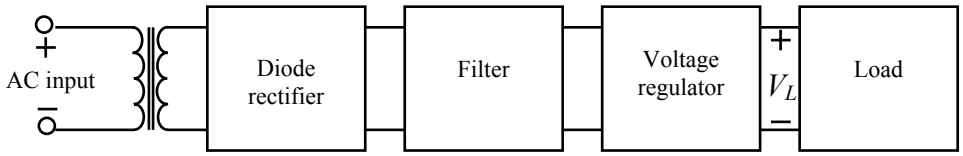
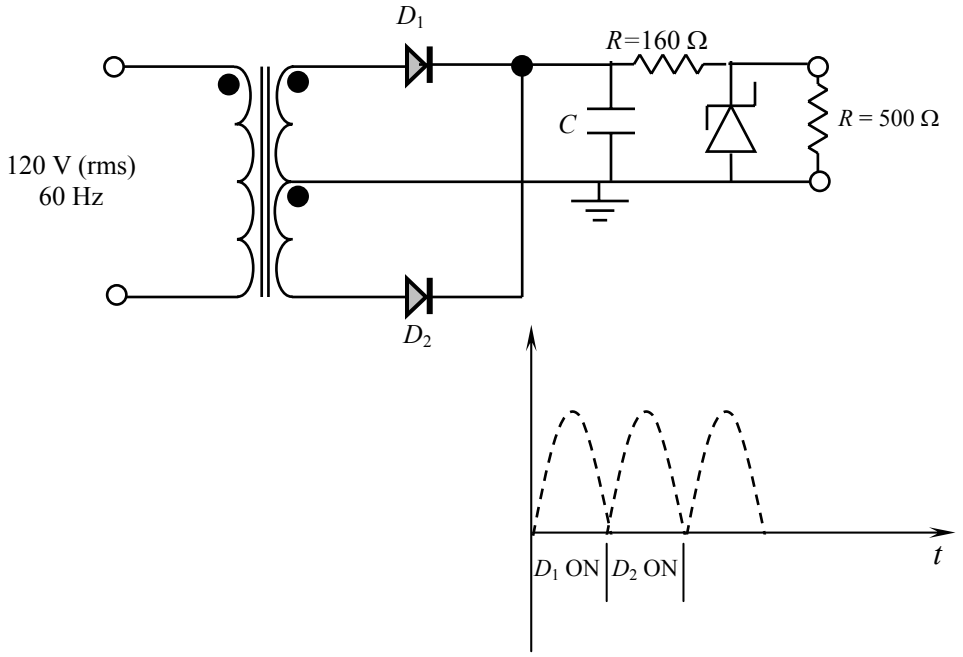
ELG3331: Design of a Regulated Power Supply

Design a power supply that provides a DC voltage of 5 V and a current of 25 mA to a load R_L of 200 Ω. Assume the availability of 5.1-V zener diodes having r_z = 10 Ω at I_Z = 20 mA and the minimum current through the zener should be at least 5 mA.





Design Steps:

- The 120-V (rms) supply is stepped down to provide 12-V peak sinusoid across each of the secondary windings using a 14:1 turns ratio for the center-tapped transformer.
- The choice of 12-V is a reasonable compromise between the need to allow for sufficient voltage above the 5 V across the load R_L.
- Allow for a ripple voltage on the capacitor of 1 V.
- Accordingly, $V_{S\min}$ = 10.2 V.
- We that from the requirements that $I_{L\max}$ = 25 mA.
- Also, $I_{Z\min}$ = 5 mA.
- Accordingly, current flowing through R should be 30 mA.
- Then, R = 5.1 V / 30 mA = 170 Ω.
- Now we need to find the value of the capacitance C. We will use the following equation $V_r = \frac{V_p}{2fR_LC}$; and $C = \frac{V_p}{2fR_LV_r} = \frac{10.7}{2\times 60\times 500\times 1} = 179\mu F$
- Use safety factor of 2: then C will be around 360 μF