(Q) function of choke & starter =>

Ans - choke -

① choke limit the current flowing through the starter during the bimetallic contact of the closing condition of the contact.

② choke (in conjunction with the starter) provides the high voltage necessary to starting during switch on the tube light

③ choke limits the current and voltage in tube light after the tube light has become on.

Starter - tubelight is filled with mercury vapour ~~the~~ tubelight are electric charge to excite mercury atom in order to produce UV light. A starter is used in the tubelight ckt to provide an initial current to filament of tube light.

(Q) What are the advantages of fluorescent tube as compared to incandescent lamp?

① more energy efficient
② Longer operational lifespan
③ better light diffusion and distrubution
④ Less heat emission

(Q) why does a fluorescent tube give more light in comparison to an encandescent — lamp of equal voltage?

Ans → Fluorescent lamps are bigger light sources than encandescent lamps. Furthermore, most fluorescent tubes readily diffuse light that results in better distribution of illumination. In contrast, incandescent Lamps are smaller light sources and they produce undiffused light as evident from glares and uneven illumination.

(Q) why does the fluorescent tube continue to glow even when the starter is removed from the circuit?

After the tube light has lighted, there is no need for the starter as the ionized gas in the tube forms the path for the current that keeps the tubelight glowing

(Q) why is the power factor of the fluorescent tube ckt is so poor?

Ans – To light florescent tube-light it required a choke coil. The coil is an inductor. For an inductor the current always lags the voltage. Hence the p.f. is always lagging.

(81) what is meant by term "the algebraic sum" ?

Ans -: sum in general means to add. positive real and rational no. where as algebraic sum include the sign (+ or -ve) of the no. in ~~conside~~ consideration.

(Q) Are the Kirchhoff's laws applicable to A.C. N/w ?

Ans - Yes but it has two conditions -:

(1) If loads connected are same such as all resistive, all inductive or all capacitive then law will be applicable for (RMS value, instantaneous value & phasor value/vector)

2) ~~if~~ but if different types of loads are connected then law will be applicable for instantaneous & phasor/vector value)
(but not for RMS value)

$\Rightarrow$ what is meant by RMS value — Home work

(Q) Are the law applicable for bilateral N/w → Yes

(Q) Are the laws applicable for non-linear N/W ? — Yes

⇒ what is ohm's law and why it is not applicable for non-linear N/W → Home work

(Q) Are the law applicable to a time-varying N/W ? — No

KCL, KVL are based on conservation of charge and energy, ~~for~~ so as long as the energy & charge are conserved these are valid. Kirchoff's law is not applicable for time varying mag. field as it is based on the assumption that mag. fld does not fluctuate in a closed loop

⇒ what is lumped Network?
= Home work

Faraday's Law of electromagnetic Induction -

(a) First law -: first law of faraday's electromag. induction state that whenever a conductor is placed in varying mag. fld, emf is induced, which is called as induced emf. If the conductor ckt is closed current is also induced

→ we can rotate either conductor or mag. fld or both.

→ when mag. fld is varying → static emf induced
when conductor is rotated - dynamic emf

(b) second law - 2nd law of faraday's electromag. induction state that the induced emf is equal to the rate of change of flux linkages.
flux linkage is the product of turns and the flux associated with it

flux linkage $= N\phi = \psi$
rate of change of flux linkage $= N\frac{d\phi}{dt}$
acc. to faraday's law induced emf is equal to rate of change of flux linkag.

$$e = -N\frac{d\phi}{dt} \text{ volt}$$

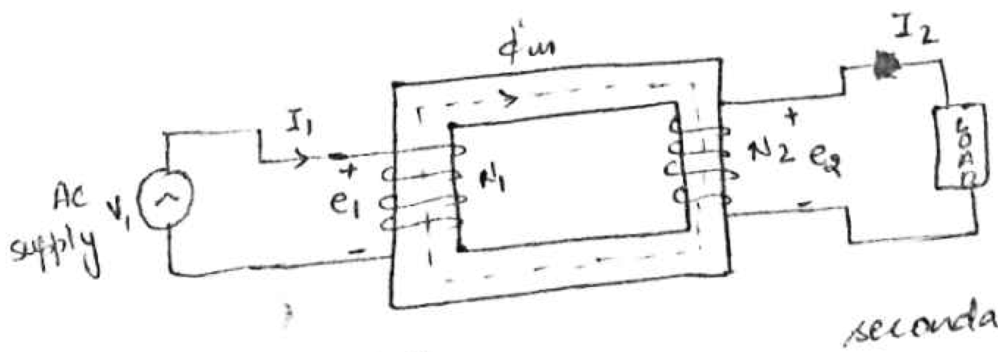
=> -ve sign represents the direction of induced current in conductor will be such that the mag. fld produced by it will oppose the cause which produce it [acc. to Lenz's Law]

Transformer :- xmer is a device that trans-fers electrical energy from one electrical ckt to another electrical ckt through the medium of mag. field, without a change in frequency. The electrical ckt which rec. energy from supply mains is called primary winding and other ckt which delivers electric energy to the load is called the secondary winding.

