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EE100 Remote Midsem

(1) (i) given,

$P = 2.614\ mW$
$S = 3.615\ mVA$

$\because P = S\cos\phi$

$\therefore \cos\phi = \frac{P}{S} = 0.72309$

$\therefore \phi = 43.69^\circ$

$\because S = V \cdot I$

$\therefore I = \frac{S}{V} = 0.3615\ mA$

and, reactive power $Q = S\sin\phi$
$= 2.4971\ mVAR$

$\because Q = I^2 X$

$\therefore X = \frac{2.4971 \times 10^{-3}}{0.3615 \times 0.3615 \times 10^{-6}}$

$X = 19.11\ k\Omega$

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$$X = \frac{1}{2\pi f\, C_{eq}}$$

$$C_{eq} = \frac{C \cdot (1nF)}{C + 1nF}$$

$$19.11K = \frac{(C + 1nF)}{6.28 \times 10K \times C \times 1nF}$$

$$1.2 = C + 1nF$$

$$\therefore \boxed{C = 0.2nF}$$

(ii) phase difference between source voltage and current is -43.69°.

(iii) given, $V_s = 10\angle 0^\circ$ V

$$I_s = 0.3615 \angle 43.69^\circ \text{ mA}$$

$$\therefore V_{1nF} = 0.3615m\angle 43.69 \times 15.923K\angle 90^\circ$$

$$V_{1nF} = 5.756 \angle 133.69^\circ \text{ V}$$

$$V_{20K} = 0.3615m\angle 43.69^\circ \times 20K\angle 0^\circ$$

$$= 7.23\angle 43.69^\circ \text{ V}$$

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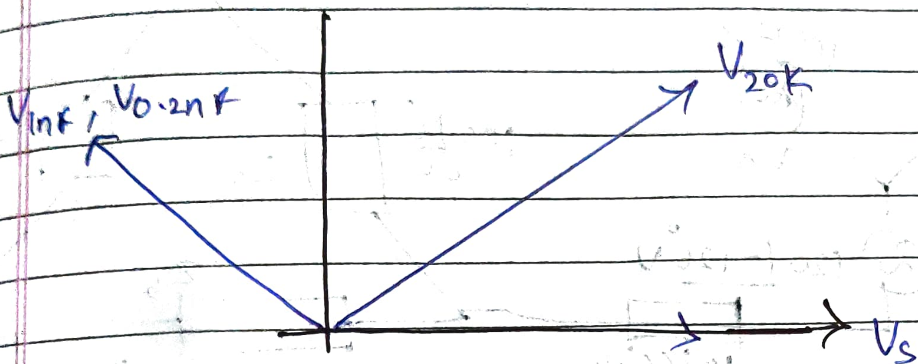
$$V_{0.2nF} = 0.3615\,m\angle 43.69^\circ \times 79.618K\angle 90^\circ$$

$$V_{0.2nF} = 28.782\angle 133.69^\circ\ V$$



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3. A transformer works on the principle of mutual induction. Mutual induction is the phenomenon by which when the amount of magnetic flux linked with a coil changes, an emf is induced in the neighboring coil.

Different types of losses in transformers are -

(i) Copper losses -: Copper losses are the resistive heating losses in primary and secondary windings. They are proportional to square of current in the windings.

(ii) Eddy Current Losses -: These are resistive heating losses in the core of transformer. They are proportional to the square of voltage applied.

(iii) Hysteresis Losses -: These are associated with the magnetization and demagnetization of the core i.e. rearrangement of domains in core during each half - cycle. The are a complex, non- linear function of voltage applied.

