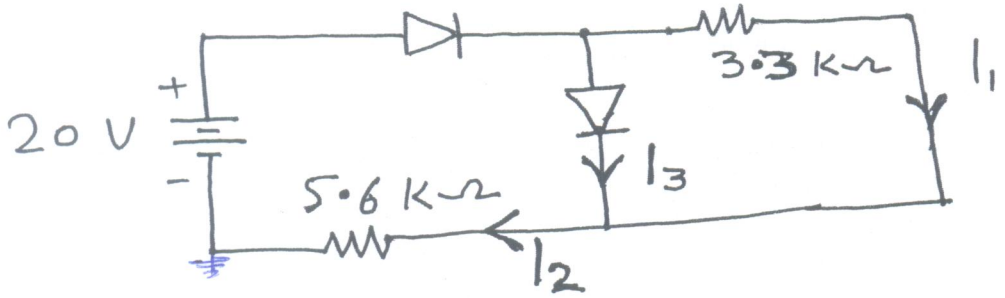
a. Calculate ripple factor in the circuit



(5)

(P.T.O)

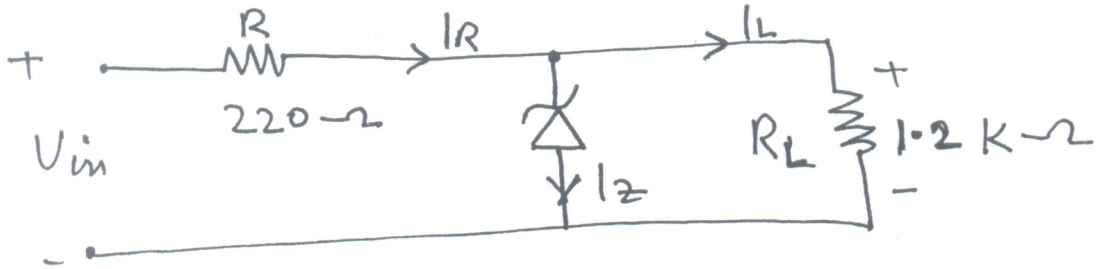
b. Compute the value of I_1, I_2 & I_3 in the Network. Diodes are made up of Si material.



(5)

Question NO-3

a. Calculate the range of values of Vin, that should maintain the zener diode in the 'ON' State. Zener voltage $V_Z = 20V$ and $I_{Z_M} = 60mA$



(6)

b. Differenciate between The followings.

i. LED and Photo Diode (2)

ii. clipping and clamping action in diode. (2)

(Good Luck).

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Mid Term Exam (BESE 15A & B)

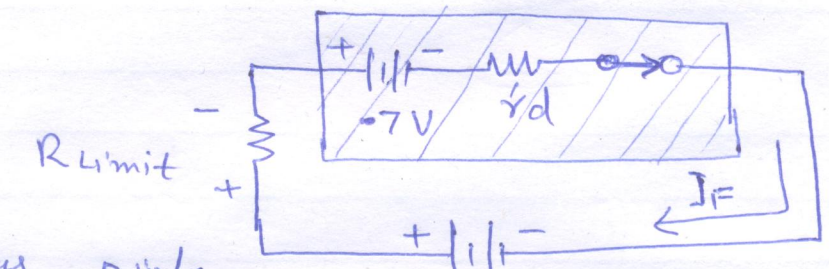
Solution:

Question No. 1

a. **Complete Diode Model** consist of followings

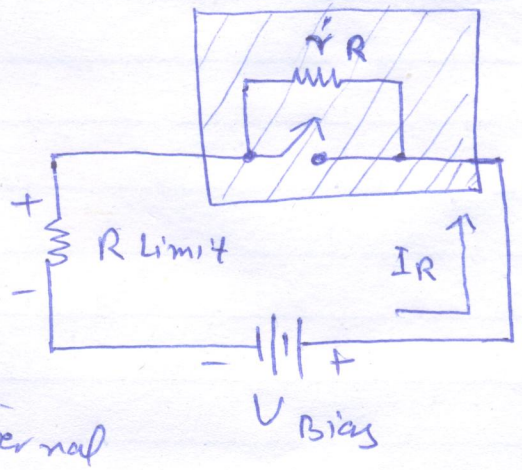
- Barrier potential
- Small Forward dynamic resistance (r'_d)
- Large Internal reverse resistance (r'_R). It provides path for reverse current. (1)

Forward bias.



