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ELECTRICAL ENGINEERING

Electrical Engineering

Hand Notes For GATE, IES, PSUs etc…

Hand Notes

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Note : *We also providing IIT JEE, Advance, NEEt, JEE UG, GATE, IES, PSUs & Competitive Exam Materials [Handnotes, Shortnotes & Books], All Reports [Seminar Reports & PPT]*

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Cover Topic :

- Electric Circuits &Network
- Basic Concept Of Nature Of Electricity
- Classification Of Resistance
- Conversion Of Current Source To Voltage Source
- Oms Law
- Kirchoffs Current Or Voltage Law
- Node Analysis
- Mesh Analysis
- Superposition Theroam
- Thevenins Theroam
- Nortons Theroam
- Ac Circuits
- Three Phase Circuits
- Transformer

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Basic terms related to electrical circuit & network.

1) current (I) :- unit - Ampere (A)

→ Flow of electrons

→ Rate of change of charge w.r.t time

$$I = \frac{dq}{dt} = \frac{q}{t}$$

$$V = IR \quad , \quad I = \frac{V}{R}$$

2) Electrical potential (V) :- unit - volts or J/c

→ workdone per unit charge

→ electrical potential energy per unit charge

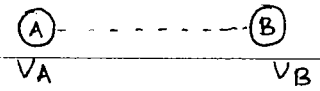
$$V = \frac{W}{Q}$$

$$V = IR$$

electrical potential is equaivlent to voltage

3) potential difference (V_{AB}) → unit → volt

The difference in the potential of two charged body.



$$V_{AB} = V_A - V_B$$

4) E.M.F (Electromotive Force) (E) - unit → volt (V)

The electrical force that moves electrical charges in a conductor & produce electric current

5) Resistance (R) - unit - ohm (Ω) or V/A

opposition to the flow of current.

opposition to the flow of electrons

$$V = IR \qquad R = \frac{V}{I}$$

$$\boxed{R = S\frac{l}{a}}$$

ρ → (rho)

6) Resistivity (ρ) OR specific Resistance

unit - ohm-meter (Ωm)

→ It is resistance of a material for unit length & unit cross-section area

$$R = \frac{\rho l}{a} \qquad \rho = \frac{Ra}{l}$$

7) conductance (G) → unit = $\frac{1}{\Omega} = \Omega^{-1}$ or siemen

→ Reciprocal of resistance

$$G = \frac{1}{R}$$

8) conductivity → $\frac{1}{\Omega m} = \Omega^{-1} m^{-1}$, siemen m^{-1}, $(S m^{-1})$

It is reciprocal of resistivity

$$\sigma = \frac{1}{R} = \frac{a}{\rho l} = \frac{1}{\rho} \frac{a}{l}$$

$\frac{1}{\rho}$ → conductivity

(W) 9) Electric Energy or Work → unit - Jule (J)

Loss of electrical potential energy in maintaining current in a circuit

or

The workdone of the electrical workdone to transfer charge from one point to another.

$$W = VQ = VIt = Pt \qquad \because P = VI$$

$$W = I^2Rt = \frac{V^2}{R} t \qquad \because Q = It$$

10) Electric power (P) unit - watt

Rate of doing work.

$$P = VI$$

$$P = VI = IRI$$

$$= I^2R = \left(\frac{V}{R}\right)^2 R = \frac{V^2}{R}$$

$$\boxed{P = \frac{V^2}{R}}$$

$$\text{power} = \frac{\text{work}}{\text{time}} = \frac{w}{t}$$

Basic concept of nature of electricity :→

Atom - smallest partical of element.

molecule - A partical which is compose of more than two atoms (which may have state solid, liquid, gas).

Atomic structure :→

Aluminium (Al → 13)	orbit	capacity.
	1 orbit	2 $e^{\ominus}$
	2 orbit	8 $e^{\ominus}$
	3 orbit	18 $e^{\ominus}$

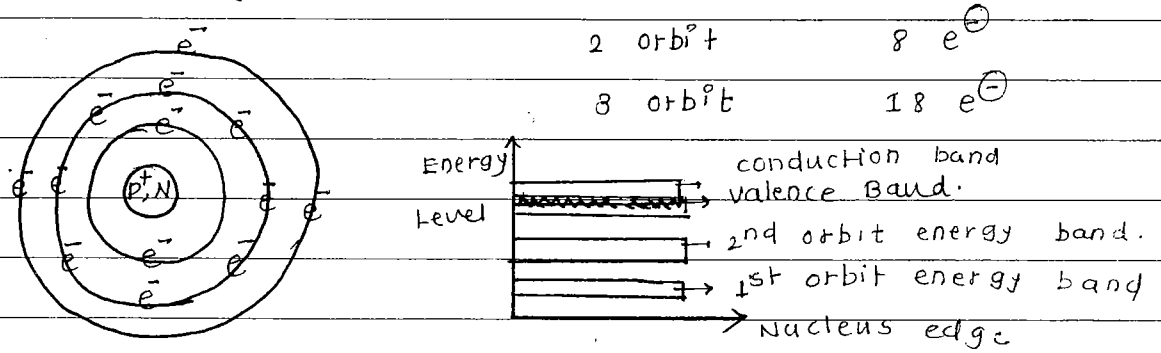
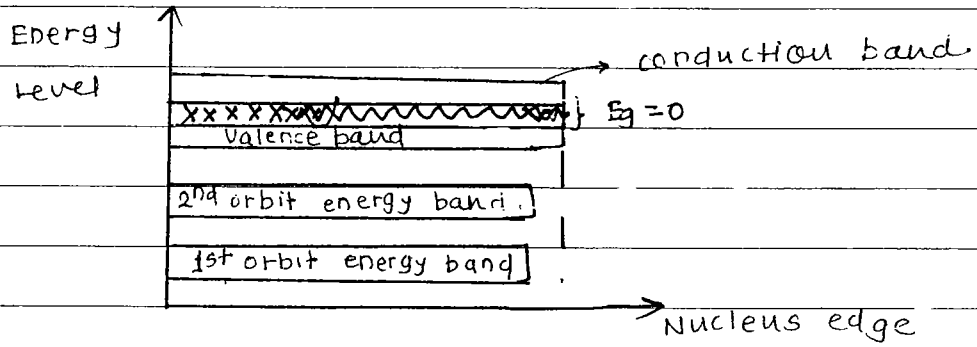


