1) Given the following periodic signal:

\[ V \]

\[
| \begin{array}{cccccc}
1 & 2 & 3 & 4 & 5 \\
\hline
-1 & -1 & -1 & -1 & -1 \\
\end{array} \]

\[ T = 2 \text{ sec} \]

Calculate its RMS value.

2) Given the following circuit containing an ideal transformer with:

- \( N_1 = 8000 \) turns
- \( N_2 = 2000 \) turns
a) Adjust $Z_L$ until the maximum average power is transferred to $Z_L$. How big is $Z_L$?

b) How large is the absorbed average power?

c) How large is the average power generated by the voltage source?

Only work with real power.
3) Given the circuit:

\[ V_s = 120V_{rms} \]

\[ Z_L = (5 + j1) \Omega \]

Show that the average power flowing into the transformer on the primary side (left) equals the average power coming out of the transformer on the secondary (right) side.
4) Given the circuit:

with the chosen tree.

a) Draw the mesh currents that correspond to the chosen tree.
b) Compute the $\Phi$-matrix, the $Z_b$-matrix, and the $Y_b$-vector.
c) Using these matrices and vector, find a set of mesh equations in matrix-vector form describing the circuit except for the mutual inductance.
d) Correct the mesh equations such that the mutual inductance is accounted for.

9) Given a balanced three-phase circuit in Y-Y configuration. For a positive phase sequence, the instantaneous power in each phase can be written as:

\[ P_A(t) = V_{AN} \cdot i_A = V_m \cdot I_m \cdot \cos(\omega t) \cdot \cos(\omega t - \phi) \]
\[ P_B(t) = V_m \cdot I_m \cdot \cos(\omega t - 120^\circ) \cdot \cos(\omega t - 2\phi - 120^\circ) \]
\[ P_C(t) = V_m \cdot I_m \cdot \cos(\omega t + 120^\circ) \cdot \cos(\omega t - \phi + 120^\circ) \]

Prove that the total instantaneous power across all three phases:

\[ P_T(t) = P_A(t) + P_B(t) + P_C(t) \]
is constant. Use trigonometric equalities to derive the result.

6) Given the following balanced three-phase circuit:
a) Draw a single-phase equivalent circuit.

b) Let:
\[ z_0 = (0.2 + j0.5) \Omega \]
\[ z_t = (0.3 + j0.9) \Omega \]
\[ z_L = (39.5 + j28.6) \Omega \]

\[ j\omega L_1 = j3\Phi \Omega \quad | \quad V_g = 120 \text{ V}_{\text{rms}} \]
\[ j\omega L_2 = j5\Phi \Omega \]
\[ j\omega M = j10 \Omega \]

Calculate the total average power consumed by the load across the three phases (both real and reactive).