Lab Exercise - 11

Q1

a) $5+2j$

⇒ So the real part is 5 (a)
imaginary part is 2. (b)

also,
complex number $(z) = a+bj$
ie.
$$z = r(\cos\theta + j\sin\theta)$$

to find r:

$$r = |z| = \sqrt{a^2+b^2}$$
$$= \sqrt{(5)^2+(2)^2}$$
$$= \sqrt{25+4} \Rightarrow \sqrt{29}$$
$$\simeq 5.385$$
$$\simeq 5.39$$

to find θ;
since $a>0$ so,
$$\theta = \tan^{-1}\left(\frac{b}{a}\right)$$
$$\theta = \tan^{-1}(2/5)$$
$$\theta = \tan^{-1}(0.4)$$
$$\theta = 0.3805 \Rightarrow 0.38$$

now,
polar value $(z) = r(\cos .38 + j\sin 0.38)$

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$z = 5.39(\cos 0.38 + j \sin 0.$

and exponential form => $5.39 e^{(0.38 \times j)}$

3) $5 - 2j$

=> so the real part is => $a = 5$
imaginary part is => $b = -2$

also,
complex number $(z) = a + bj$
ie.
$z = r(\cos\theta + j\sin\theta)$

to find r:
$r = |z| = \sqrt{a^2 + b^2}$

$= \sqrt{(5)^2 + (-2)^2}$

$= \sqrt{25 + 4} \Rightarrow \sqrt{29}$

to find θ;
$\theta = \tan^{-1}(b/a)$
$= \tan^{-1}(-2/5)$
$\theta \Rightarrow \tan^{-1}(-0.4)$
$\theta \Rightarrow -0.38$

now,
polar value $(z) = r(\cos\theta + j\sin\theta)$
ie.

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~~$z = \sqrt{29}(\cos 0.380 \; j\sin ...)$~~

$$z = \sqrt{29}\left(\cos(-0.38) + j\sin(-0.38)\right)$$

& exponential form is $\sqrt{29}\, e^{(j \times (-0.38))}$

c) $6 + 4j$

$\Rightarrow$ real part $(a) = 6$
imaginary part $(b) = 4$

also, complex number $(z) = a + bj$
ie.

$$z = r(\cos\theta + j\sin\theta)$$

find r:

$$r = |z| = \sqrt{a^2 + b^2}$$
$$= \sqrt{(6)^2 + (4)^2}$$
$$= \sqrt{36 + 16} = \sqrt{52}$$

find θ:

$$\theta = \tan^{-1}(b/a)$$
$$= \tan^{-1}(4/6) \Rightarrow 0.583$$

now,
polar value $(z) = \sqrt{52}\left(\cos(0.583) + j\sin(0.583)\right)$

exponential form $= \sqrt{52}\, e^{(j * (0.583))}$

d) $5-5j$

$\Rightarrow$ real part $\Rightarrow a = 5$
imaginary part $\Rightarrow b = -5$

also, complex number $(z) = a+bj$
ie.
$z = r(\cos\theta + j\sin\theta)$
also θ:

$\theta = \tan^{-1}(-5/5)$

$= \tan^{-1}(-1) \Rightarrow -\pi/4$

$\theta = -\pi/4$
also r:

$r = |z| = \sqrt{a^2+b^2} \Rightarrow \sqrt{(5)^2+(-5)^2}$

$= \sqrt{25+25} = \sqrt{50}$
now,
polar value $(z) = \sqrt{50}(\cos(-\pi/4) + j\sin(-\pi/4))$

exponential form $= \sqrt{50}\, e^{(j*(-\pi/4))}$

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c) $2+3j$

real part $\Rightarrow a = 2$
imaginary part $\Rightarrow b = 3$

also, complex number = $(z) = a+bj$
ie.

$$z = r(\cos\theta + j\sin\theta)$$

for r :

$$r = |z| = \sqrt{a^2+b^2}$$
$$= \sqrt{4+9}$$
$$r = \sqrt{13}$$

for θ :

$$\theta = \tan^{-1}(3/2)$$
$$= \tan^{-1}(1.5) \Rightarrow 0.96$$

now,
polar value $(z) = \sqrt{13}(\cos 0.96 + j\sin 0.98)$

also,

exponential form $= \sqrt{13}\, e^{\wedge}(j * 0.98)$

Ex. 2

(1) $2e^{\frac{\pi}{3}j}$

Euler's formula: $e^{ix} = \cos(x) + i\sin(x)$

$x = \frac{\pi}{3}$

$z = 2\cdot\left(\cos\frac{\pi}{3} + j\cdot\sin\frac{\pi}{3}\right)$

$z = 2\cdot\cos\frac{\pi}{3} + 2\sin\frac{\pi}{3}j$

$z = \cancel{2}\cdot\frac{1}{\cancel{2}} + \cancel{2}\cdot\frac{\sqrt{3}}{\cancel{2}}j$