In Forward bias Diode act as closed switch in series with barrier potential, r'_d (2)

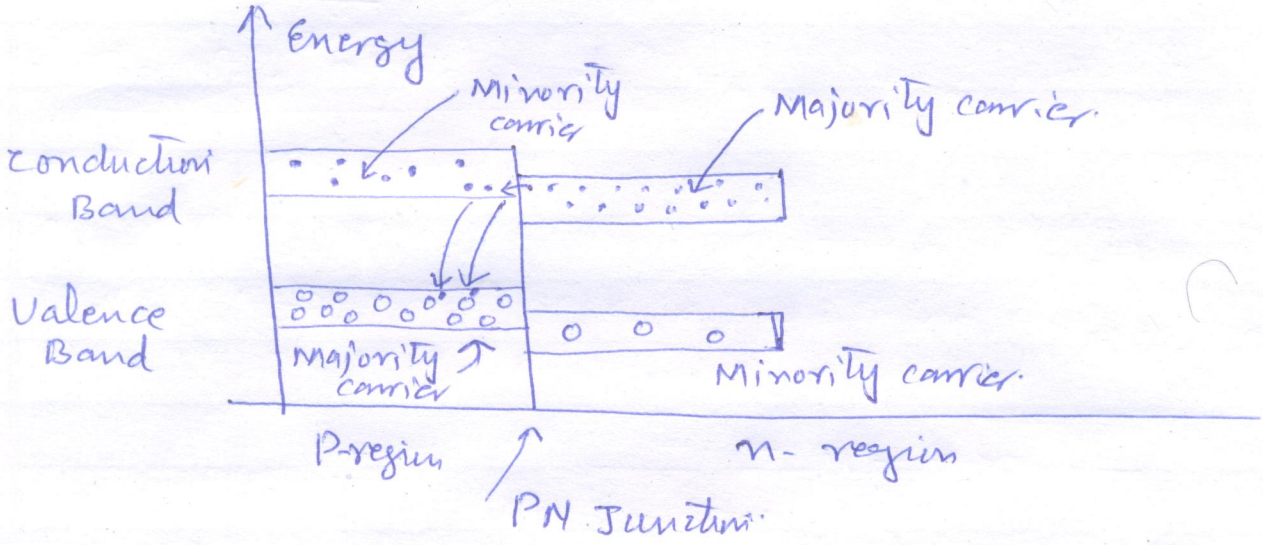
Reverse bias



In reverse bias it act as a open switch in parallel with Large internal reverse resistance (r'_R) (2)

b. Due to atomic characteristics (3rd & 5th) group impurity atoms, The Valence and conduction band in N-Type are at a little bit lower energy level than P-Type.

- The energy diagram at the instant of Junction formation is as under.

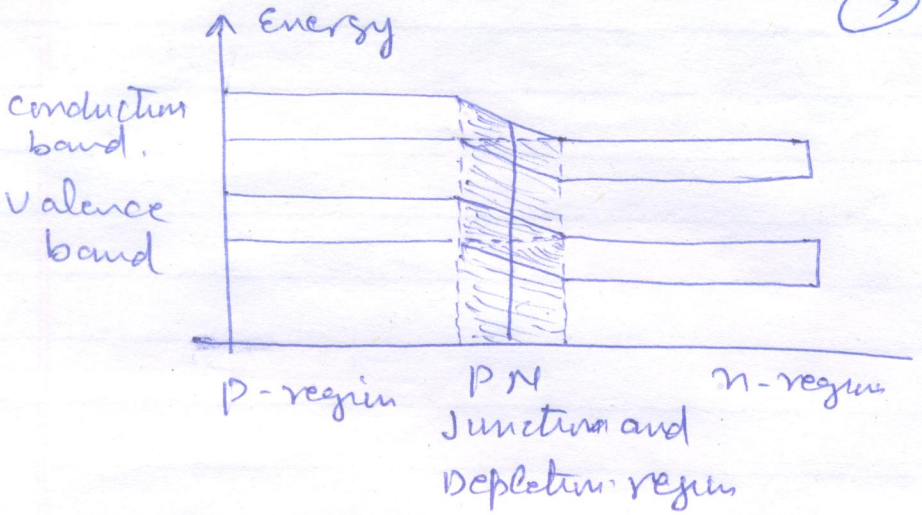


(1.5)

There is overlapping in energy level, the electron in n-region occupy upper part of conduction band and easily diffuse across the Junction. After crossing the Junction they losse energy and falls into the holes in P-region valence band. The diffusion continues and depletion region begins to form.