fig :- Atomic structure of aluminium.



As per away from nuclues energy required to remove electron away from orbit is going to decrease.

Fundamental partical	Mass of partical	charge on partical.
1) electron $e^{\ominus}$	~~1675×10^{-27}~~ 9.107×10^{-31}	-ve
2) proton $p^{\oplus}$	1672×10^{-27}	+ve
3) Neutron N	1675×10^{-27}	No charge

valence electron - valence band મા આવેલા $e^{\ominus}$ ને valence $e^{\ominus}$ કહેવાય છે.

free electron → conduction band મા આવેલા $e^{\ominus}$ ને free electron કહેવાય છે.

$P \cong N = 1837 \times$ mass of electrons

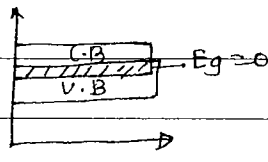
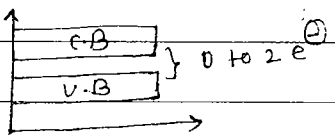
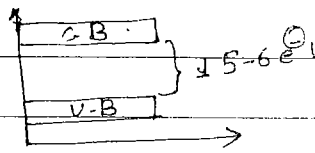
$= 1837 \times e^{\ominus}$

* charge on single electron :→ 1.6×10^{-19} coloumb.

* 1 coloumb charge = $6.25 \times 10^{16}\ e^{\ominus}$

$= 6.25 \times 10^{16}\ e^{\ominus}$

classification of materials :→

properties	conductor	semiconductor	insulator.
1) about current flow	Allow	partially allow low temp- act as insulator & high temp→ act as conductor.	not Allow
2) Resistance	Low	medium	high.
3) conductivity	High	medium	Low
4) Energy Gap (Eg)	Eg = 0	Eg = near about 0 to 2 $e^{\ominus}$	more than 5 to 6 $e^{\ominus}V$
5) Energy band diagram.			
Example	copp aluminium (13)→ 2,8,3 copper (29)→ 2,8,18,1	silicon (14)→ 2,8,4 Germium (32)→ 2,8,18,4	plastic, wood, rubber & glass.
Temperature coeff. property	+ve $R \propto T$	-ve $R \propto \frac{1}{T}$	-ve $R \propto \frac{1}{T}$

Slope $= \frac{y_2 - y_1}{x_2 - x_1}$ slope $m = \tan\theta$ θ line, x axis

$\tan(0) = 0$ ——— , $\tan 90^\circ = \infty$ | , slope +ve / , slope -ve \

Effect of temp. on resistance :→

i) for conductor $R \propto T$ — +ve temperature coefficient

ii) for semiconductor $R \propto \frac{1}{T}$ -ve temperature coeff.

iii) for insulator $R \propto \frac{1}{T}$ — -ve temperature coeff.

Temperature coefficent of resistance / Resistance temp coeff.

RTC (α_t)

→ The ratio of change in resistance per degree celsius. to the resistance at $t^\circ C$

$$RTC\ (\alpha_t) \text{ at } t^\circ C = \frac{\Delta R / {}^\circ C}{R_t}$$

RTC at $t_1^\circ C$, $\alpha_1 = \frac{R_2 - R_1 / t_2 - t_1}{R_1}$

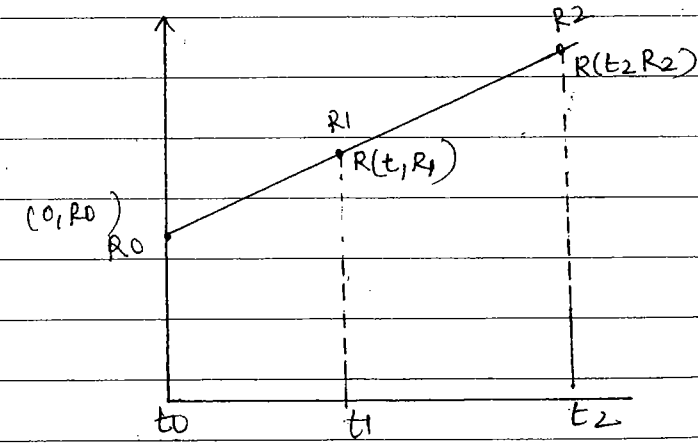
where, $\Delta R = R_2 - R_1$

Δt = change in temp $= t_2 - t_1$.

$$\boxed{R_2 = R_1(1 + \alpha_1(t_2 - t_1))}$$ — if $t_2 > t_1$

R_1 R_2

t_1 t_2



$$\alpha_n = \frac{\alpha_0}{1 + \alpha_0 t_n}.$$