ELEMENTS OF ELECTRICAL ENGINEERING (UE24EE141B)

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Unit 2 – Single Phase AC Circuits – Lecture 19 – Overview of Generation, Transmission & Distribution

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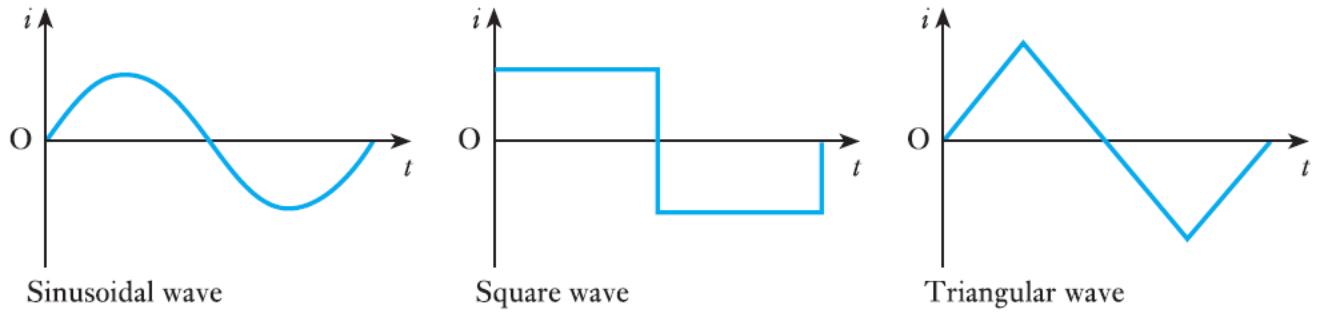
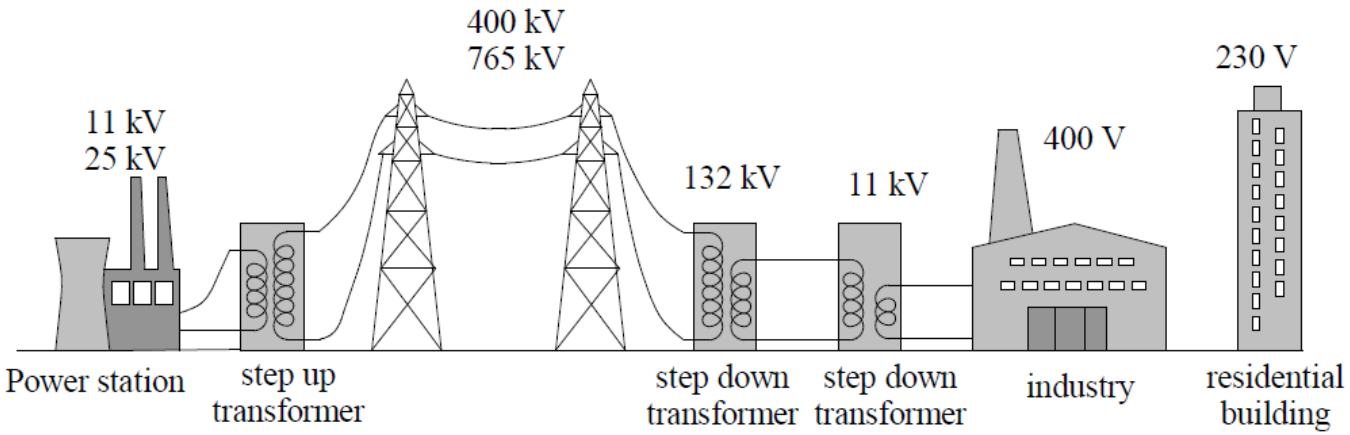
Introduction to Single Phase System

- First Power distribution system was a DC System invented by Edison
- Due to the invention of transformer, AC systems have gained popularity over DC Systems for Power Generation, Transmission and Distribution.
- AC Stands for 'Alternating Current'.
- An AC waveform is a periodic waveform which alternates.



Overview of Power Systems



- Power Generation and Power Transmission is done as Three Phase AC Power.
- Power distribution to industries is done as Three Phase AC Power & to domestic consumers is done as Single Phase AC Power.