<u>In Equilibrium</u>. the Depletion region is complete and diffusion ceased and energy hill is form. The energy level in n-region shifted down and energy gape between valence & conduction band remains the same.

Diagram is shown on next page. (1)



AT Equilibrium.

C. Configurations of BJT

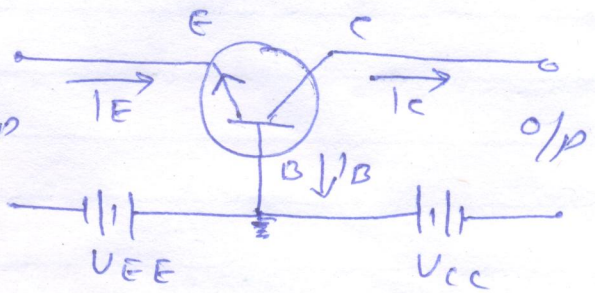
(2)

BJT are used for amplification. There are 3 x different configuration. In each arrangement one of the three leads is used as a common reference and other 2 are used as I/P and O/P connection.

the 3 circuit arrangements are.

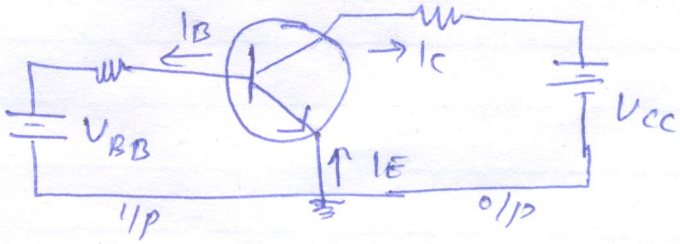
- Common base.

npn Transistor in CB configuration



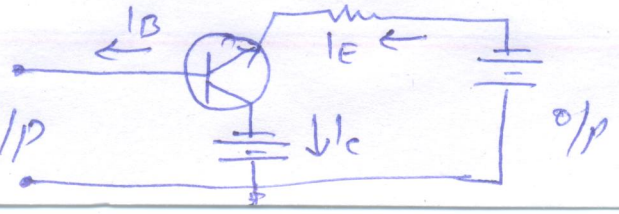
- Common Emitter configuration

npn Transistor in CE configuration



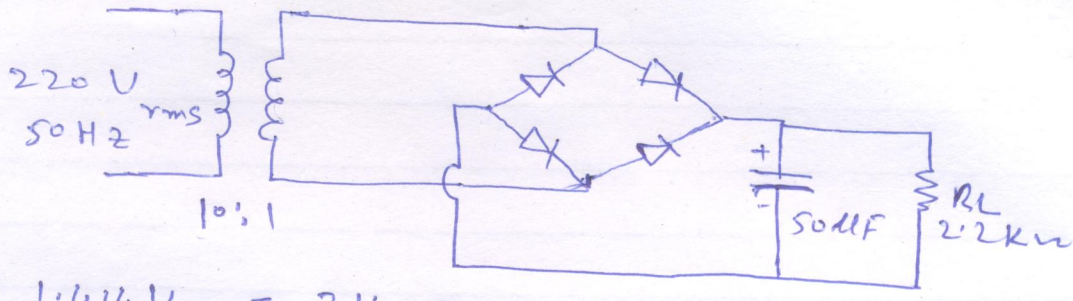
- Common collector config

npn Transistor in CC config.



Question No. 2

a.



