

Signals and Noise

□ Fourier series

- Constructed from fundamental harmonic sine and cosin functions
- In practical system, a much less than infinite bandwidth is true
- As n become larger, the amplitude coefficients a_n, b_n tend to become smaller

Saw tooth waveform

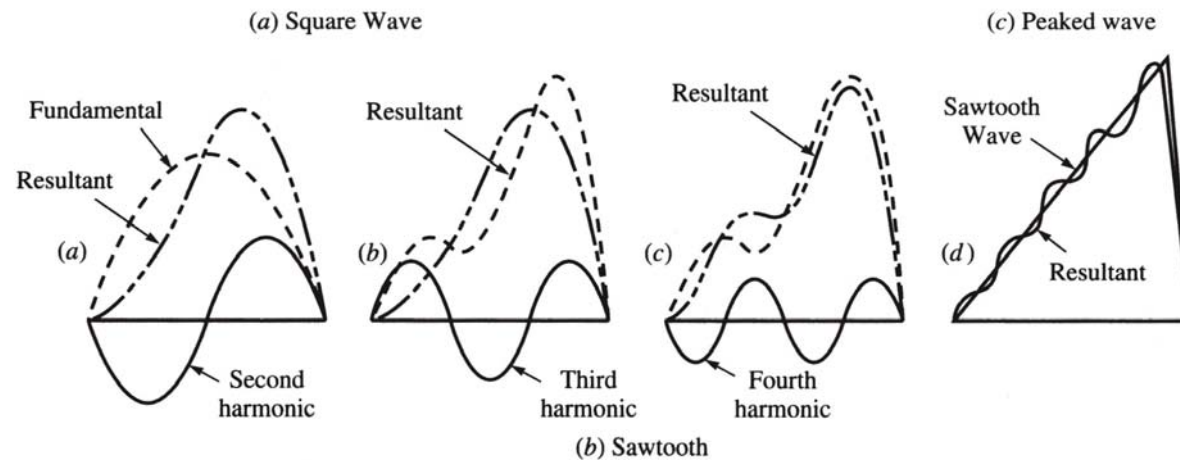
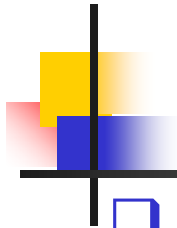


Figure 5-3

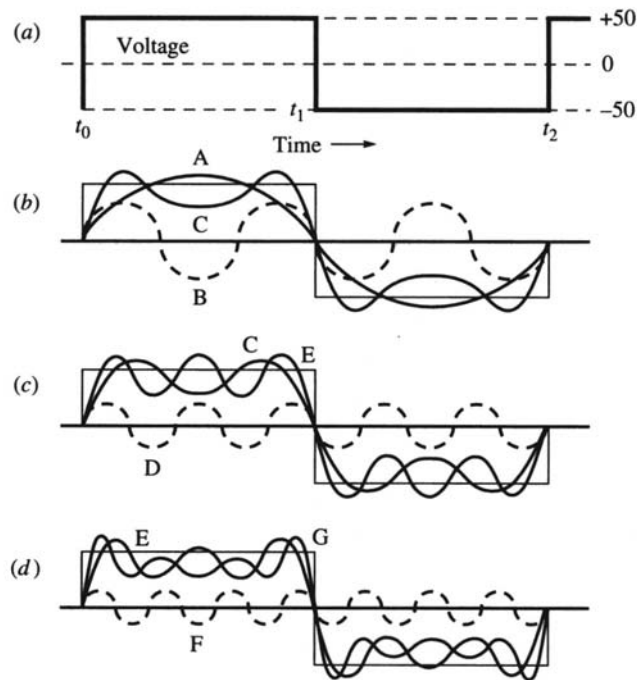
The Fourier series makes up waveforms. (a) Square wave. (b) Sawtooth wave. (c) Peaked wave.



