

1. A rectifier needs to be designed to supply a resistive load as shown in Fig. 1.

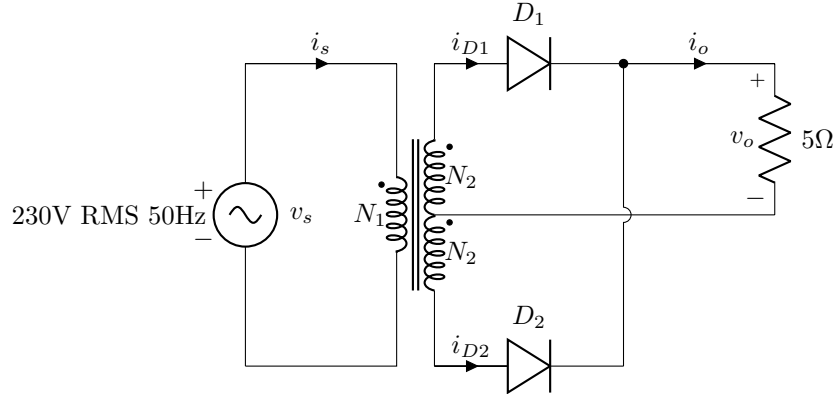


Figure 1: Single-phase diode rectifier

- (a) Determine the turns ratio of the transformer if the average power dissipated in the  $5\Omega$  load resistance is  $105.8\text{W}$ . Assume that the diodes and the transformer are ideal.
  - (b) Draw the waveform of source current  $i_s$  with the same assumptions considered above.
  - (c) Diodes are usually selected based on their peak-inverse-voltage (PIV) and average-current. Available PIV ratings are (50V, 100V, 150V, 200V) and average-current ratings are (2A, 3A, 5A, 6A). Choose an appropriate diode for  $D_1$  and  $D_2$ , considering a safety factor of 2 for both voltage and current ratings.
  - (d) The power loss in the transformer is  $2\text{W}$ . If  $D_1$  and  $D_2$  have a forward voltage drop of  $0.8\text{V}$  for any current, what is the approximate total power loss in the rectifier? Neglect reverse recovery.
2. (a) Design a capacitive filter at the output of a three-phase diode bridge rectifier supplying a load of  $8\text{kW}$ . Input voltage to the rectifier is  $415\text{V}$  RMS line-to-line AC,  $50\text{Hz}$ . The output voltage shouldn't fall below  $555\text{V}$ . Make suitable assumptions.
  - (b) With the designed value of capacitance and an appropriate load resistance chosen, simulate the circuit using SEQUEL. Verify the designed peak-to-peak ripple with simulation results. Present the waveforms of output voltage and indicate the peak-to-peak ripple.
  - (c) Estimate the peak value of input current in R-phase. Verify this value with simulation result. Present the simulated waveforms of input (AC-side) current and input voltage (pertaining to R-phase).
  - (d) Estimate the displacement power factor and distortion power factor from the simulation results.
  - (e) Obtain and plot the harmonic spectrum (RMS Magnitude of each harmonic versus frequency, upto 20th harmonic) of input current waveform from the simulation results. Use a bar chart or comb plot to present the spectrum.
  - (f) What is the total harmonic distortion in input current (estimated from the simulation results)?