$n = 0.1$

$$V_{P(pri)} = 1.414\, V_{rms} = 311.08\ V$$

$$V_{P(sec)} = n\, V_{P(pri)} = 0.1(311.08) = 31.108\ V$$

Full wave rectified voltage

$$V_{P(rect)} = V_{P(sec)} - 1.4\ V = 29.708\ V$$

Freq of FWR voltage is $2 \times f_{in} = 100\ Hz$

$$V_{r(PP)} = \left(\frac{1}{f R_L C}\right) V_{P(rect)}$$

$$= \left(\frac{1}{(100\ Hz)(2.2 \times 10^{3}\ \Omega)(50 \times 10^{-6}\ F)}\right) 29.708\ V$$

$$= (0.0909090)\, 29.708 = \boxed{2.70072}$$

$$V_{DC} = \left(1 - \frac{1}{2 f R_L C}\right) V_{P(rect)} =$$

$$= \left(1 - \frac{1}{(2\nu)(2.2K)(50\mu F)}\right) 29.708$$

$$(1 - 04545)\, 29.708$$

$$(0.954545)\, 29.708 = \boxed{28.357636\ V}$$

$$r_{filter} = \frac{V_{r(PP)}}{V_{DC}}$$

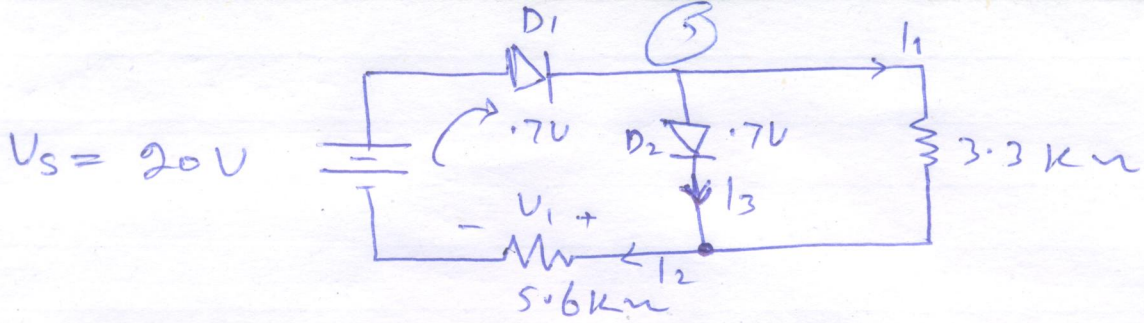
$$= \frac{2.70072}{28.357636}$$

$$= \boxed{0.095237\,83}$$

or

0.0952

b.



$V_S = 20V$

This is simple DC series parallel network.

$$I_1 = \frac{V_{D2}}{3.3k\Omega} = \frac{0.7V}{3.3k} = \boxed{0.212\ mA}$$

Apply KVL on Left loop.

$$-V_S + V_{D1} + V_{D2} + V_1 = 0$$

$$-20 + .7 + .7 = -V_1 \quad \text{or} \quad V_1 = 18.6V$$

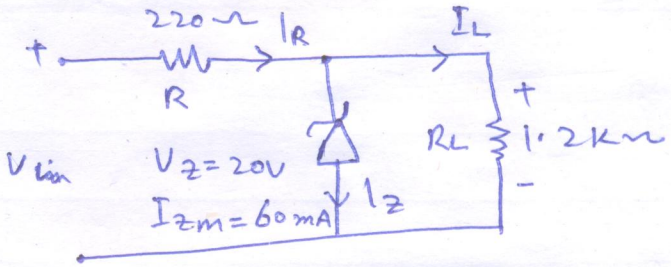
$$I_2 = \frac{V_1}{5.6k} = \frac{18.6}{5.6k\Omega} = \boxed{3.32\ mA}$$

KCL at top or bottom node $= I_2 = I_1 + I_3$

$$I_3 = I_2 - I_1 = \boxed{3.11\ mA}$$

Question No. 3

a.



Inverse V. Division.

$$V_{in(min)} = \frac{(R+R_L)V_Z}{R_L} = \frac{(220+1200)\,20V}{1200} = 23.666 \cong 23.67V$$

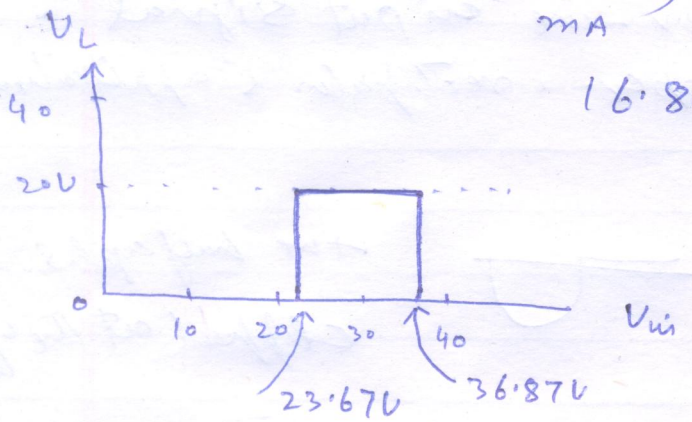
$$I_L = \frac{V_L}{R_L} = \frac{V_Z}{R_L} = \frac{20V}{1.2k\Omega} = 16.67\ mA$$