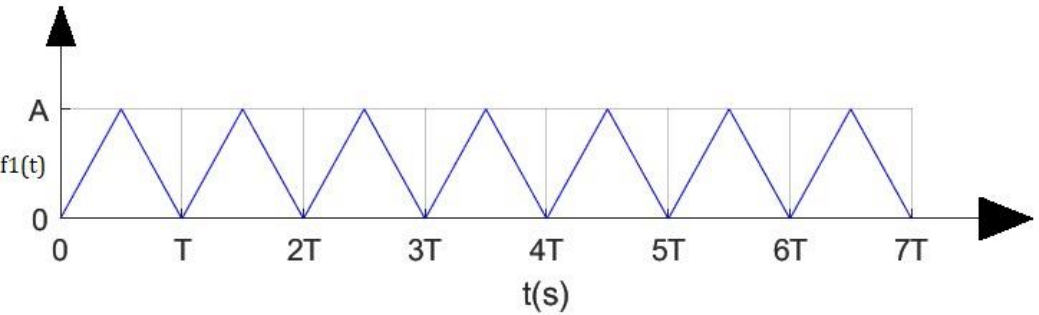
Basic Terminology

- **Periodic waveform**:

A periodic waveform is one which repeats itself after certain time interval.

- **Time Period(T)**:

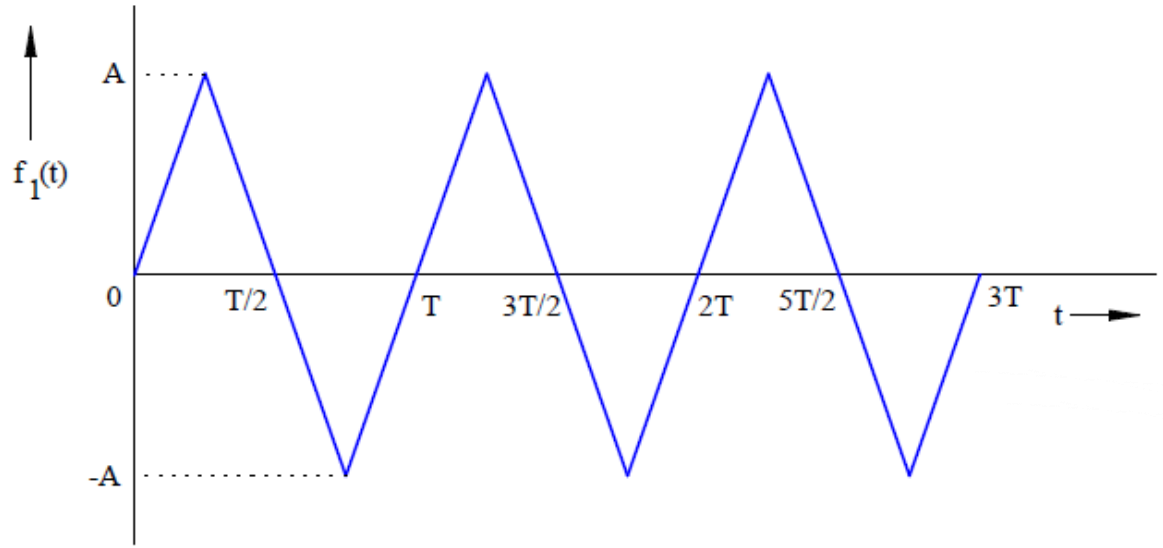
The time taken to complete one cycle of a periodic waveform. It is measured in Seconds.



