Design, build, and demonstrate a switching power supply that meets the following specs.
(You may choose to build either the boost or flyback topology.)

Specifications

- Output voltage: for the boost 20 V, for the flyback −10 V
- Steady state error: Zero (use an integrator in the loop).
- Output voltage ripple: ≤ 200 mVpp (peak-to-peak)
- Input voltage range: 8 V ≤ \( V_{in} \) ≤ 16 V
- Input ripple current (calculated): ≤10 mA rms
- Output power: 5 watts
- Small signal bandwidth: ≥ 5 kHz
- Small signal step overshoot: ≤ 10%

Lab Hints

Build your converter in stages rather than attempting to construct and test the entire loop in one smoke-producing flip of the switch.

1. Build the switching section
   - use ceramic capacitors for the main filtering caps in your converter. use electrolytics only for damping legs.
   - drive the switch with a function generator (D = 0.5 or whatever)
   - start with a small input voltage (\( V_{in} = 0.5 \) V or so)
   - if the waveforms look ok, gradually increase \( V_{in} \)
   - use the function generator’s symmetry control to vary D, and convince yourself that the converter is operating correctly.

2. Build the controller section
   - test the controller section using “fake” inputs
• use lab kit supplies to power controller circuitry (not $V_{in}$ supply)
• verify proper operation before attempting to close the loop

3. Consider start-up details before closing the loop.
   • soft-start
   • current-limit
   • duty-cycle limit

4. Pray, sacrifice a token 3904, then power up the closed-loop system