Engineering Mathematics

A Foundation for Electronic, Electrical, Communications and Systems Engenieers

INTRODUCTION

Currents and voltages often vary with time. Engineers may wish to know the average value of such a current or voltage over some particular time interval. The average value of a time-varying **fonction** is defined in terms of an **integral**. An associated quantity is the **root mean squ**are (**r.m.s.**) value of a fonction. The **r.m.s.** value of a current is used in **the calculation of the power dissipated by a resistor.**

Example 15.2 Sawtooth waveform

Consider the sawtooth waveform shown in Figure 15.2.

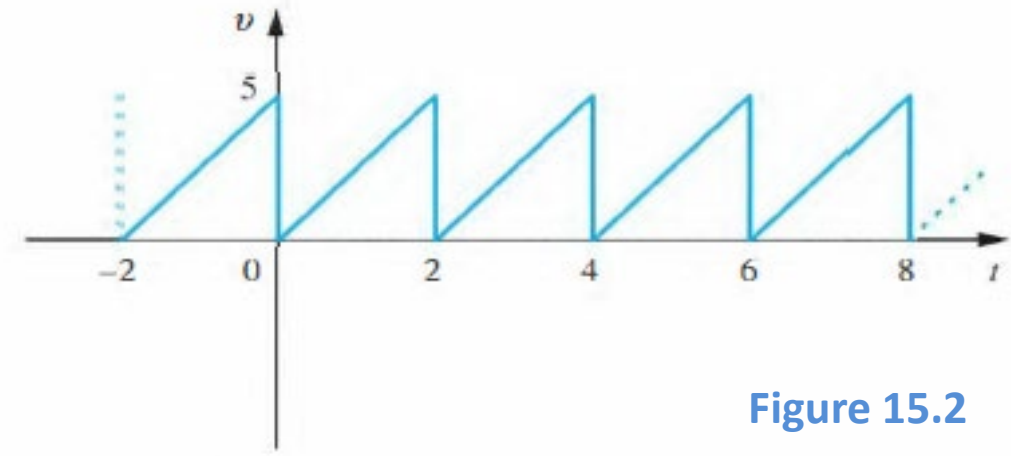

Figure 15.2

A sawtooth waveform.

Calculate the average value of this **waveform over a complete period**.

Engineering Mathematics

Example 15.3 A thyristor firing circuit

Figure 15.3 shows a simple circuit to control the voltage across a load resistor, R_L. This circuit has many uses, one of which is to adjust the level of lighting in a room. The circuit has an a.c. power supply with peak voltage, V_S. The main control element is the thyristor. This device is similar in many ways to a diode. It has a very high resistance when it is reverse biased and a low resistance when it is forward biased. However, unlike a diode, this low resistance depends on the thyristor being 'switched on' by the application of a gate current. The point at which the thyristor is switched on can be varied by varying the resistor, R_G. Figure 15.4 shows a typical waveform of the voltage, v_L, across the load resistor.

The point at which the thyristor is turned on in each cycle is characterized by the quantity αT, where $0 \leqslant \alpha \leqslant 0.25$ and T is the period of the waveform. This restriction

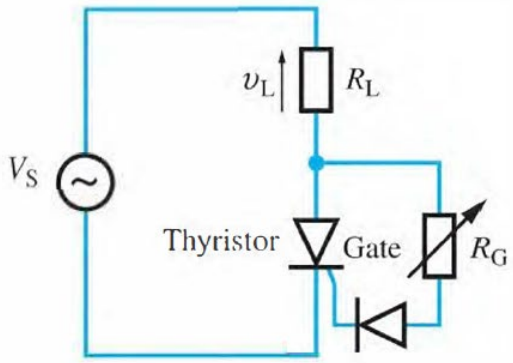

Figure 15.3
A thyristor firing circuit.

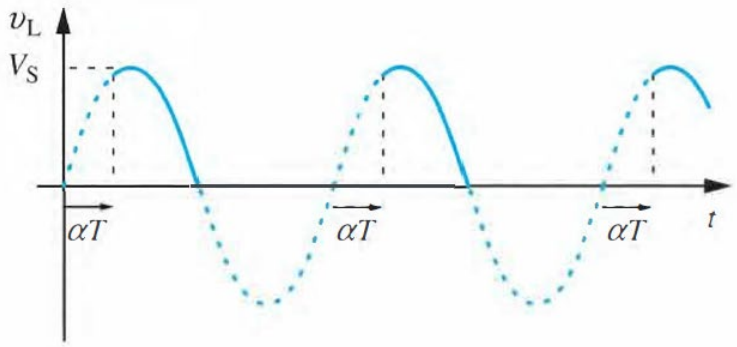

Figure 15.4
Load voltage waveform.

on α reflects the fact that if the thyristor has not turned on when the supply voltage has peaked in the forward direction then it will never tum on.

Calculate the average value of the waveform over a period and comment on the result.