Example Sheet: Transformers

1. Considering a single-phase transformer:
    a. Draw a B-H curve for a transformer core. Using the diagram explain briefly what is meant by hysteresis loss.
    b. Draw the equivalent circuit of a transformer referred to the primary side. In your circuit show how the copper and iron losses are represented.
    c. Explain how you would determine, experimentally, the component values in the equivalent circuit.
    d. In the design of a transformer explain how you might mitigate against Eddy currents.

2. An 800Ω resistance is connected across the secondary winding of a 55V(rms)/220V(rms) transformer with the equivalent circuit parameters shown in Table Q2.
    a. Draw the equivalent circuit of the transformer
    Determine the following values of the circuit:
    b. The output current (I_S)
    c. The output voltage (V_S)
    d. The magnetising current (I_M)
    e. The transformer efficiency (%)

Equivalent Circuit Parameters of the Transformer

R_{1eq}	2.5 Ω
X_{1eq}	6.7 Ω
X_M	2 kΩ
R_C	2kΩ

Table Q2

3. A three-phase Δ/Y transformer bank shown in Fig. Q2 is rated 11kV/22kV and delivers 220kVA to a balanced delta connected load at rated voltage. Assuming an ideal transformer:
    a. Construct a phasor diagram showing all primary phase voltages and secondary line voltages for the three-phase transformer in the question.
    b. The magnitudes of the primary side phase current.

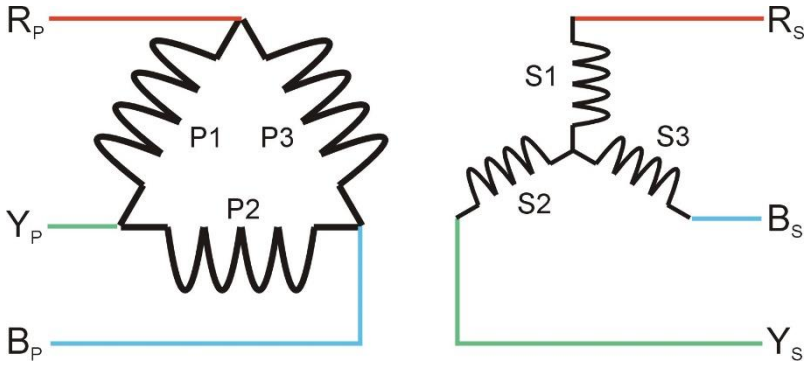

Fig. Q2

4. The following results were obtained on a 50 kVA transformer:

    Open circuit test – primary voltage, 3300 V; secondary voltage, 400 V; primary power, 400 W.

    Short-circuit test – primary voltage, 124 V; primary current, 15.3 A; primary power, 495 W; secondary current, full-load value.

    Calculate the efficiencies at full load and at half load for 0.75 power factor.