

CO-1

Basic Electronics (EC-1000)

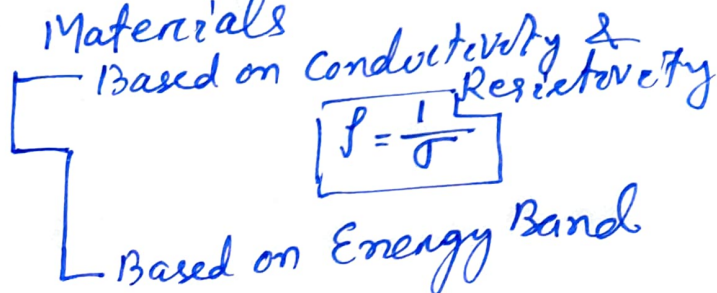
proper labeling ①

(Try to represent your answers pointwise with points and mathematical expressions)

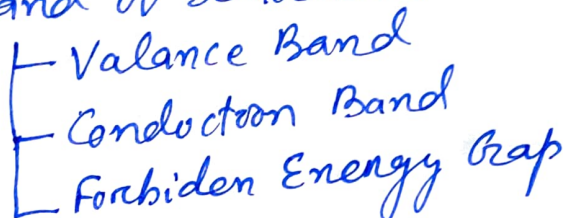
• Classification of Materials



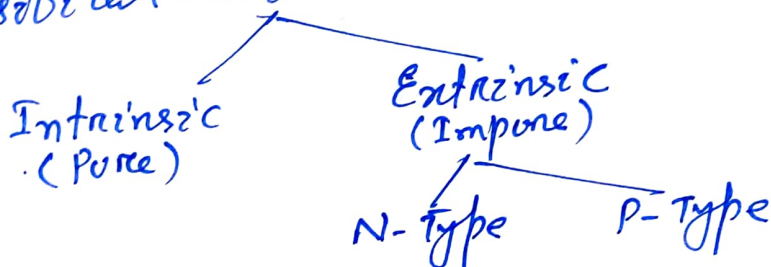
• Properties of Materials



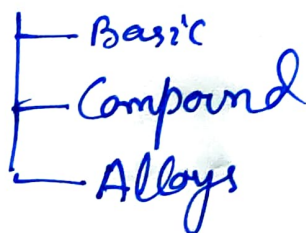
• Energy Band of Semiconductor



• Classification of Semiconductors



• Different Types of Semiconductor



• Doping Process — Dopant

Trivalent Pentavalent

Why doping?

What happens to Fermi level in Energy Band diagram?

(2)

- Crystalline structure of N-Type & P-Type Semiconductor.
- Concept of Drift & Diffusion Current.
- Understanding of Terms —
 - Donor
 - Dopant
 - Acceptor
 - Immobile Ions
 - Majority & Minority Carriers.
 - Electron & Hole Current.
 - Breakdown of Covalent Bond
 - Recombination Process

• Mass action law — $n \cdot p = n_i^2$

(Numerical)

- Comparison betⁿ Basic Semiconductor
Silicon (Si) | Germanium (Ge)

- Sample Numerical
(Q) In an extrinsic semiconductor concentration of holes is $5.2 \times 10^{10} \text{ cm}^{-3}$. Calculate concentration of electrons. Intrinsic concentration = $2.3 \times 10^{13} \text{ cm}^{-3}$ at 300K.

- Effect of Temperature on the resistance of a conductor and semiconductor.

- P-N Junction Diode & its operation

- What is Biasing

Forward Reverse

- Characteristics of Crystal & Zener Diode with its Terms —

— V-I characteristics (FB & RB)
 — V_{knee}
 — Breakdown Voltage
 — Reverse Saturation Current.
 — $PIV \propto PRV$ of a Diode

- Ideal Diode & Equivalent ckt. of practical Diode.

- Diode Equation:

$$I_D = I_S \left(e^{\frac{(kV_D)}{T_{K1}}} - 1 \right)$$

(Define all parameters) (Numerical)

- Diode Resistance

Static
(DC)

Dynamic
(AC)

- Breakdown in Reverse Bias

Avalanche

Zener

- Sample Problem

The reverse saturation current at 300K of a p-n junction Ge diode is $5 \mu A$. Find the voltage to applied across the junction to obtain a forward current of 50mA.

Application of Diode

Ch. diagram & operation

Rectification using crystal diode

Half Wave

Full Wave (Only Center tap)

Voltage Regulation using Zener diode

Performance of Rectifier with its expression & calculation.

HW

$$I_{DC} = \frac{I_m}{\pi}$$

$$V_{DC} = \frac{V_m}{\pi}$$

P_{DC} & P_{AC} for Efficiency $\eta = 40.6\%$

PIV & PRV of Halfwave Rectifier $\geq V_m$

Ripple factor $\gamma = 1.211$

$$I_{DC} = \frac{2I_m}{\pi}$$

$$V_{DC} = \frac{2V_m}{\pi}$$

~~Efficiency~~ Efficiency, $\eta = 81.2\%$

Ripple Factor $\gamma = 0.48$

PIV of Full wave Rectifier $\geq 2V_m$

Advantage & Disadvantage of HW & FW Rectifier

Different Input & output waveforms of Rectification process.

Rectifier output with different Filter (C, LC) and its waveform representation.

• Sample Problem

- A diode, the forward resistance is 50Ω , supplies power to a load resistance 1200Ω from a $20V$ (rms) source. Calculate
- the dc load current
 - the dc voltage across the diode
 - the ac load current
 - the dc output power
 - the conversion efficiency
 - the percentage regulation.

- A center tap full wave rectifier has load resistance of $5k\Omega$ and input voltage is $150 \sin(120\pi t)$ V. Determine
- peak, average and rms value of load current
 - dc output voltage
 - PIV of each diode
 - efficiency
 - output efficiency (Assume diodes to be ideal diode).

*** Do not try to ^{simply} answer the questions only

*** Try to properly present your answer



Bipolar Junction Transistor

NPN



PNP



- Doping level of Emitter, Base & collector

~~General~~

- Operation of BJT through proper Biasing arrangement.

- Fundamental Current Eqⁿ

$$I_E = I_C + I_B$$

- Different Configuration

CE CB CC

Gain = $\beta = \frac{I_C}{I_B}$ Gain = $\alpha = \frac{I_C}{I_E}$ Gain = $\gamma = \frac{I_E}{I_B}$

Relation between α, β, γ .

- Leakage Current

I_{CBO} & I_{CEO}

- Current Relations

$$I_C = \alpha I_E + I_{CBO}$$

$$I_B = (1 - \alpha) I_E - I_{CBO}$$

$$I_C = \beta I_B + (1 + \beta) I_{CBO}$$

$$I_C = \beta I_B + I_{CEO}$$

- Sample Problem

1. - If $\beta = 16.5$, $I_E = 1.8 \text{ mA}$ and $I_{CO} = 12 \mu\text{A}$, calculate I_C and I_B when transistor used in the CE configuration.
2. - If $\alpha = 0.95$, then find β of the transistor.