Signals and Noise

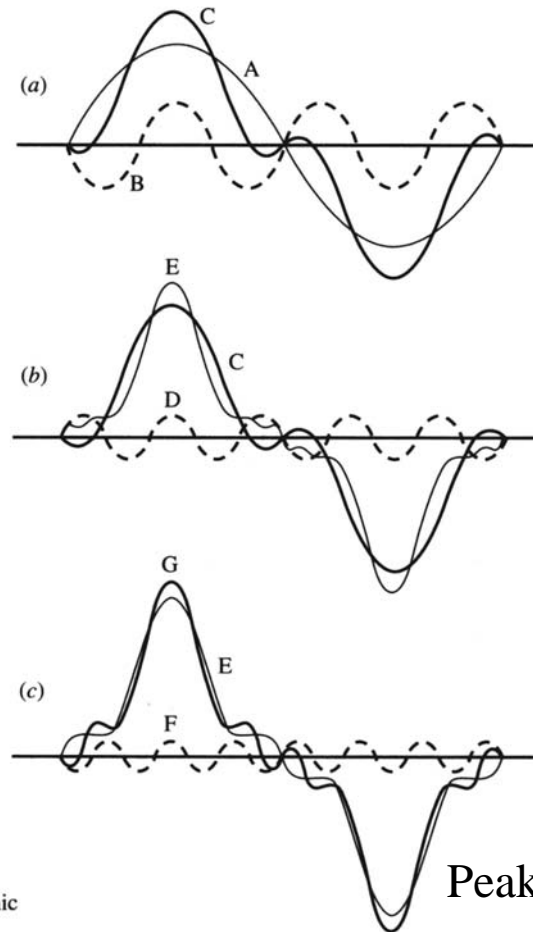
Fourier series

❖ Square wave and peak wave



Square wave

- A Fundamental
- B 3rd harmonic
- C Fundamental plus 3rd harmonic
- D 5th harmonic
- E Fundamental plus 3rd and 5th harmonics
- F 7th harmonic
- G Fundamental plus 3rd, 5th, and 7th harmonics



Peak wave

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□ The human arterial pressure waveform superimposed on the same time line as the ECG wave

- ❖ The pressure waveform
 - ✓ Be accurately reproduced with about 25 harmonics (30 Hz bandwidth)

