MADE EASY

ELECTRICAL ENGINEERING

D.C. Machine

By.Roshan Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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ELECTRICAL MACHINE

Lecture 01

→ Transformer] static m/c
→ DC Machine
→ Induction machine] Rotating m/c
→ Synchronous machine
** special machine

Basic Concepts of Rotating machine

Rotating m/c are of two types

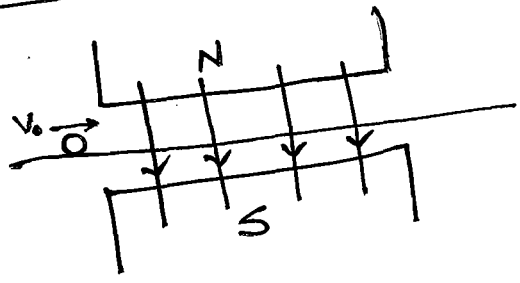
(1) Generator [mech energy → Electrical Energy] in presence of mag. field

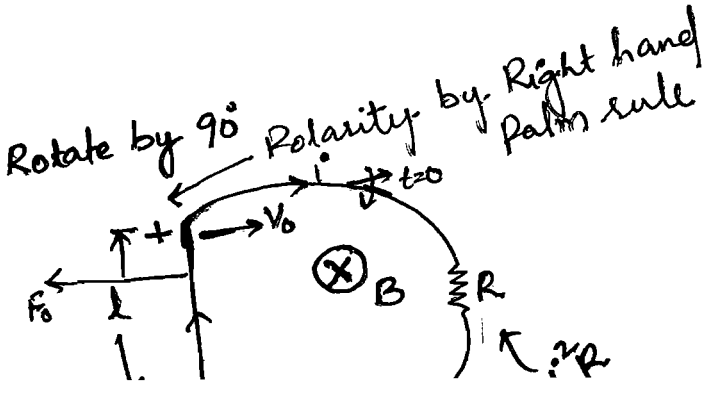
(2) Motor [Electrical energy → Mechanical Energy]

Magnetic field acts as a coupler b/w mechanical energy and electrical energy means it provides a medium from one form to another.

Assumption:
Lossless system

Basic Generator





$$e = (\vec{v} \times \vec{B})l$$

$$|e| = vBl\sin\theta$$

$$E_0 = V_0 Bl \quad \because \theta = 90^\circ$$

At $t = 0^+$

$$I_0 = \frac{E_0}{R} = \frac{V_0 Bl}{R}$$

As this current carrying conductor is placed in a magnetic field a force is developed in a conductor and is given by

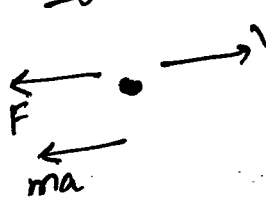
$$F = \vec{I}l \times \vec{B}$$

$$F_0 = \vec{I_0}l \times \vec{B}$$

$$|F_0| = I_0 lB\sin\theta'$$

$$F_0 = I_0 lB \quad \because \theta = 90^\circ$$ (using Right hand Palm rule)

Free body Diagram (FBD) of Conductor



$$ma + f = 0$$

$$m\frac{dv}{dt} + iLB = 0$$

$$\frac{dv}{dt} = -\frac{iLB}{m} \rightarrow (1) \qquad i = \frac{e}{R} = \frac{vBl}{R} \rightarrow (2)$$

From (1) & (2)

$$\ldots vB^2l^2$$

$$\frac{dv}{v} = \frac{-B^2l^2}{mR} dt$$

On integrating

$$\ln v = -\frac{B^2l^2}{mR} t + K_1$$

$$v = e^{-\frac{B^2l^2}{mR} t + K_1}$$

$$v = K_2 e^{-\frac{B^2l^2}{mR} t}$$

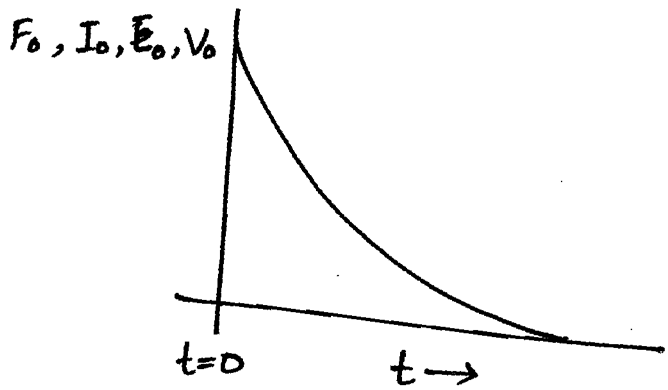
At $t=0$ $\quad v = V_0$

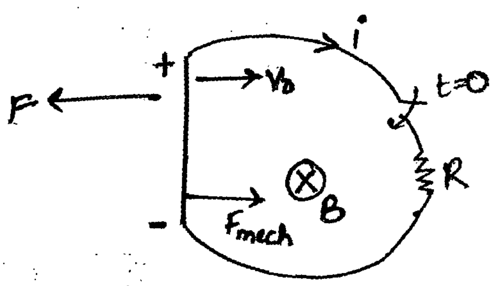
$$\boxed{v = V_0 e^{-\frac{B^2l^2}{mR} t}} \longrightarrow (A)$$

$$\boxed{e = vBl = V_0 Bl e^{-\frac{B^2l^2}{mR} t}} \longrightarrow (B)$$

$$\boxed{i = \frac{e}{R} = \frac{V_0 Bl}{R} e^{-\frac{B^2l^2}{mR} t}} \longrightarrow (C)$$

$$\boxed{F = ilB = \frac{V_0 B^2l^2}{R} e^{-\frac{B^2l^2}{mR} t}} \longrightarrow (D)$$





|F|

Generator Principle:

An electric generator is based on the principle that whenever a flux is cut by a conductor an emf is induced which will cause a current to flow if the conductor ckt is closed. The direction of induced emf (hence current) is given by Fleming's Right hand rule.

Therefore the essential components of a gen are:

(i) mag. field

(ii) conductor or group of conductors

(iii) motion of conductor wrt mag. field