$$I_{R(max)} = I_{Zm} + I_L = 60mA + 16.67mA = 76.67mA$$

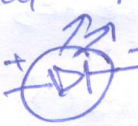
$$V_{in(max)} = I_{R(max)} \cdot R + V_Z$$

$$\left(76.67 \frac{mA}{}\right) 0.22\,K\Omega + 20V = 36.87$$

$$16.867 + 20 = 36.867\,V$$



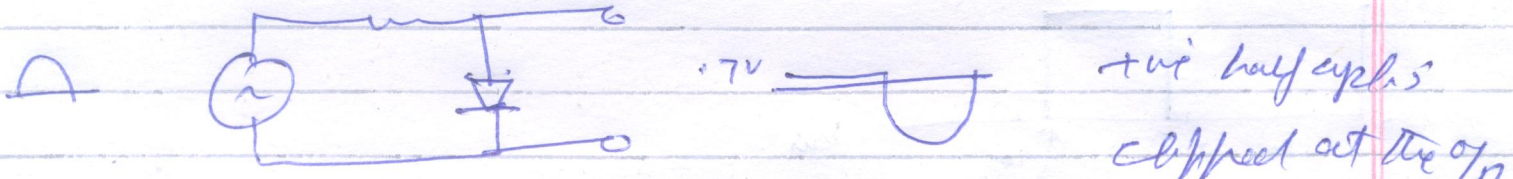
b. LED & Photo Diode

(i) In LED when device's forward bias electron cross PN Junction from n-Type material and recombine with Hole in p-Type. the recombination of electron with hole release energy & light. The material permits the photons to be emitted as visible light. The wavelength depends on doping & determine the color of Light. made up of GaAs. GaAsP or GaP. Si & Ge are not used as they produce heat. Required voltages are between 1.2V to 3.2V. Symbol's 

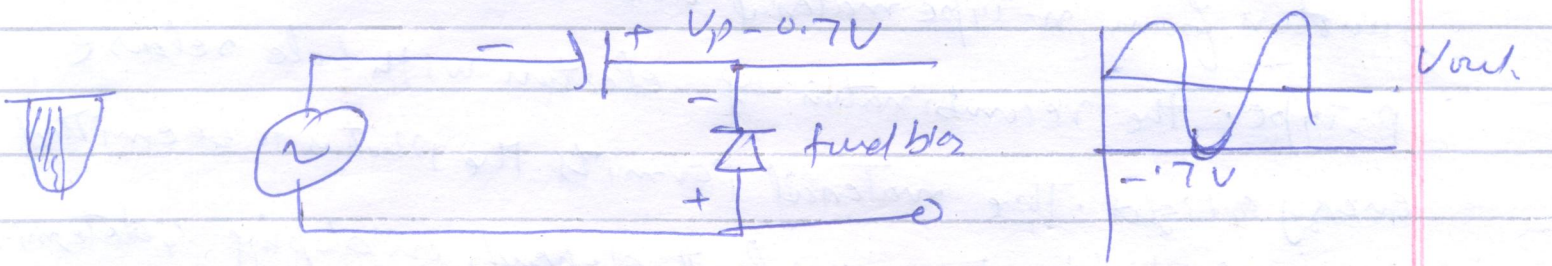
Photodiode operates in reverse bias. It has small Transparent window. when Light strike on PN Junction Reverse biased current flows and it increase with temp as more e, Hole pair are generated. Value of current depends upon intensity of Light. if no light no current flow. Symbol's 

11. clipping and clamping

clipper are also called Limiter as they limit or clips the portion of +ve or -ve input signal HWR is typical example of clipper. rectifier's application



- clamper are also called DC restorer. they insert +ve DC level in the o/p wave form. capacitor's used in series instead of Resistor.



can be +ve or -ve clamper.
" " series or parall " also
Typical use's voltage multiplier.