ECE 385 – Fall 2024

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HW #2

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Problem 1

A single-phase transformer has 500 turns in the primary winding. When it is connected to a single-phase, 120 [V], 60 [Hz] power supply, the no-load current is 1.6 [A] and the no-load power is 80 [W]. Neglect the winding resistance and leakage reactance. Calculate:

- the core loss current, I_c,
- the magnetizing current, I_m,
- the peak value of the core flux, ϕ_{max},
- the magnetizing reactance, X_m, and core loss resistance, R_c.

Problem 2

A single-phase, 10 [kVA], 2400/120 [V], 60 [Hz] transformer has the following equivalent circuit parameters:

- $Z_{eq,H} = 5 + j25\ [\Omega]$
- $R_{c,H} = 64\ [\text{k}\Omega]$
- $X_{m,H} = 64\ [\text{k}\Omega]$

where subscript H represents the values referred to high-voltage side. Standard no-load and short-circuit tests are performed on this transformer. Determine the following:

- No-load test results : V_{oc}, I_{oc}, and P_{oc}
- Short-circuit test results : V_{sc}, I_{sc}, and P_{sc}

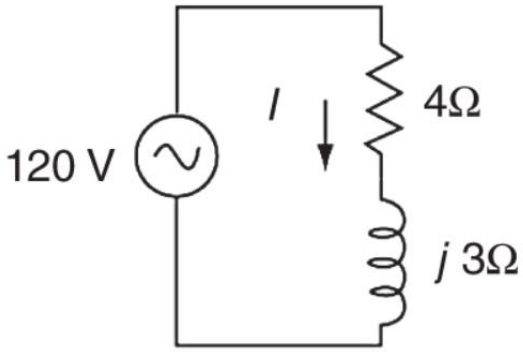
Problem 3

A single-phase, 1200 [kVA], 240/120V, 60 [Hz] transformer has a no load loss of 3.2 [kW] at rated voltage and a copper loss of 9.5 [kW] at rated current. Determine the efficiency for the following load conditions:

- 1200 [kVA] at unity power factor.
- 1200 [kVA] at 0.9 power factor.
- 1200 [kVA] at 0 power factor (i.e., pure L or C load).

Problem 4

A 120-V AC supply delivers power to a load modeled as a 5-Ω resistance in series with a 3-Ω inductive reactance. Find the active, reactive, and apparent power consumption of the load along with its power factor. Draw its power triangle.



Problem 5

Three 1φ, 10 kVA, 460/120 V, 60 Hz transformers are connected to form a 3φ, 460/208 V transformer bank. The equivalent impedance of each transformer referred to the high-voltage side is 1.0 + j2.0 Ω. The transformer delivers 20 kW at 0.8 power factor (leading).

(a) Draw a schematic diagram showing the transformer connection.
(b) Determine the transformer winding current.
(c) Determine the primary voltage.
(d) Determine the voltage regulation.

Problem 6

Two identical 250 kVA, 230/460 V transformers are connected in open delta to supply a balanced 3φ load at 460 V and a power factor of 0.8 lagging. Determine

(a) The maximum secondary line current without overloading the transformers.
(b) The real power delivered by each transformer.
(c) The primary line currents.
(d) If a similar transformer is now added to complete the Δ, find the percentage increase in real power that can be supplied. Assume that the load voltage and power factor remain unchanged at 460 V and 0.8 lagging, respectively.