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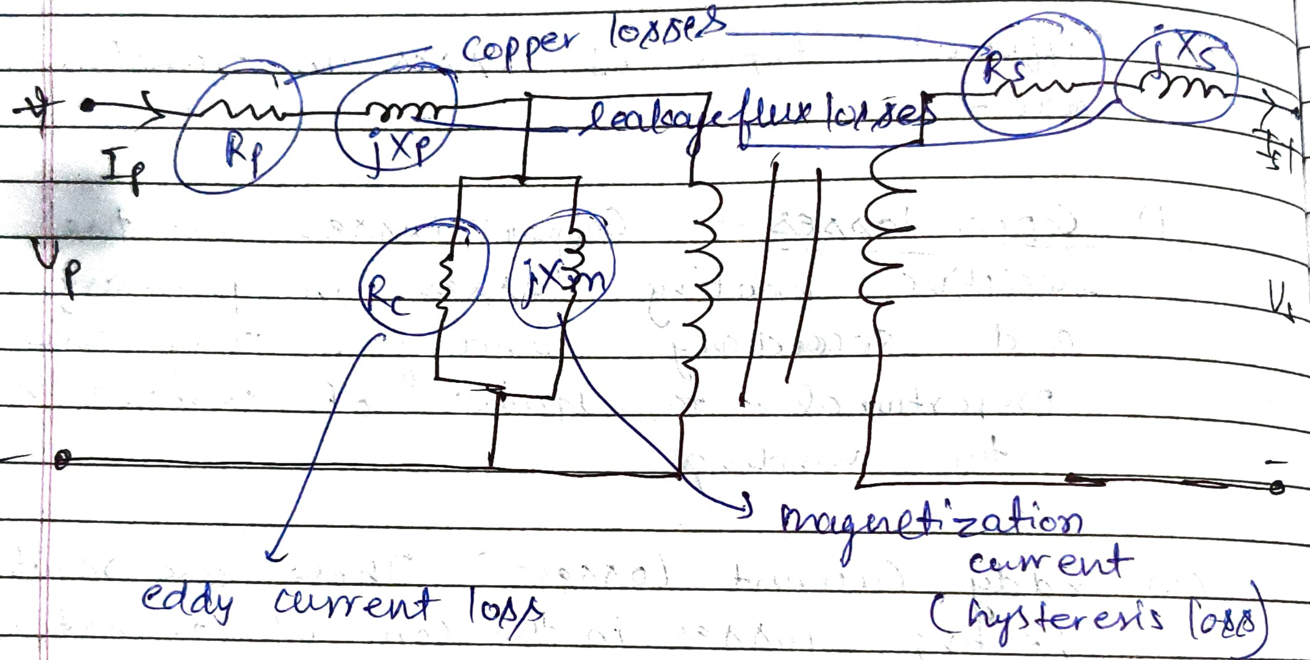
(iv) Leakage flux :- The fluxes which escape the core and pass through only one of transformer winding are leakage fluxes. They produce a leakage inductance in primary and secondary coils.



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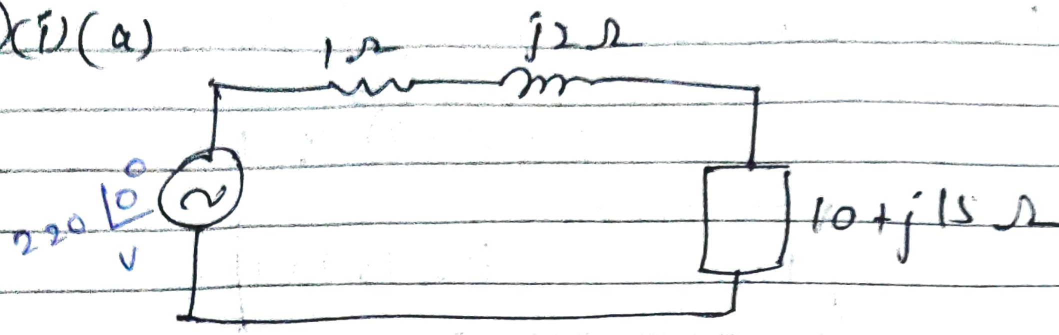
4 (i)(a)



