(Signals and systems)

هندسة حاسبات
شعبة كمبيوتر
احتمالات وجبر الرياضة

اجتهدوا ثم اجتهدوا ثم اجتهدوا

المواد المعتمدة
- math1
- math2
- math3
- Stat1
- Stat2

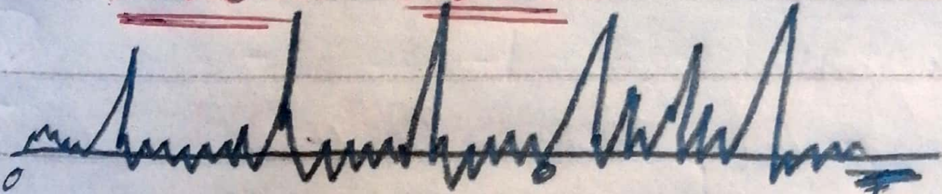
100
- ميدترم (40)
- فاينل (60)
- سيكشن + كويز + بونص

Any measurable quatity (Signal.) متغيرة
+ That usually has some form of Variation and it is a mean to convey information

Dependant Variable → x(t) → Independant Variable
- Time
- Location

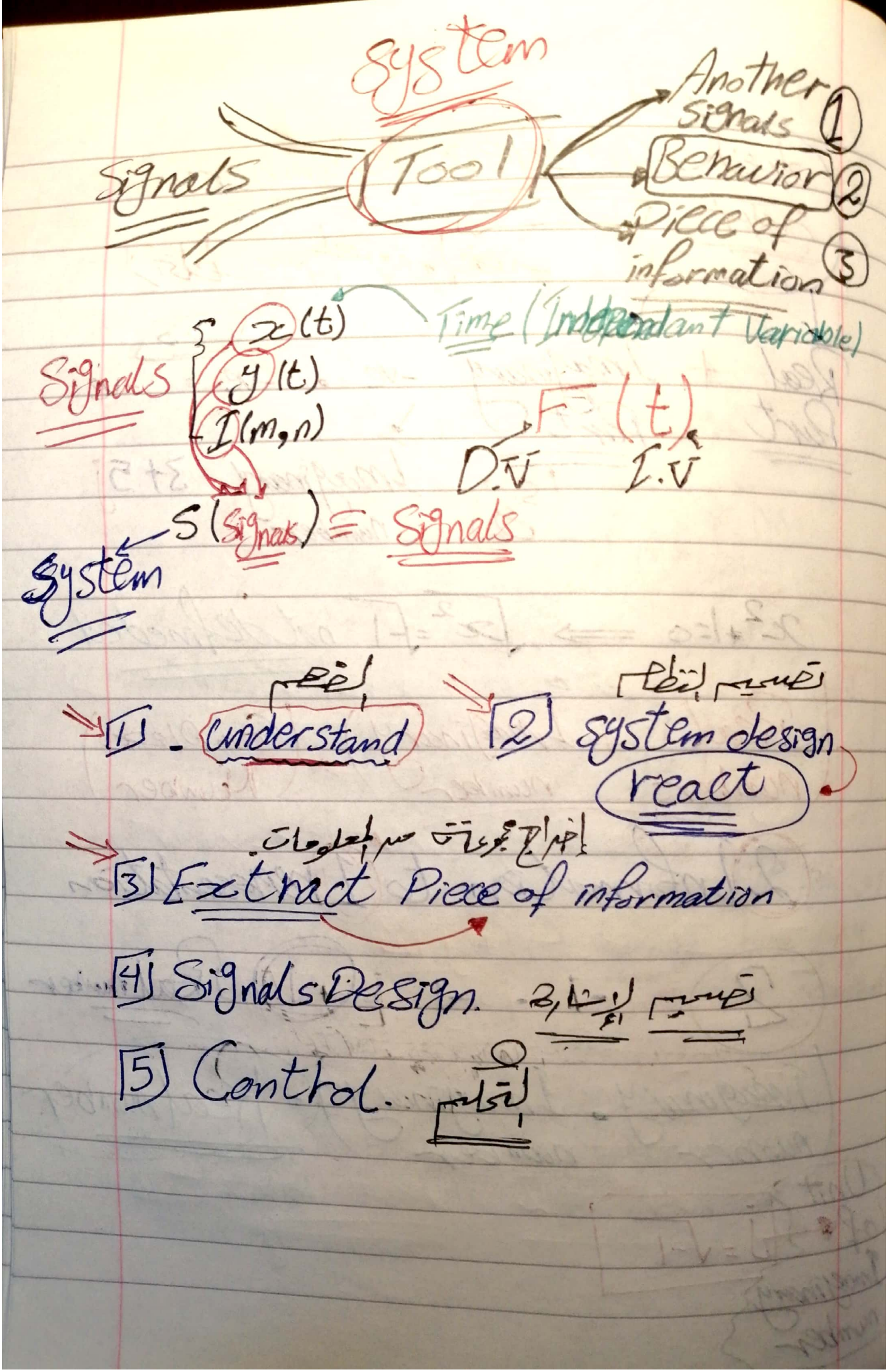
y(t)
z(m,n) new Cols

Audio waves



S(t)

Mathematically



الأعداد المركبة Complex Number

لا تخلط بين المعروف والمجهول
عرض
ت ه

Real Part + Imaginary Part (j)

-ve . -ve = -ve → Imaginary number 3+5j

$x^2+1=0 \Longrightarrow \sqrt{x^2}=\sqrt{-1}$ not defineded

(Real number + Imaginary number) = (Complex Number)

(2) Information to (1) representation

(2) -1 . -1 = (+1) Real number

(Imaginary number . Imaginary number) = Real number

