Problem 7

Consider the voltage-regulator circuit shown in Fig. P4.52. The value of R is selected to obtain an output voltage V_O (across the diode) of 0.7 V.

(a) Use the diode small-signal model to show that the change in output voltage corresponding to a change of 1 V in V+ is:

$$\frac{\Delta V_O}{\Delta V^+} = \frac{V_T}{V^+ + V_T - 0.7}$$

This quantity is known as the line regulation and is usually expressed in mV/V.

(b) Generalize the expression above for the case of m diodes connected in series and the value of R adjusted so that the voltage across each diode is 0.7 V (and V_O =0.7×m V).

(c) Calculate the value of line regulation for the case V + = 10 V (nominally) and (i) m = 1 and (ii) m = 3.

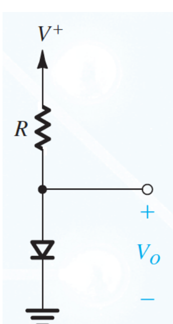

Figure P4.52

Problem 8

A shunt regulator utilizing a zener diode with an incremental resistance of 5 Ω is fed through an 82-Ω resistor.
If the raw supply changes by 1.0 V, what is the corresponding change in the regulated output voltage?

Problem 9

A half-wave rectifier circuit with a 1-kΩ load operates from a 120-V (rms) 60-Hz household supply through a 10-to-1 step-down transformer. It uses a silicon diode that can be modeled to have a 0.7-V drop for any current.
What is the peak voltage of the rectified output? For what fraction of the cycle does the diode conduct? What is the average output voltage? What is the average current in the load?

Problem 10

The op amp in the circuit of Fig. P4.84 is ideal with output saturation levels of ±12 V. The diodes exhibit a constant 0.7-V drop when conducting. Find v_-, v_A, and v_O for:
(a) $v_I = +1$ V
(b) $v_I = +2$ V
(c) $v_I = -1$ V
(d) $v_I = -2$ V

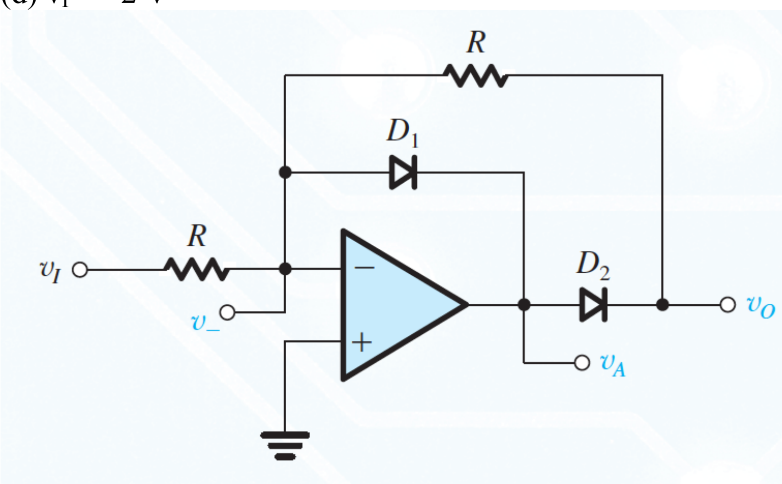

Figure P4.84

Problem 11

Sketch the transfer characteristic v_O versus v_I for the limiter circuits shown in Fig. P4.85. All diodes begin conducting at a forward voltage drop of 0.5 V and have voltage drops of 0.7 V when conducting a current iD ≥ 1 mA

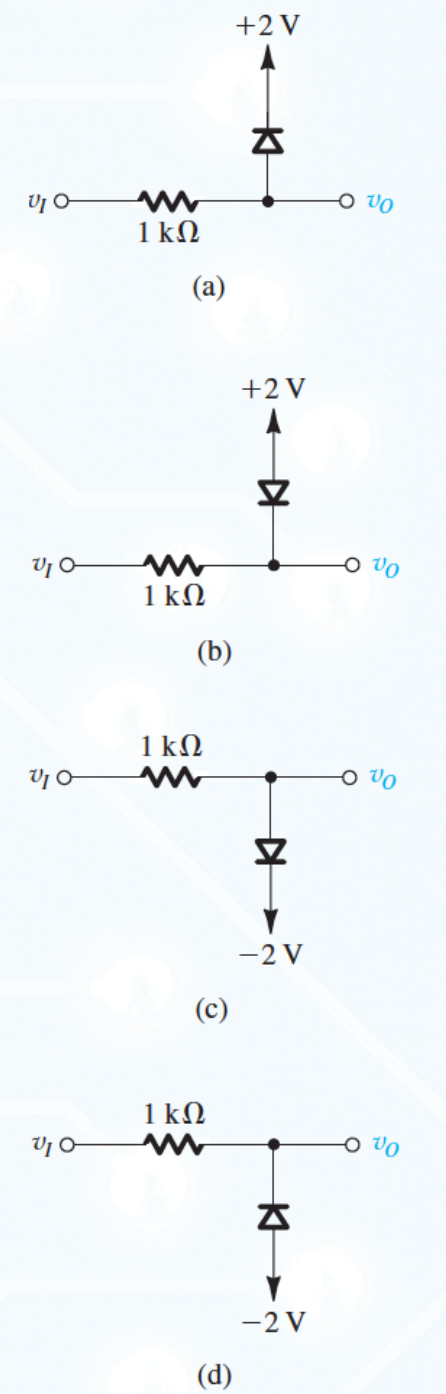

Figure P4.85