The xmer is an electromagnetic energy conversion device, since the energy received by primary is 1st converted to mag. energy and it is then reconverted to useful electrical in secondary wndg. we use transformer for — 1) step up Voltage

2) step down voltage

3) Isolation (isolation of two electric ckt)



* MMF = $NI = H \cdot l$, l = mean length of flux path

* $\phi = \dfrac{MMF}{reluctance} = \dfrac{NI}{l/\mu A}$, reluctance $= \dfrac{1}{\mu} \times \dfrac{l}{A}$

* $B = \mu H$, H = mag. fld intensity
B → mag. fld density, μ = permeability

Operating principle of transformer -

Case I

$$\begin{cases} v_s(t) = v_m \sin \omega t \\ I_s(t) = I_m \sin(\omega t - 90^\circ) \end{cases}$$

1st Approach

induced voltage

$\rightarrow e_1(t) = L \cdot \frac{di}{dt}$

$= L \frac{d}{dt}(I_m \sin(\omega t - 90^\circ))$

$= L I_m \cos(\omega t - 90^\circ) \times \omega$

$= L I_m * \omega \cos(\omega t - 90^\circ)$

$\boxed{e_1(t) = E_{max} \cos(\omega t - 90^\circ)}$

Case II

$v_s(t) = v_m \cos \omega t$

$I_s(t) = I_m \cos(\omega t - 90^\circ)$

induced voltage -

$e_1(t) = L \frac{di}{dt}$

$= L \frac{d}{dt}(I_m \cos(\omega t - 90^\circ))$

$= L I_m[-\sin(\omega t - 90^\circ) \times \omega]$

$= -L I_m \omega \sin(\omega t - 90^\circ)$

$\boxed{e_1(t) = -E_{max} \sin(\omega t - 90^\circ)}$

2nd Approach

$mmf = N_1 I_s(t)$

$\phi = \frac{mmf}{R} = \frac{N_1 I_s(t)}{R}$

$\phi \propto I_s(t)$

$\therefore \phi(t) = \phi_m \sin(\omega t - 90^\circ)$

now induced emf -

$e_1 = \frac{d\psi}{dt}$ = flux linkage

$\psi = N \phi(t)$

$e_1(t) = N \frac{d}{dt}[\phi_m \sin(\omega t - 90^\circ)]$

$= N \phi_m \omega \cos(\omega t - 90^\circ)$

$\boxed{e_1(t) = E_{max} \cos(\omega t - 90^\circ)}$

$\phi(t) = \phi_m \cos(\omega t - 90^\circ)$

$e_1(t) = \frac{d\phi}{dt}$

$= N \frac{d}{dt}(\phi_m \cos(\omega t - 90^\circ))$

$= N \phi_m \omega [-\sin(\omega t - 90^\circ)]$

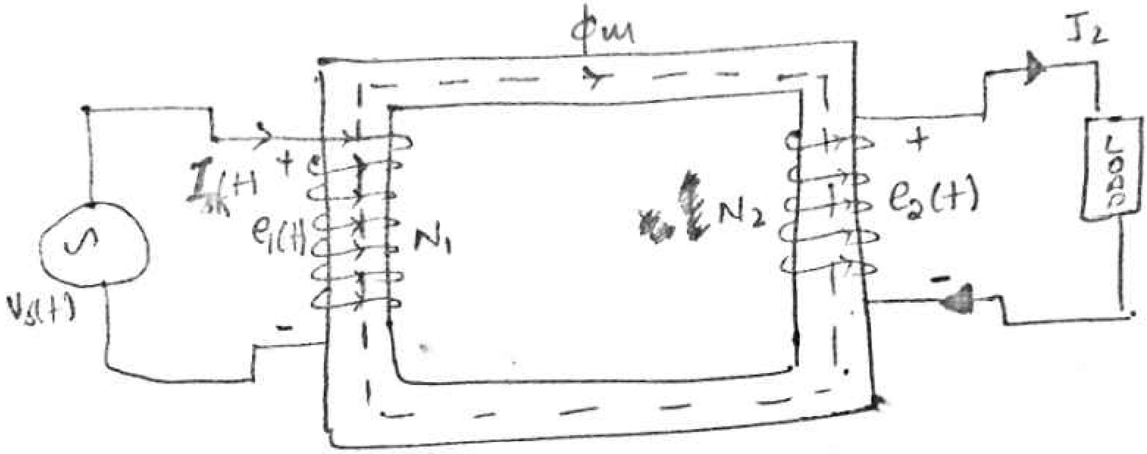
$\boxed{e_1(t) = -E_{max} \sin(\omega t - 90^\circ)}$

