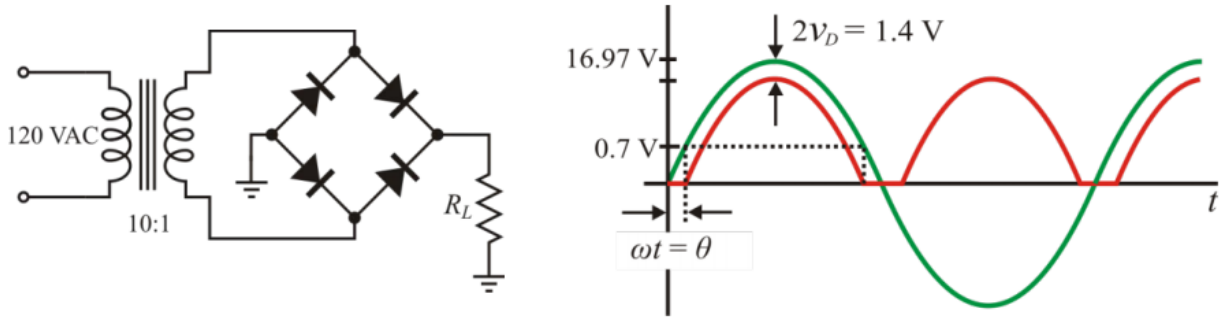
CE 432 Robotics II Homework Package - Solutions

Chapter 1 Power Supply for Robots

1. 1. A full-wave, 4-diode bridge 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 silicon diodes that one can model to have a 0.7-V drop for any current. (a) What is the peak voltage of the rectified output?

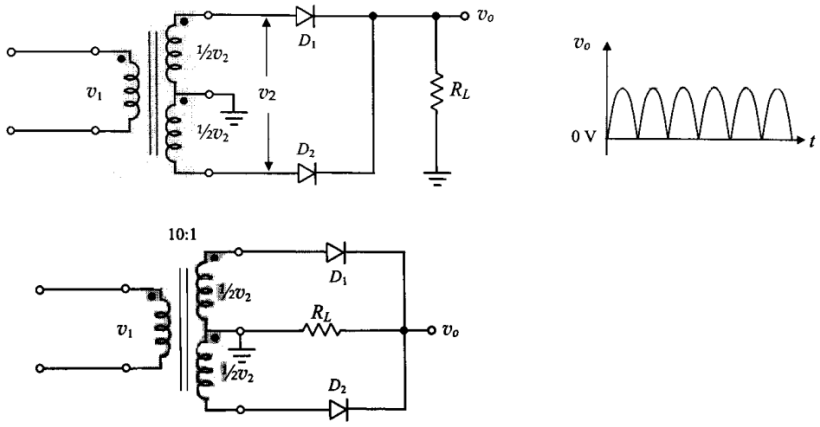


(a) The peak voltage after the 10-to-1 step down is VP = (12)(√2) = 16.97 V so the peak voltage of the rectified output is this, minus two diode drops, or $VP(load)$ = 16.97 − 1.4 = 15.57 V

(b) 81.13%

(c) PIV=16.97 – 0.7 =- 16.27V

2. For the following Full Wave Center-Tapped Rectifier, find the rectified DC voltage output. Vin (RMS) == 110V (60Hz), Turns Ration 10:1.



Given: vin(RMS) = 110 V (60 HZ) Turns Ratio 10:1 Find: Vout(DC Effective)

vin(Peak Center) = 1.414 *V(RMS)

vin(RMS) = 1.414 x 110 = 155.5 V

vout(Peak) = (1/2) (1/10)

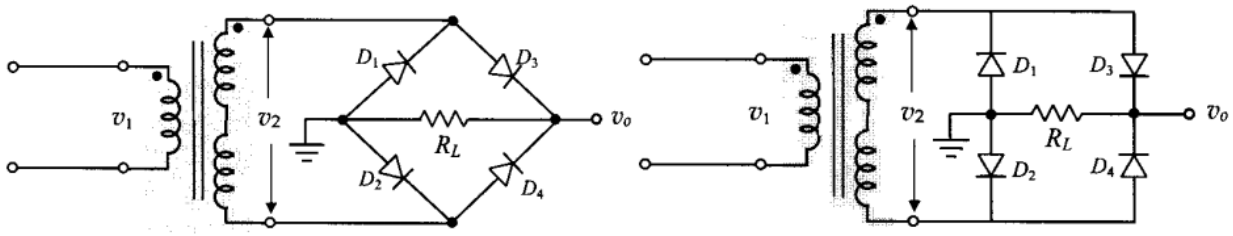
vin(RMS) = 1/20 x 155.5 = 7.8 V

vDiode = 7.8 - 0.7 = 7.1 V

Vout (DC Effective) = 0.636 (which comes from 2*vm/3.14)

vDiode = 0.636 x 7.1 ≈ 4.5 VDC

3. For the following Full Wave Bridge Rectifier, find the rectified DC voltage output. Vin (RMS) ==110V (fin=60Hz), Turns Ration 10:1.



Given: vin(RMS) = 110 V (60 HZ)

Turns Ratio 10:1

(a) Find: Vout(DC Effective)

vin(Peak) = 1.414

vin(RMS) = 1.414 x 110 = 155.5 V

vout(Peak) = 1/10

vin(RMS) = 1/10 x 155.5 = 15.6 V

vo (RMS) = 15.6 - 2(0.7) = 14.2 V

vout(DC Effective) = 0.636 x vo = 0.636 x 14.2 ≈ 9 VDC

(b) Smoothing filter:

Vripple=Iout(DC)/fC

Iout(DC) = vout(DC) / RLoad = 9/100 = 90mA

C=Iout(DC)/Vripplexf= 90mA/(1V*120Hz)=0.75 mF (note: f is 2xfin=120Hz)