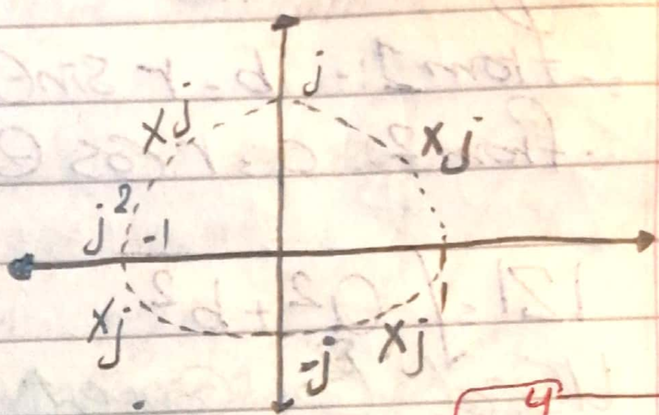
Unit of Imaginary number ← $j = \sqrt{-1}$

القاعدة الوحيدة التي لا تنطبق على الاعداد التخيلية

math law ⇒ ~~$\left(A^{a}\right)^{b} = \left(A^{b}\right)^{a}$~~ $\boxed{j^2}$ $j = \sqrt{-1}$

$j^2 = \left((-1)^{\frac{1}{2}}\right)^2 = \left((-1)^2\right)^{\frac{1}{2}} = (1)^{\frac{1}{2}} = \boxed{\pm 1}$

$\boxed{j^2 = -1}$



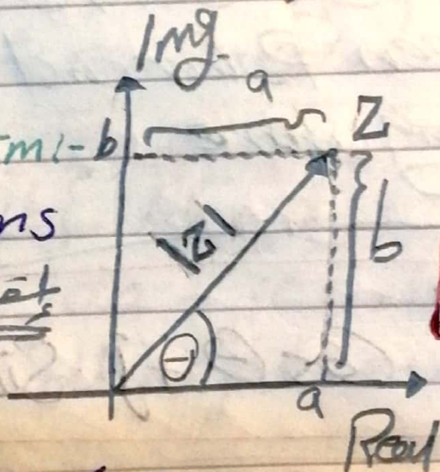
$j^{100} = j^4 = 1$

$j^{99} = j^3 \cdot j^{96}$

$-j \cdot 1 = \boxed{-j}$

$j^4 = 1$
$j^1 = j = \sqrt{-1}$
$j^2 = -1$
$j^3 = -j$

Rectangular Form :- b
Using Projections
خطأ



• $Z = a \boxed{+j} b$

j^{P} if $P/4$ = 1
Else $P \% 4$ remained

$a = Re\{Z\}$ real $b = Im\{Z\}$ imaginary

$|Z|$ magnitude of Z → abs Value

Positive always → $\boxed{Z = |Z| e^{j\theta}} \equiv \boxed{Z = a + jb}$

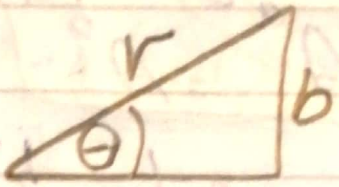
Polar Form — الصورة القطبية

Rectangular Form — الصورة المثلثية

Let $|Z|$ be r.