3rd Approach

$$\cancel{\psi = LI = N\phi}$$

$$E_{rms} = \frac{E_{max}}{\sqrt{2}} = \frac{N\phi_m \omega}{\sqrt{2}} = \frac{N\phi_m (2\pi f)}{\sqrt{2}}$$

$$\boxed{E_{rms} = 4.44\, N\phi_m f}$$ induced emf at primary



$$e_1(t) = N_1 \frac{d\phi}{dt} \Rightarrow E_{1\,rms} = 4.44 f \phi_m N_1$$

$$e_2(t) = N_2 \frac{d\phi}{dt} \Rightarrow E_{2\,rms} = 4.44 f \phi_m N_2$$

$$\frac{e_1}{e_2} = \frac{N_1}{N_2} = a = \text{turn ratio}$$

$a > 1 \rightarrow N_1 > N_2$ – step down x^{mer}

$a < 1 \rightarrow N_1 < N_2 \rightarrow$ step up x^{mer}

$a = 1 \rightarrow N_1 = N_2 \rightarrow$ isolation x^{mer}

Transformer efficiency – the efficiency of X^{mer} (or any other device) is defined as the ratio of o/p power to the input power

$$\eta = \frac{\text{o/p power}}{\text{I/p power}} = \frac{\text{I/p power} - \text{Losses}}{\text{I/p power}}$$

$$= 1 - \frac{\text{Losses}}{\text{I/p power}} \Rightarrow \text{Or} \ \frac{\text{o/p}}{\text{o/p} + \text{loss}}$$

if T/f has 25% losses then $\eta = 80\%$

$$\eta = \frac{\text{o/p}}{\text{o/p} + .25\ \text{o/p}} = \frac{\text{o/p}}{1.25\text{o/p}} = 80\%$$

if T/f has 100% losses then $\eta = 50\%$

$$\eta = \frac{\text{o/p}}{\text{o/p} + 1\ \text{o/p}} = \frac{\text{o/p}}{2\text{o/p}} = 50\%$$

Losses

- core loss $= (P_i)$
  - Hysteresis Loss
    - $P_H = K_H B^x f$ Volume
    - x = steinmetz's const
  - eddy current Loss
    - $P_e = K_e B^2 f^2$ Volume t^2
    - t = thickness
- cu loss $= P_{cu}$ (wndg, resistive loss) $= I^2 R_{eq}$
  - cu loss $\propto I^2$
  - I = load current

$$\boxed{\therefore \eta = \frac{VI\cos\phi}{VI\cos\phi + I^2 R_{eq} + P_i}}$$

Condition for max^m efficiency —

→ If the load current is constant but the load p.f. is variable then the max^m η of x^mer is obtained when load p.f. is unity.

→ but if load pf is constant but the load current is variable then the condition for max^m η is obtained by as follows —

$$\eta = \frac{VI\cos\phi}{VI\cos\phi + I^2 R_{eq} + P_i}$$

$$= \frac{V\cos\phi}{V\cos\phi + IR_{eq} + \frac{P_i}{I}}$$

· η will be max^m when denominator is minimum.

i.e $\frac{d}{dI}(\text{denominator}) = 0$

$$\frac{d}{dI}\left(V\cos\phi + IR_{eq} + \frac{P_i}{I}\right) = 0$$

$$0 + R_{eq} - \frac{P_i}{I^2} = 0$$

$$\boxed{I^2 R_{eq} = P_i}$$ condition for max^m efficiency

copper loss = core loss

$$I_{\eta max} = \sqrt{\frac{P_i}{R_{eq}}} \Rightarrow VI_{\eta max} = V\sqrt{\frac{P_i}{R_{eq}}}$$

$$S_{\eta max} = VI\sqrt{\frac{P_i}{I^2 R_{eq}}} \Rightarrow \boxed{S\sqrt{\frac{P_i}{P_{cuFL}}} = S_{\eta max}}$$

→ at any load