- **Frequency(f):**

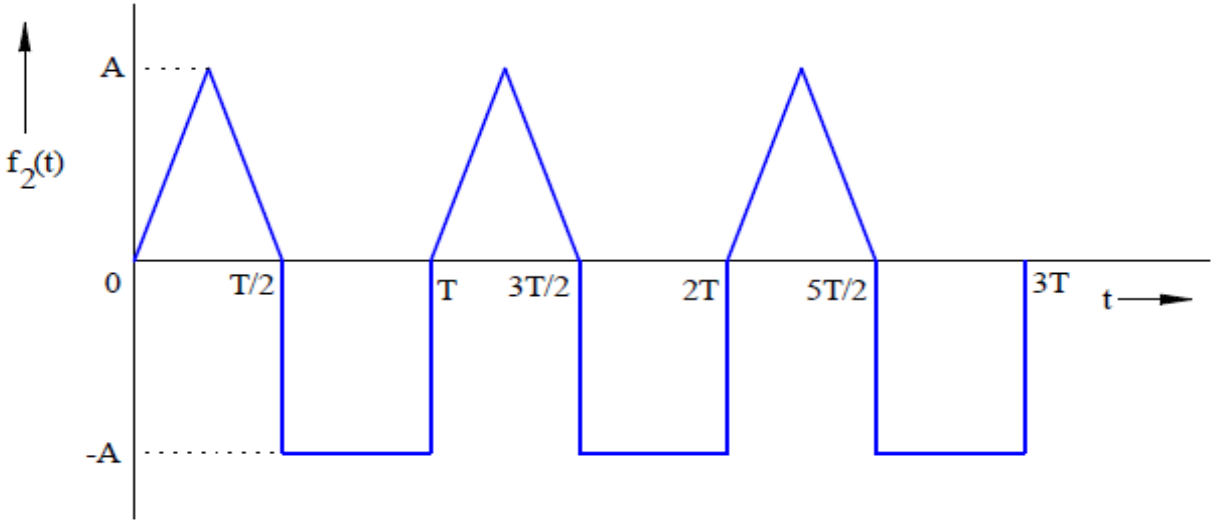
The number of cycles completed in one second of a periodic waveform . It is measured in Hz.

Concept of Pure AC waveform



- A pure AC waveform is one in which positive area is matched by equal negative area.
- Its average value is zero.
- f1(t) is a pure AC waveform

AC waveform with DC Component



- Positive Area is not matched by equal Negative Area

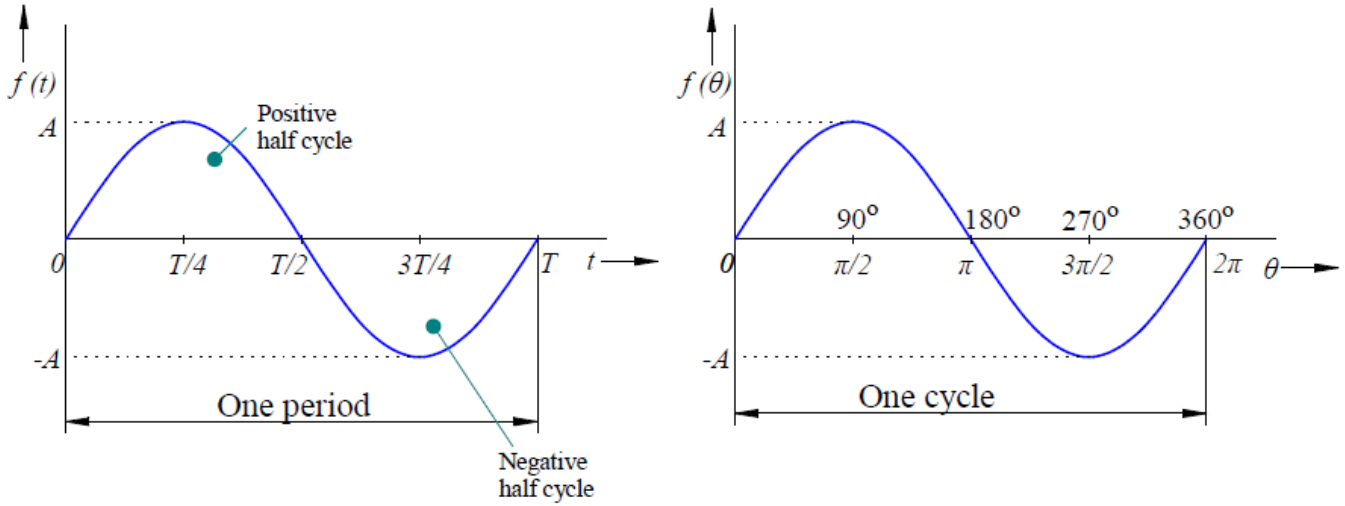
Hence, Average Value is Finite

- f2(t) is an AC wave with DC component (Not Pure AC)

Sinusoidal waveform

- Most widely used AC waveform for power generation, transmission & distribution is Sinusoidal Waveform.