$\therefore \sin\theta = \frac{b}{|Z|} = \frac{b}{r} \rightarrow (1)$

$\therefore \cos\theta = \frac{a}{|Z|} = \frac{a}{r} \rightarrow (2)$



$\therefore$ from 1: $b = r\sin\theta = |Z|\sin\theta$.

$\therefore$ from 2: $a = r\cos\theta = |Z|\cos\theta$

$|Z| = \sqrt{a^2 + b^2}$

Used to convert between Polar and rectangular

$\tan = \frac{b}{a}$ $\Rightarrow$ $\tan^{-1}\theta$

$|Z|e^{j\theta}$

$e^{j\theta} = \cos\theta + j\sin\theta$ = Eular form

$Z = |Z|\cos\theta + j|Z|\sin\theta$

$a + jb$ = Proof

$Z = |Z| \cdot e^{j \text{ Argument of } Z}$

Argument of Z = Phase angle = θ

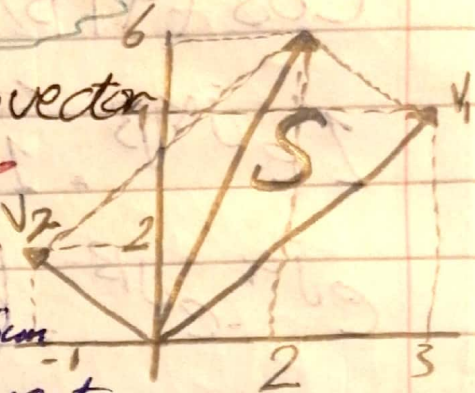
$$Z_1 = a + jb \quad \pm \quad Z_2 = c + jb$$

$$Z_1 \pm Z_2 = a + jb \pm c + jb = (a \pm c) + j(b \pm d)$$

Img Part ± Img Part, Real Part ± Real Part

The Complex number is a vector

To add 2 vectors create Parellelo gram and their sum is vector S between 2 vectors



$$Z_1 \cdot Z_2 = \{a + jb\} \cdot \{c + jd\}$$
$$= ac + jda + jcb + (-bd)$$
$$= (ac - db) + j(da + cb)$$

Simplification

Rationalizing the denominator

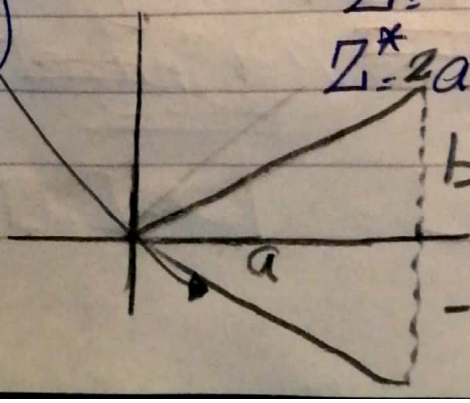
$$\frac{3}{1+2j}$$

Complex Conjicate

$$\frac{3}{1+2j} \cdot \frac{(1-2j)}{(1-2j)}$$

Conjicate

$Z = a \pm jb$
$Z^* = a \mp jb$



$$Z^* = |Z| e^{-j(\theta)}$$
$$Z^* = |Z| e^{j(-\theta)}$$

$\cos(a+b) = \cos a \cos b - \sin a \sin b$

$\sin(a+b) = \sin a \cos b + \sin b \cos a$

$\cos(\alpha+\beta) =$ $1 e^{j\alpha+\beta}$

$1 e^{j\alpha+\beta} = 1\cos(\alpha+\beta) + j\, 1 \sin(\alpha+\beta)$

$e^{j\alpha} \cdot e^{j\beta} = (\cos\alpha + j\sin\alpha)\cdot(\cos\beta + j\sin\beta)$

$= \cos\alpha\cos\beta + j\sin\alpha\cos\beta$

$+ j\cos\alpha\sin\beta - \sin\alpha\sin\beta$

$= (\cos\alpha\cos\beta - \sin\alpha\sin\beta) + j(\sin\alpha\cos\beta + \cos\alpha\sin\beta)$

$\cos(\alpha+\beta) + j\sin(\alpha+\beta)$

Complex Number = Complex Number

Real = Real Img. = Img.