TUTORIAL SHEET NO. 3
(Rectifier: Half wave, Centre-tap, Bridge Rectifier and Voltage Regulator)

Q1. The forward resistance R_F of a diode is 20 Ω. This is used in a half wave rectifier circuit. The applied input voltage is v = 50 sin wt and the load resistance R_L is 800 Ω. Determine:
a) I_m , I_{dc} , I_{rms} b) ac power input and dc power output
c) Output dc voltage d) Rectification Efficiency.
Ans- a) $I_{m=}$ 60.97 mA , I_{dc}= 19.41 mA, I_{rms}= 30.48 mA
b) P_{ac}= 0.7618 W, P_{dc}= 0.3016 W c) V_o= 15.53 V d) η= 39.59 %

Q2. In a centre tap full wave rectifier the load resistance is 7500 Ω. Each diode has an ac plate resistance of 50Ω. If the ac voltage applied to each diode has a peak amplitude of 400 V and frequency 50 Hz. Calculate:
(a) I_m , I_{dc} , I_{rms} (b) P_{dc} (c) P_{ac} (d) η (e) ripple factor
(f) Output frequency
Ans-a) I_m= 52.98 mA, I_{dc}= 33.73 mA, I_{rms}= 37.46 mA b) P_{dc}= 8.53 W
c) P_{ac} = 10.594 W d) η= 80.54 % e) r= 0.483 f) f_o= 100 Hz

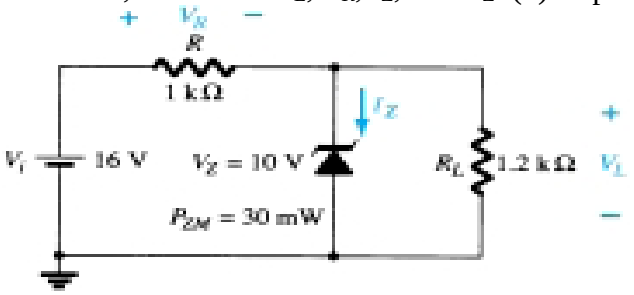
Q3. A 230 V, 60 Hz voltage is applied to the primary of a 5:1 step-down, centre tap transformer used in a full wave rectifier having a load of 900Ω. If the diode resistance is of 100 Ω. Determine:
(a) Dc voltage across the load (b) Dc current flowing through the load (c) PIV
(d) Dc power delivered to the load (e) Ripple voltage (f) Output frequency
Ans- a) $V=_o$ 18.63 V b) I_{dc}= 20.70 mA c) PIV= 65.05 V
d) P_{dc}= 0.386 W e) $V_{r(rms)}$= 10V f) f_o=120Hz

Q4. A centre tap full wave rectifier has R_L=1000Ω, R_F= 20Ω.Voltage across half of the secondary winding is given by the equation v = 200 sin 314 t. Determine:
(a) Peak value of current (b) average or dc value of current
(c) the rms value of current (d) ripple factor e) η
Ans- a) I_m=0.196A b) I_{dc}=0.124A c) I_{rms}=0.138A d) r=0.488 e) η=79.4%

Q5. AC voltage of 200 V is applied to half wave rectifier circuit through transformer of turn ratio 4:1, R_L=300Ω.Assuming diode as ideal one. Determine the following:
(a) dc output voltage (b) PIV
(c) Maximum value of power delivered to load (d) Average value of power delivered to load
Ans- a) V_{dc} = 22.44 V b) PIV= 70.71 V c) P_m= 16.66 W d)P_{dc}= 1.68 W

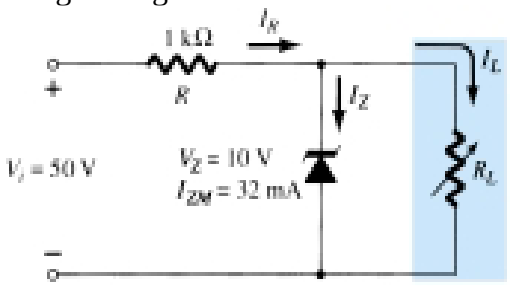
Q5. A bridge rectifier is applied with input from a step down transformer having turns ratio 8:1 and input 230 V, 50 Hz. If the forward resistance of diode is 1Ω, secondary winding resistance is 10Ω and load resistance is 2kΩ. Find
(a) DC power output (b) PIV across each diode
(c) Efficiency (d) percentage regulation at full load
Ans- a) P_{dc} = 0.3307 W b) PIV= 40.6586 V c) η = 80.56% d) % Regulation = 0.645%