- ❖ The ECG waveform
 - ✓ Requires 70~80 harmonics for faithful reproduction

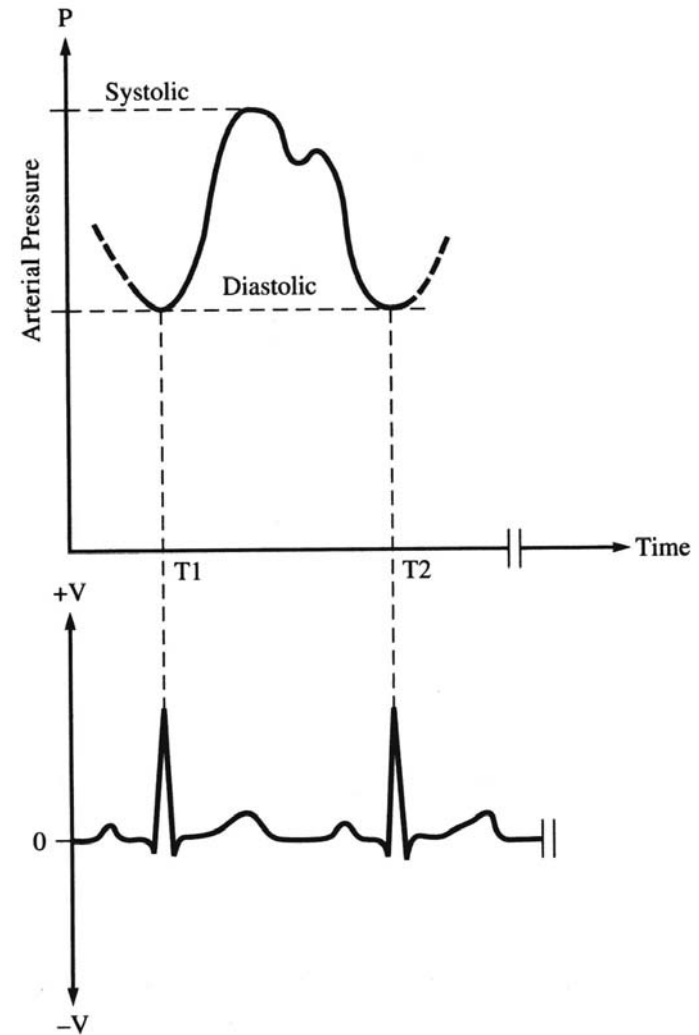


Figure 5-4
Human arterial pressure wave.

Signals and Noise

□ The profile of the Fourier series of a specific waveform is whether the function is odd or even

❖ Even function: $f(t) = f(-t)$, $a_n \neq 0$, $b_n = 0$

❖ Odd function: $f(t) = -f(-t)$, $a_n = 0$, $b_n \neq 0$

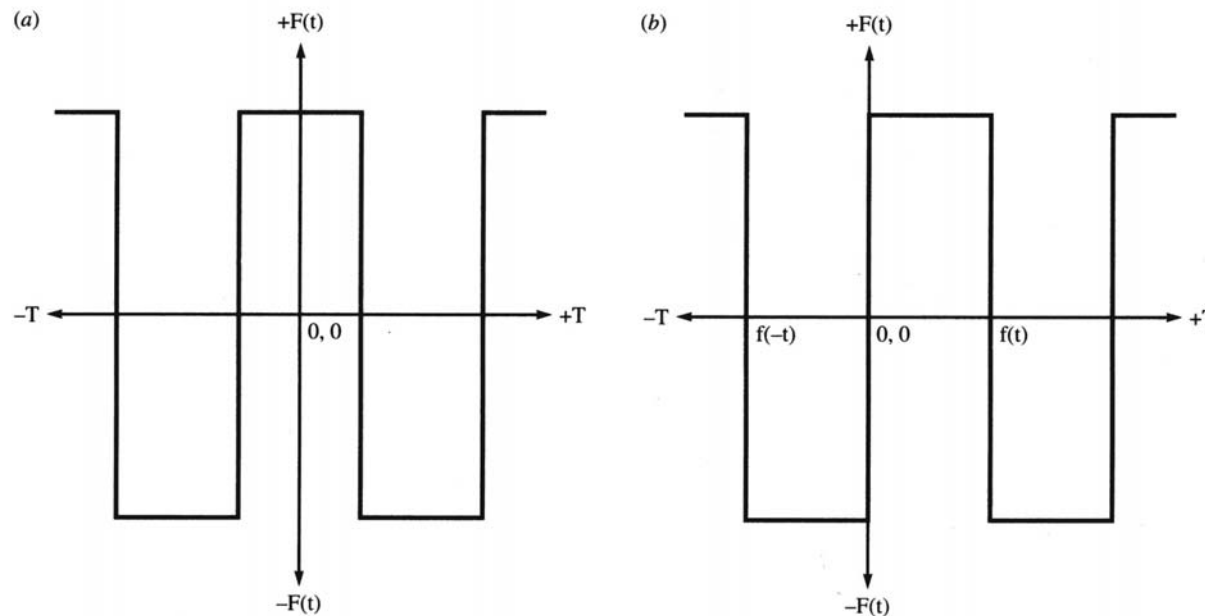


Figure 5-5
Odd and even Fourier series waveforms. (a) Odd-function square wave. (b) Even-function square wave.

Signals and Noise

□ Waveform symmetry

❖ Zero-axis symmetry: $|+V_m| = |-V_m|$

- It will contain even harmonics

