Question 1:

For a half wave rectifier, the source voltage is 120 V-RMS at 60

Hz. The load resistance is 5 Ω. Find,

a) Average load current.

b) Average power absorbed by load.

c) Power factor.

a) <u>Average Load Current:</u>

We know that,

$$I_{o\,(avg)} = \frac{V_{o\,(avg)}}{R}$$

$$\therefore V_{o\,(avg)} = \frac{V_m}{\pi}$$

$$I_{o\,(avg)} = \frac{V_m}{\pi R}$$

$$I_{o\,(avg)} = \frac{V_{rms}\ x\ \sqrt{2}}{\pi R} = \frac{120\ x\ \sqrt{2}}{\pi\ x\ 5} = 10.8\ A$$

b) <u>Average Power Absorbed by Load:</u>

We have,

$$P_{out} = \frac{V^2_{o\,(rms)}}{R}$$

where,

$$V_{o\,(rms)} = \frac{V_m}{2} = \frac{120\ x\sqrt{2}}{2} = 84.9\ V$$

$$P_{out} = \frac{(84.9)^2}{5} = 1441\ W$$

c) Power Factor:

We have,

$$PF = \frac{P}{S} = \frac{P}{V_{in\ (rms)} I_{in\ (rms)}}$$

for $I_{in\ (rms)}$,

$$P_{out} = I^2_{(rms)}\ x\ R$$

$$I_{in(rms)} = \sqrt{\frac{P_{out}}{R}} = \sqrt{\frac{1441}{5}} = 16.9\ A$$

So,

$$PF = \frac{1441}{120\ x\ 16.97} = 0.7$$

Question 2:

A half wave rectifier is supplied with a voltage of 600 V-RMS

at a frequency of 50 Hz. The load resistance is 50 Ω. Find,

a) Average load current.

b) Power absorbed by load

c) Apparent power supplied by source.

d) Power factor.

a) **Average Load Current:**

We know that,

$$I_{o\,(avg)} = \frac{V_{o\,(avg)}}{R}$$

$$I_{o\,(avg)} = \frac{V_m}{\pi R}$$

$$I_{o\,(avg)} = \frac{V_{rms}\ x\ \sqrt{2}}{\pi R} = \frac{600\ x\ \sqrt{2}}{\pi\ x\ 50} = 5.4\ A$$

b) **Power Absorbed by Load:**

$$P_{out} = I_{o\,(rms)}^2\ x\ R$$

where,

$$I_{o\,(rms)} = \frac{V_{o\,(rms)}}{R} = \frac{V_m}{2R} = \frac{600\ x\ \sqrt{2}}{2\ x\ 50} = 8.4\ A$$

So,

$$P_{out} = (8.4)^2\ x\ 50 = 3600\ W$$

c) **Apparent Power Supplied by Source:**

We have,

$$S = V_{in\,(rms)}\ x\ I_{in\,(rms)}$$
$$S = 600\ x\ 8.4$$
$$S = 5088\ VA$$

d) **Power Factor:**

$$\text{PF} = \frac{P}{S}$$
$$\text{PF} = \frac{3600}{5088}$$

$$\text{PF} = 0.7$$

Question 3:

For a half wave rectifier with RL load, Vm=100 V, R=100 Ω,

L=0.1H and β=3.5, w=377. Find,

a) Current expression.

b) Average current.

c) RMS current.

d) Power absorbed by load.

e) Power factor.

a) Current Expression:

The current expression is given as,

$$i(t) = \frac{V_m}{\sqrt{R^2 + (Lw)^2}} \sin(wt - \theta) + Ae^{-wt / \frac{Lw}{R}}$$

and,

$$\theta = \tan^{-1} \frac{Lw}{R}$$

$$\theta = \tan^{-1} \frac{0.1 \; x \; 377}{100} = 20.6° = 0.36 \, rad$$

and,

$$\sqrt{R^2 + (Lw)^2} = \sqrt{100^2 + (0.1x377)^2} = 106.87$$

and,

$$A = \frac{V_m \; Sin \; \theta}{\sqrt{R^2 + (Lw)^2}}$$

So, we have

$$i(wt) = \frac{100}{106.87} \sin(wt - 0.36) + \frac{100 \sin(0.36)}{106.87} e^{-wt / \frac{Lw}{R}}$$

$$i(wt) = 0.93 \sin(wt - 0.36) + 0.33 \, e^{-wt / \frac{Lw}{R}} \quad \text{For } 0 \leqslant wt \leqslant 3.5$$

$$i(wt) = 0 \quad \text{For } 3.5 < wt \leqslant 2\pi$$

b) Average Current:

$$i(wt) = \frac{1}{T} \int_0^T i(wt) \, dwt$$

$$i(wt) = \frac{1}{2\pi} \left[\int_0^{3.5} i(wt) \, dwt + \int_{3.5}^{2\pi} i(wt) \, dwt \right]$$

$$i(wt) = \frac{1}{2\pi} \int_0^{3.5} \left(0.936 \sin(wt - 0.36) + 0.33 \, e^{-wt / \frac{Lw}{R}} \right) dwt$$