1. A transformer having 300 and 100 turns in primary and secondary windings respectively, is wounded on a magnetic core having reluctance $\Re = 2.5\times10^4$ AT/Wb. Assume no leakage flux, no iron losses, and ignore wire resistance.
   a. If the primary winding is connected to 240 V, 50 Hz supply, while keeping the secondary open circuited, find the primary winding current?
   b. If the secondary winding is connected to a resistance of 50 ohm, determine the current in the resistor?
   c. For the circuit in part (b), what would be the magnitude of the current in the primary?

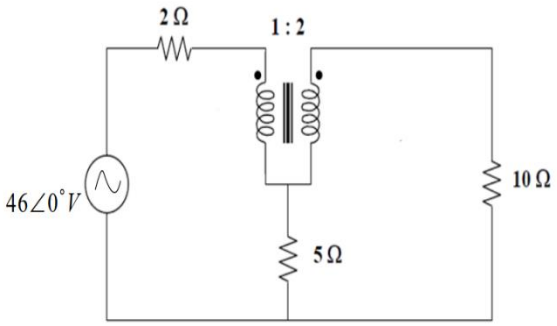
   (Ans: (a) $0.2122\angle-90^\circ A$, *(b)* $1.6\angle0^\circ A$, *(c)* $0.574\angle-21.7^\circ A$*)*

2. A 50 Hz, single phase iron core transformer with $\mu_i = 4500\mu_0$, area = 0.05 m^2 and nominal mean length of iron 2.0 m has 600 turns on the high voltage side and 200 turns on low voltage side. At the rated voltage, the flux density (rms) in the iron is 1.0 Tesla.
   a. Find the rated voltage at both the HV and LV sides?
   b. Find the magnetizing current required on the HV side?
   c. The rated current in the transformer is 80 A on the HV side. The losses at the rated current are 2000 Watt. Find an equivalent circuit for transformer, neglecting iron losses and leakage inductance?

   Why are we using that formula here and why are we using these values as V(rms) in next question?

   (Ans: (a) $9418.66V$ *and* $3139.554V$, *(b)* $0.589\angle-90^\circ A$, *(c)* $R_{eq} = 0.3125\Omega$, $X_{m1} = j15.98k\Omega$*)*

3. Find the power absorbed by the 10Ω resistor in the ideal transformer circuit. (160W)



4. The core loss for a given specimen of magnetic material is found to be 3000W at 50Hz. Keeping the flux density constant, the frequency of the supply is raised to 75 Hz resulting in core loss of 5000 W. Compute separately hysteresis and eddy current losses at both frequencies. What will be these losses at 60 Hz? The hysteresis loss coefficient is 1.6

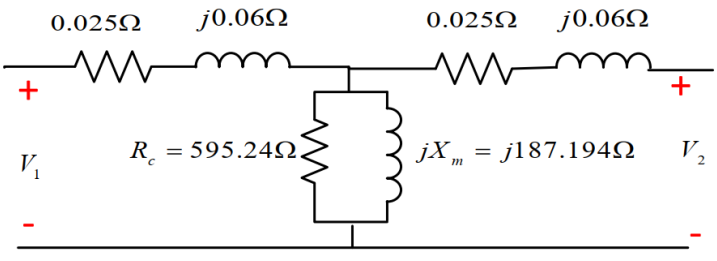
   (Ans: hysteresis loss = 2333.3W, 3500.025W and 2800.02W, eddy current loss=666.75W, 1500.1875W and 960.12W for frequencies 50Hz, 75Hz and 60Hz, respectively.)

5. A 20 kVA, 2500/250 V, 50 Hz, single-phase transformer gave the following test results:

Open-circuit test (on LV side):	250 V, 1.4 A, 105 W
Short-circuit test (on HV side):	104 V, 8 A, 320 W

Compute the parameters of the approximate equivalent circuit referred to high-voltage and low-voltage sides. Also draw exact equivalent circuit referred to LV side. You may assume the leakage inductance and winding resistance of the primary and secondary side are same when they are expressed in the equivalent circuit.

