

BASIC 2/7

Harmonic Signals and Exponentials.

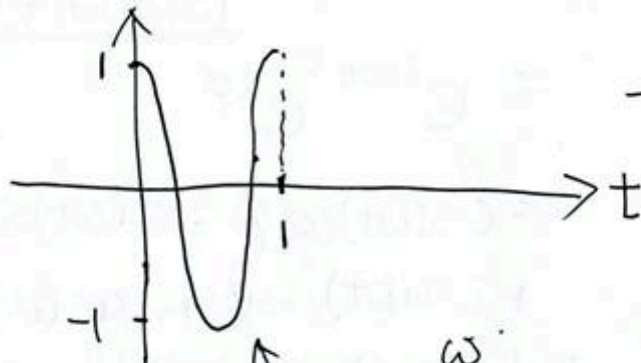
$$\boxed{\cos(\omega t)}$$

ω : angular frequency

$$\cos(\omega t)$$

rad
單位時間內轉多少 rad
 $2\pi = 360^\circ$

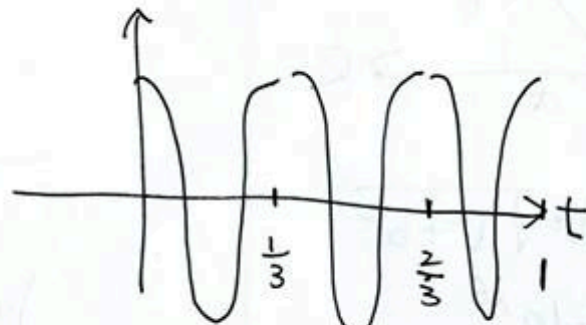
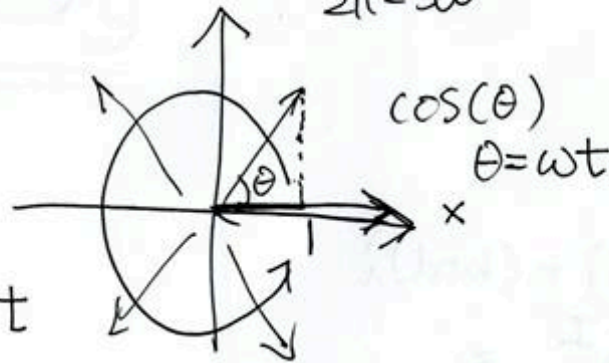
$$\omega = 2\pi f$$



$f=1$

$$\cos(2\pi t)$$

$$\cos(6\pi t)$$



$f=3$

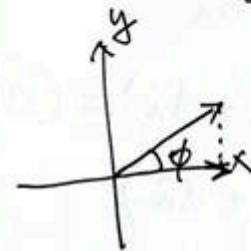
f: frequency.

單位時間內轉多少圈 (2π)

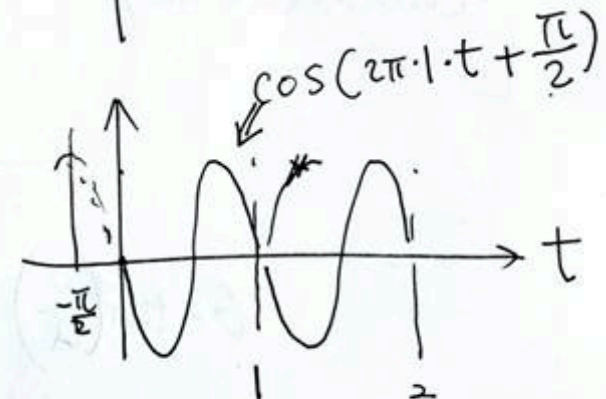
$$\cos(2\pi f t)$$

$$\cos(2\pi \frac{f}{f} t)$$

$$\cos(2\pi f t + \phi)$$



$$\cos(\phi)$$



$$f = 2.4 \text{ GHz}$$

$$= 2.4 \times 10^9 \text{ 1/s}$$

$$Hz = 1/s$$

$$G = 10^9$$

Complex Numbers

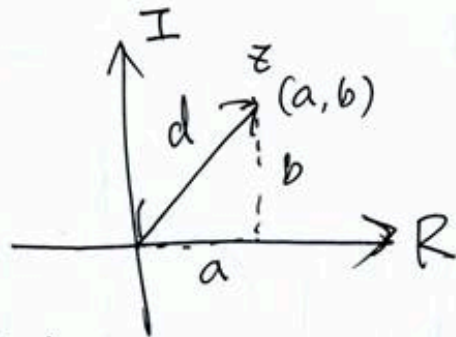
$$i = \sqrt{-1}$$

$$z = a + bi$$

$$z^* = a - bi$$

$$(a+bi) + (c+di) = (a+c) + (b+d)i$$

$$(a+bi)(c+di)$$



$$\theta = \tan^{-1}\left(\frac{b}{a}\right), \quad d = \sqrt{a^2 + b^2}$$

$$\underline{z = d e^{i\theta}}$$

$$z_1 = d_1 e^{i\theta_1} \quad z_2 = d_2 e^{i\theta_2}$$

$$z_1 \cdot z_2 = \boxed{d_1 d_2} e^{i(\theta_1 + \theta_2)}$$

$$\boxed{e^{i\theta_1}} e^{i\theta_2}$$

$$\underline{e^{i(\omega t + \phi)}} = \underline{\cos(\omega t + \phi) + i \sin(\omega t + \phi)}$$

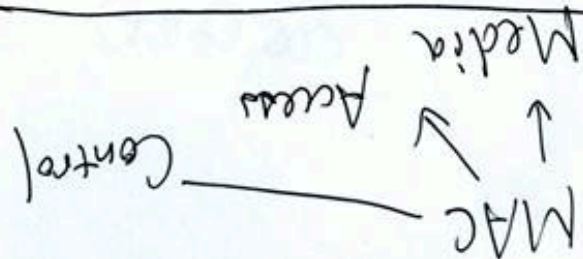
$$= e^{i\omega t} e^{i\phi}$$

$$= \cos(\omega t) \cos \phi - \sin(\omega t) \sin \phi$$

$$+ i \sin(\omega t) \cos \phi + i \cos(\omega t) \sin \phi$$

$$= [\cos(\omega t) + i \sin(\omega t)] [\cos \phi + i \sin \phi]$$

$$= e^{i\omega t} e^{i\phi}$$



P3 Project 2.

Software Defined Radio (SDR) ↑ C code FPGA

調變 modulation
↓
de