Q6. (a) For the Zener diode network of, determine V_L, V_R, I_Z, and P_Z. (b) Repeat part (a) with R_L = 3 k Ω.



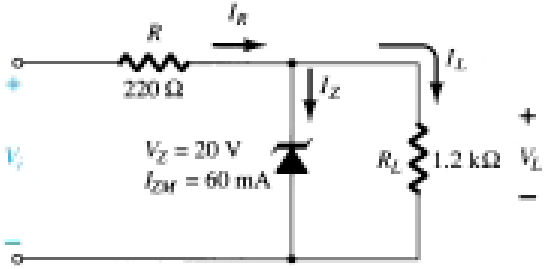
Ans: (a) V_L = **8.73 V,** V_R =**7.27 V,** I_Z = **0 A,** P_Z = **0 W**
(b) V_L =**10 V,** V_R = **6 V,** I_L = 3.33 mA , I_R = 6 mA , I_Z = **2.67 mA.**

Q7. (a) For the network determine the range of R_L and I_L that will result in V_{RL} being maintained at 10 V.
(b) Determine the maximum wattage rating of the diode.



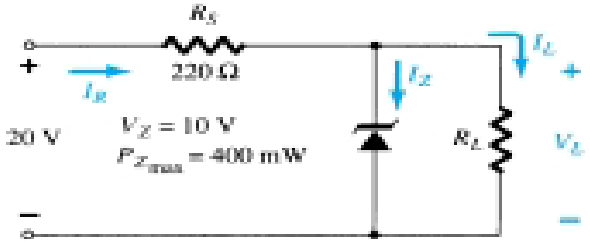
Ans: (a) $R_{L\min}$ =**250 Ω**, $R_{L\max}$ = **1.25 kΩ**, I_{Lmax} = **40 mA,**, $I_{L\min}$ = **8 mA.** (b) $P_{\max}$ = **320 mW**

Q8. Determine the range of values of V_i that will maintain the Zener diode in the "on" state.



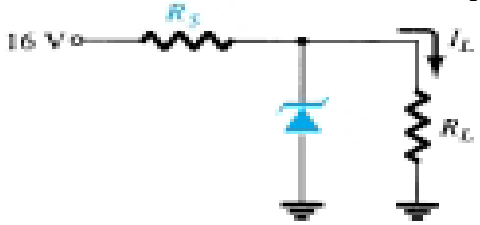
Ans: $V_{i\ min}$ = **23.67 V,** $V_{i\ max}$ = **36.87 V**

Q 9. (a) Determine V_L, I_L, I_Z, and I_R for the network if R_L = 180 Ω (b) Repeat part (a) if R_L = 470 Ω
(c) Determine the value of R_L that will establish maximum power conditions for the Zener diode.
(d) Determine the minimum value of R_L to ensure that the Zener diode is in the "on" state.



Ans: (a) I_L = I_R = **50 mA**, I_Z = **0 mA**, V_L = **9 V** (b) V_L = **10 V,** I_R =**45.45 mA**, I_L = **21.28 mA**, I_Z = **24.17 mA**
(c) R_L = **1,834.86 Ω** (d) R_L = **220 Ω**

10. (a) Design the network of Fig. 2.166 to maintain V_L at 12 V for a load variation (I_L) from 0 to 200 mA. That is, determine R_s and V_Z. (b) Determine $P_{Z\max}$ for the Zener diode of part (a).



Ans: (a) V_Z = 12 V, R_L = **60 Ω**, R_s = **20 Ω** (b) $P_{Z\max}$ = **2.4 W**