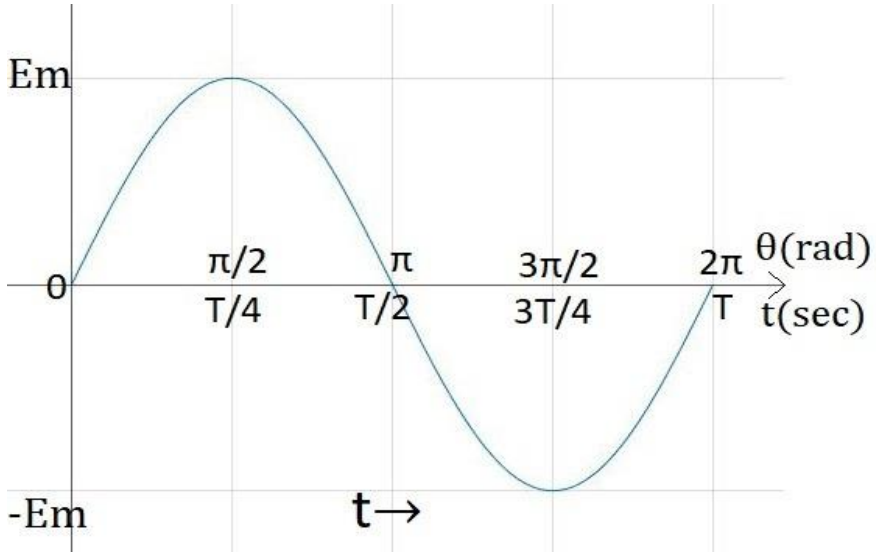
Sinusoidal Waveform:



- It can be expressed as a function of angle or time. Accordingly, one cycle completes in 2π radians or T seconds.

Sinusoidal Waveform – Relation between time and angle

e(θ)/e(t)



Time (sec)	Angle θ(Rad)
T	2π
T/2	π
1	(2π/T)
t	2π/T*t

Mathematical Representation of a Sinusoidal waveform

- $e(\theta) = E_m \sin(\theta)$

- $e(t) = E_m \sin((2\pi/T)*t) = E_m \sin(\omega t)$

where, $\omega = 2\pi/T = 2\pi f$ is called the angular frequency of the sine wave in rad/s.

- In general, the standard representation of a sinusoidal function is $E_m \sin(\omega t+\varphi)$ where φ is called the phase angle which can be either positive or negative.

Numerical Example 1

Question: For a Sinusoidal function of frequency 50 Hz, find
i) Half time period
ii) Angular frequency

Solution:

Time period, $T = 1/f = 1/50 = 0.02s = 20$ ms

i) Half time period $T/2 = 20/2 = 10$ ms

ii) Angular frequency (ω)
$\omega = 2\pi f = 2\pi(50) = 100\,\pi = 314.159$ rad/sec

Numerical Example 2

Question:

The maximum value of a sinusoidal alternating current of frequency 50Hz is 25 A. Write the equation for the instantaneous expression of current,. Determine its value at 3ms and 14 ms.

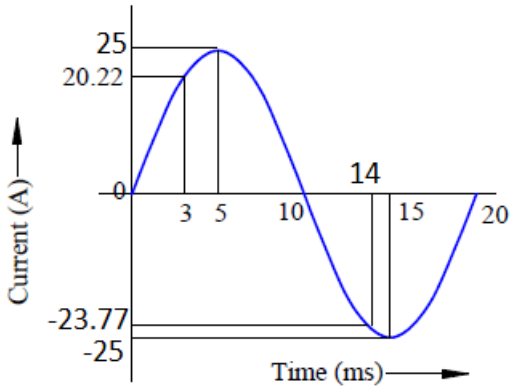
Solution:

$\omega = 2\pi f = 100\pi$ rad/s

$i(t) = 25\sin(100\pi t)$ A

$i(3ms) = 25\sin(100*\pi*0.003) = 20.22A$

Similarly, $i(14ms) = -23.77A$



Note: If radian scale is selected then substitute 'π' symbol in above equation. If degree scale is selected then don't use 'π' symbol, but substitute 180 in place of 'π'.

Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
2. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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