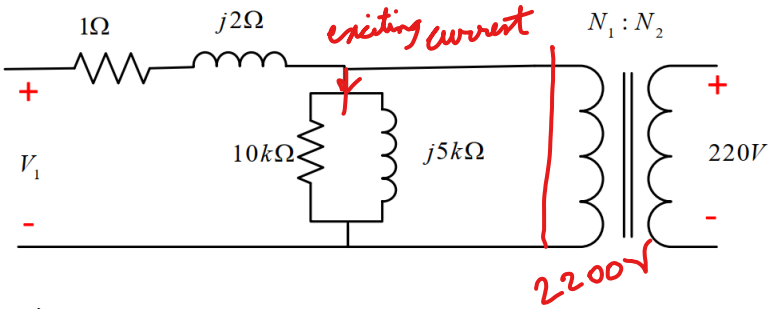
(Ans: equivalent circuit referred to LV side:



6. The equivalent circuit for a 50 kVA, 2200/220 V, 50 Hz single-phase transformer is shown in figure. Assume that the transformer is operating at rated secondary voltage and apparent power with a 0.8 power factor (lagging).

   a. Estimate the iron losses?
   b. Estimate the copper losses?
   c. What would be the exciting current?
   d. Estimate the input power factor?

(Ans: (a) 484W, (b) 536.756W, (c) $\bar{I}_e = (0.22 - j0.44)A$, (d) 0.788 lagging)



7. A single-phase, 25 kVA, 2300/230 V transformer has the following parameters:

$\bar{Z}_{eq(HV)} = 4.0 + j5.0\Omega$, $R_{c(LV)} = 450\Omega$, $X_{m(LV)} = 300\Omega$

The transformer is connected to a load whose power factor may vary. Derive the condition pertaining to the load value and its power factor, when voltage regulation will be maximum (worst). What will be the worst-case voltage regulation for the above transformer?

(Ans: $(VR)_{max}$ = 3.025%)

8. A single-phase, 10 kVA, 2400/240 V transformer has the following losses:
Core loss at full rated voltage = 100 W, Copper loss at half load = 60 W. Determine the efficiency of the transformer, when it delivers full load at rated voltage (240 V) at 0.8 power factor (leading).

(Ans: η =95.92%)

9. Core loss at rated voltage and copper loss at 80% of the full load of a 20 kVA, 2200/220 V, 50 Hz, single phase transformer are 200 W and 500 W, respectively. Calculate the efficiency of the transformer if the output power at the LV side of the transformer is

   a. 5 kVA at 0.8 pf lagging
   b. 10 kVA at 0.9 pf lagging
   c. 20 kVA at unity power factor
   d. 10 kVA at 0.8 pf Leading.

At what fraction of the rated load connected on the LV side, would the efficiency of the transformer be maximum? Also find the maximum efficiency of transformer at 0.8 pf lagging.

(Ans: a)94.14%, b)95.79%, c)95.32%, d)95.29%, 50.6% of rated load, $\eta_{max} = 95.29\%$)

10. A single-phase auto transformer supplies a load of 5 kW at 115 V and at unity power factor. If the primary voltage (source side) is 230 V, determine:

   a. Voltage Transformation ratio (High Voltage/ Low Voltage)
   b. Secondary current
   c. Primary current
   d. Number of turns in secondary if total number of turns is 400 at the primary side.
   e. Power transformed and Power conducted directly from the supply to load.

(Ans: a) 2, b) 43.47 A, c) 21.74 A, d) 200, e) 2.5 kW, 2.5 kW)

11. An 11500/2300 V transformer is rated at 100 kVA as a 2- winding transformer. If the windings are connected in series to form an autotransformer, what will be the possible voltage ratios and output power in each case?
(Ans: a) n=6/5, P=600 kVA, b) n=6, P=120 kVA, c) n=6, P=120 kVA, d) n=6/5, P=600 kVA)