$\boxed{z = 1 + \sqrt{3}j}$

(2) $-4e^{\frac{\pi}{6}j}$

Using Euler's formula, we have:

$x = \frac{\pi}{6}$

$z = -4\cdot\left(\cos\frac{\pi}{6} + j\cdot\sin\frac{\pi}{6}\right)$

$z = -4\cos\frac{\pi}{6} - 4\sin\frac{\pi}{6}j$

$z = -\cancel{4}\cdot\frac{\sqrt{3}}{\cancel{2}} - \cancel{4}\cdot\frac{1}{\cancel{2}}j$

$\boxed{z = -2\sqrt{3} - 2j}$

(3) $5\cdot\left(\cos\frac{\pi}{3} + j\cdot\sin\frac{\pi}{3}\right)$

Using Euler's formula, we have:

$$5\cos\frac{\pi}{3} + 5\sin\frac{\pi}{3}j = 5\cdot\frac{1}{2} + \frac{5\sqrt{3}}{2}j$$

$$\boxed{= \frac{5}{2} + \frac{5\sqrt{3}}{2}j}$$

(4) $2\cdot\left(\cos\frac{\pi}{4} + j\cdot\sin\frac{\pi}{4}\right)$

Using Euler's formula, we have:

$$2\cos\frac{\pi}{4} + 2\sin\frac{\pi}{4}j = \cancel{2}\cdot\frac{\sqrt{2}}{\cancel{2}} + \cancel{2}\cdot\frac{\sqrt{2}}{\cancel{2}}j$$

$$= \boxed{\sqrt{2} + \sqrt{2}j}$$

Q3

$$z_1 = 2+3j \ ; \ z_2 = -1+4j$$

for z_1 => real part => $a = 2$
imaginary part => $b = 3$

also, complex number = $(z) = a+bj$
ie.

$$z = r(\cos\theta + \sin\theta)$$

also,

$$\theta = \tan^{-1}(b/a)$$

$$\theta = \tan^{-1}(3/2)$$

$$\theta = \tan^{-1}(1.5) = 0.98$$

also r:

$$r = |z| = \sqrt{a^2+b^2}$$
$$= \sqrt{4+9}$$
$$= \sqrt{13}$$

now,

polar value $(z) = \sqrt{13}(\cos(0.98) + j\sin(0.98))$

also,
exponential form $= \sqrt{13}e^{\wedge}(j*(0.98))$

for $z_2 \Rightarrow$ real part $\Rightarrow -1$
imaginary part $\Rightarrow 4$

also,
complex number $\Rightarrow (z) = a+bj$
ie.

$$z = r(\cos\theta + \sin\theta)$$

$$r = |z| = \sqrt{a^2+b^2} = \sqrt{1+16}$$
$$= \sqrt{17}$$

also,

$$\theta = \tan^{-1}(b/a)$$
$$= \tan^{-1}(4/-1)$$
$$\theta = \tan^{-1}(-4)$$
$$\theta = -1.32$$

now,

$$z = \sqrt{17}\left(\cos(-1.32) + j\sin(-1.32)\right)$$

also,
exponential form $= \sqrt{17}e^{(j*(-1.32))}$

In Rectangular form :

$$(z_1)^2(z_2) = (2+3j)^2(-1+4j) = -5+12j$$

$$= 4+9j^2+12j$$

$$z_1/z_2 = \frac{(2+3j)}{(-1+4j)}$$

$$= \frac{(2+3j)}{(-1+4j)}\frac{(-1+4j)}{(-1-4j)}$$

$$= \frac{(-2-11j)}{17}$$

In Polar form :

for $(z_1)^2$ ie. : $(-5+12j)^2$

$$\sqrt{(25+144)}\, e^{\wedge}\left(j * \tan^{-1}(12/-5)\right)$$

$$= 13\, e\left(j \times (-67.38)^\circ\right)$$

In exponential form :

for : $(z_1)(z_2) = 13e(j - 67.38)$

for : $z_1/z_2 = \frac{\sqrt{17}e(-j(75.96)^\circ)}{17}$

$= \sqrt{17}/7 \; e^{\wedge}(-j(75.96)^\circ)$

Now, while comparing, we find that :

$Z_1 \times Z_2$ in polar form is $13e^{\wedge}(j*(-67.38)^\circ)$

$Z_1 \times Z_2$ exponential form is $13e^{\wedge}(j*(-67.38)^\circ)$

And

Z_1/Z_2 polar form : $\sqrt{\frac{(4+121)}{17}}e^{\wedge}(j*-(80.537)^\circ)$

Z_1/Z_2 in exponential : $\frac{\sqrt{17}}{17}e^{\wedge}(j*(-75.96)^\circ)$

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