Homework 5

Page 96, Chinese textbook

Question 18

Considering a single-phase bridge fully-controlled rectifier circuit, which harmonics are there in the rectifier output voltage and which one in it has the largest magnitude? Which harmonics are there in the second side current of the transformer and which ones in it are dominating?

Question 19

Considering a three-phase bridge fully-controlled rectifier circuit, which harmonics are there in the rectifier output voltage and which one in it has the largest magnitude? Which harmonics are there in the second side current of the transformer and which ones in it are dominating?

Question 24

What is the main purpose of using multiplex rectifier circuit?

Question 25

Which harmonics are there in the rectifier output voltage and AC input current of the 12-pulse and 24-pulse rectifier circuit respectively?

Question 27

Considering a three-phase bridge fully-controlled converter connected to a EMF load with resistor and inductor, when $R = 1\Omega, L = \infty$, $U_2 = 220\text{V}$, $L = 1\text{mH}$, $E_M = -400\text{V}$, $\beta = 60°$, calculate the value of U_d, I_d,and γ. How much active power is being sent back to the grid?

Answer 18

For a single-phase bridge fully-controlled rectifier circuit, there exists 2kth harmonics in the output voltage, the maximum of which is second harmonics. (k=1,2,3……) There exists (2k+1)th harmonicsin the current of the secondary side of the transformer. (k=1,2,3……) The 3rd and 5th harmonics are the main part of the current.

Answer 19

For a single-phase bridge fully-controlled rectifier circuit, there exists 6kth harmonics in the output voltage, the maximum of which is second harmonics. (k=1,2,3……) There exists (6k+1)th and (6k-1)th harmonics in the current of the secondary side of the transformer. (k=1,2,3……) The 5th and 7th harmonics are the main part of the current.

Answer 24

The main reasons of using multiplex rectifier circuit are

(1) With the power of rectifier circuit increasing, the need of the capacity of rectifier is higher.

(2) Reduce harmonic and reactive power generated by power grid

Answer 25

There are (12k+1)th and (12k-1)th harmonics in the AC input current of the 12-pulse rectifier circuit. And there are 12kth harmonics in the rectifier output voltage of the 12-pulse rectifier circuit. (k=1,2,3……)

There are (24k+1)th and (24k-1)th harmonics in the AC input current of the 24-pulse rectifier circuit. And there are 24kth harmonics in the rectifier output voltage of the 12-pulse rectifier circuit. (k=1,2,3……)

Answer 27

There are 3 *equations according to the question*

$$U_d = 2.34U_2\cos(\pi-\beta) - \Delta U_d$$

$$\Delta U_d = \frac{3X_B I_d}{\pi}$$

$$I_d = \frac{U_d - E_M}{R}$$

the results are

$$U_d = -290.3V$$

$$I_d = 109.7A$$

with this equation mentioned below

$$\cos\alpha - \cos(\alpha+\gamma) = \frac{2X_B I_d}{\sqrt{6}U_2}$$

$$\gamma = 8.9^\circ$$

so the active power of power grid

$$P = |E_M I_d| - I_d^2 R = 400\times 109.7 - 109.7^2\times 1 = 31845.9W$$