Problems related to half-wave and full-wave rectifier

1. A half-wave rectifier uses a diode with a forward resistance of 100 Ω. If the input ac voltage is 220 V rms and local resistance is 2kΩ. Determine:
   (i) I_{max}, I_{dc}, and I_{rms} (ii) PIV (iii) load output voltage (iv) d.c. output power and a.c. input power (v) ripple factor (vi) TUF (vii) rectification efficiency.
   Ans: (i) 148 mA, 47 mA, and 74 (ii) 311 V (iii) 94.32 V (iv) 4.45 W, 11.5 W (v) 1.21 (vi) 0.27 (vii) 38.6%

2. The load resistance of a centre tap full-wave rectifier is 500 Ω and secondary voltage is 60sin(100πt). Calculate (i) peak, average and rms value of current (ii) ripple factor (iii) efficiency. Each diode has and idealized I-V characteristics having slope corresponding to a resistance of 50Ω.
   Ans: (i) 0.109 A, 0.069 A and 0.077 A (ii) 0.482 (iii) 73.82%

3. A half-wave rectifier has a load resistance of 3.5 kΩ. If the diode and secondary of the transformer have a total resistance of 800 Ω and the input voltage has an a.c. signal of 240 V (peak value). Determine:
   (i) peak, average and rms value of current (ii) d.c. output power (iii) a.c. input power (iv) efficiency (iii) ripple factor.
   Ans: (i) 55.81 mA, 17.76 mA and 27.91 mA (ii) 1.1 W (iii) 3.35 W (iv) 32.85% (v) 1.21

4. A half-wave rectifier, having a diode of resistance 1000Ω and load resistance of 1000Ω rectifies an a.c. voltage of 310 V peak value. Calculate:
   (i) peak, average and rms value of current (ii) d.c. output power (iii) a.c. input power (iv) efficiency
   Ans: (i) 0.219 A, 0.07 A and 0.1096A (ii) 4.868 W (iii) 24.02 W (iv) 20.26%

5. A full-wave rectifier uses a double diode with each element having a constant forward resistance of 500 Ω. The transformer rms secondary voltage from the centre tap to each plate is 300 V, the load resistance of 2.5 KΩ. Determine:
   (i) dc out power and ac input power (ii) efficiency.
   Ans: (i) 20.3 W and 30 W (ii) 67.67 %

6. A single wave full-wave rectifier uses two diodes the internal resistance of each being 20 Ω. The transformer rms secondary voltage for centre tap to each of the secondary is 50 V and load resistance is 980 Ω. Determine:
   (i) mean load current (ii) rms load current (iii) efficiency
   Ans: (i) 45 mA (ii) 50 mA (iii) 79.58%

7. The turn ratio of a transformer used in a half-wave rectifier is 10:1. The primary is connected to the power mains 220V. The diode resistance in forward bias is 5Ω. The load resistance is 10KΩ. Determine:
   (i) dc output voltage, (ii) rms output voltage, (iii) TUF (iv) Rectification efficiency.

8. An a.c. supply of 230 V is applied to a half wave rectifier circuit through a transformer of turn ratio 10:1. Find (i) the output d.c. voltage and (ii) the peak inverse voltage. Assume the diode to be ideal.
   Ans: (i) 10.36 V (ii) 32.35

9. A crystal diode having internal resistance $r_f = 20Ω$ is used for half wave rectification. If applied voltage $v = 50\sin \omega t$ and load resistance $R_L = 800Ω$, find:
   (i) I_m, I_{dc}, I_{rms} (ii) a.c. power input and d.c. power output (iii) d.c. output voltage (iv) efficiency
   Ans: (i) 61 mA, 19.4 mA, 30.5 mA (ii) 0.763 W, 0.301 W (iii) 15.52 V (iv) 39.5%

10. A half wave rectifier is used to supply 50V d.c. to a resistance load of 800Ω. The diode has a resistance of 25Ω. Calculate a.c. voltage required.
    Ans: maximum voltage required V_m = 162 V

11. A full wave rectifier uses two diodes, the internal resistance of each diode may be assumed constant at 20Ω. The transformer rms secondary voltage from center tap to each end of secondary is 50V and load resistance of 980Ω. Find:
    (i) the mean load current (ii) the rms value of load current
    Ans: (i) 45 mA (ii) 50 mA

12. A full wave rectifier uses two ideal diodes. The turn ratio of a transformer used is 5:1. The primary is connected to the power mains 230V and load resistance of 100Ω. Find:
(i) d.c. output voltage (ii) PIV (iii) rectification efficiency
Ans: (i) 20.7V (ii) 65 V (iii) 81.2%

13. A half wave bridge rectifier uses four ideal diodes. The turn ratio of a transformer used is 4:1. The primary is connected to the power mains 230V, 50Hz and load resistance of 200Ω. Find:
(i) d.c. output voltage (ii) PIV (iii) output frequency
Ans: (i) 52V (ii) 81.3V (iii) 100Hz

14. The four diode used in a bridge rectifier circuit have forward resistance which may be considered constant at 1Ω and infinite reverse resistance. The alternating supply voltage is 240 V r.m.s. and load resistance is 480Ω. Calculate (i) mean load current (ii) power dissipated in each load.
Ans: (i) 0.45 A (ii) 0.123 W