$I_a = I_{line} = I_{load}$

$I_{line} = \dfrac{V}{Z_{line} + Z_{load}}$

$= \dfrac{220\angle 0^\circ\ V}{(1+j2)+(10+j15)}$

$= \dfrac{220\angle 0^\circ}{11+j17}$

$\bar{I}_{line} = 10.87\angle -57.09^\circ\ A$

(i) $\bar{V}_{load} = \bar{I}_{line} \times \bar{Z}_{load}$

$= 10.87\angle -57.09^\circ \times (10+j15)$

$\boxed{\bar{V}_{load} = 195.99\angle -0.781^\circ\ V}$

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(b) line loss, $P_{loss} = (I_{line})^2 R_{line}$

$$= (10.87)^2 \times 1$$

$$\boxed{P_{loss} = 118.157\,W}$$

(c) $$\frac{V_{load}}{V_a} = \frac{195.99}{220}$$

$$\boxed{\frac{V_{load}}{V_a} = 0.891}$$

(d) $$P_{load} = (I_{load})^2 \times R_{load}$$

$$= (10.87)^2 \times 10$$

$$= 1181.57\,W$$

$$P_{a} = P_{load} + P_{loss}$$

$$= 1181.57 + 118.157$$

$$= 1299.727\,W$$

efficiency $\eta = \frac{P_{load}}{P_a} \times 100\%$

$$\eta = \frac{1181.57}{1299.727} \times 100\%$$

$$\boxed{\eta = 90.909\%}$$

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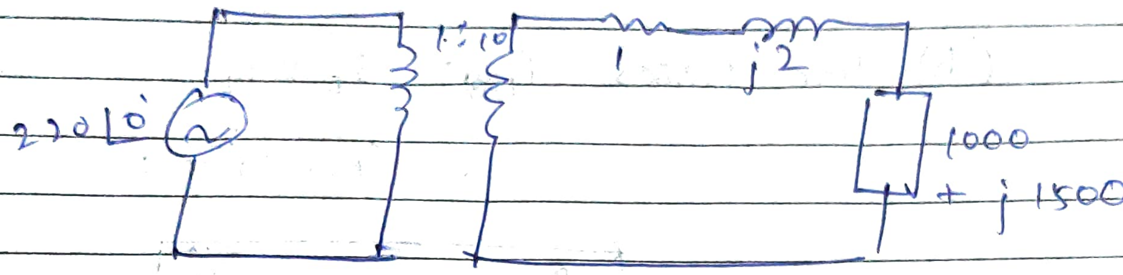
(ii)

reflected load at primary of T_2,



$$Z = 100\,(10 + j15\,\Omega)$$

$$= 1000 + j\,1500\,\Omega$$

$$\therefore\ \bar{I}_L = \frac{\bar{V}_a \times 10}{Z_{line} + Z_{load}}$$

$$= \frac{2200}{1001 + j\,1502}$$

$$= \frac{2200\,\angle 0^\circ}{1804.99\,\angle 56.32}$$

$$\bar{I}_L = 1.219\,\angle -56.32^\circ\ A$$

(a) $\therefore\ \bar{I}_2 = 10 \times \bar{I}_L$

$$= 12.19\,\angle -56.32^\circ\ A$$

$$\therefore\ \bar{V}_{load} = \bar{I}_2 \times Z_{load}$$

$$= 12.19\,\angle -56.32 \times (10 + j\,15)$$

$$= 12.19\,\angle -56.32 \times 18.03\,\angle 56.31$$

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$\overline{V}_{load} = 219.7857 \angle -0.01^{\circ}$ V

(b) line losses, $P_{Loss} = I_L^2 \times R_L$

$= (1.219)^2 \times 1$

$\boxed{P_{Loss} = 1.486 \text{ W}}$

(c) $\dfrac{V_{load}}{V_G} = \dfrac{219.7857}{220} = 0.999$.

(d) $P_{out} = I_Z^2 \times R_{load}$

$= (12.19)^2 \times 10$

$= 1485.961$ W

$P_G = P_{out} + P_{loss}$

$= 1485.961 + 1.486$

$= 1487.447$

$\therefore$ efficiency $\eta = \dfrac{1485.961}{1487.447}$

$\boxed{\eta = 99.9\%}$