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Group 2 - Lab 12 Submission

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**Questions**

Question 1. Find the equivalent polar and exponential forms of the below complex numbers:

* 5 – 2j5–2*j*
* 6 + 4j6+4*j*
* 5 – 5j5–5*j*
* 2 + 3j2+3*j*

**Polar Form**

z = r(\cos \theta + j \sin \theta)*z*=*r*(cos*θ*+*j*sin*θ*) where;

r = \sqrt{x^2+y^2}*r*=*x*2+*y*2​ and

\theta = \tan^{-1} (\dfrac {y}{x})*θ*=tan−1(*xy*​)

* 5.38(\cos 21.80 + j \sin 21.80)5.38(cos21.80+*j*sin21.80)
* 5.38(cos -21.80 + j sin -21.80)5.38(*cos*−21.80+*jsin*−21.80)
* 7.21(cos 33.69 + j sin 33.69)7.21(*cos*33.69+*jsin*33.69)
* 7.07(cos -45.00 + j sin -45.00)7.07(*cos*−45.00+*jsin*−45.00)
* 3.06(cos 56.31 + j sin 56.31)3.06(*cos*56.31+*jsin*56.31)

**Exponential Form**

z = r\ e^{j\theta}*z*=*r* *ejθ* where \theta*θ* is in radians

* 5.38 e^{0.38j}5.38*e*0.38*j*
* 5.38 e^{-0.38j}5.38*e*−0.38*j*
* 7.21 e^{0.59j}7.21*e*0.59*j*
* 7.07 e^{-0.78j}7.07*e*−0.78*j*
* 3.06 e^{0.98j}3.06*e*0.98*j*

Question 2. Find the equivalent rectangular form of the below complex numbers:

* 2e \dfrac{\pi}{3} j2*e*3*π*​*j*
* -4e \dfrac{\pi}{6} j−4*e*6*π*​*j*
* 5(\cos \dfrac{\pi}{3} + j\sin \dfrac{\pi}{3})5(cos3*π*​+*j*sin3*π*​)
* 2(\cos \dfrac{\pi}{4} + j\sin \dfrac{\pi}{4})2(cos4*π*​+*j*sin4*π*​)

Ans: In rectangular form; z = x + jy*z*=*x*+*jy* and

\tan \theta = \dfrac{y}{x}tan*θ*=*xy*​ and r^2 = x^2 + y^2*r*2=*x*2+*y*2

y \approx \sqrt {r^2 - x^2}*y*≈*r*2−*x*2​ and x = \sqrt{\dfrac{r^2}{(\tan \theta)^2 + 1}}*x*=(tan*θ*)2+1*r*2​​

Respective Rectangular Form are

* 1 + j\sqrt 31+*j*3​
* \sqrt12 + 2j1​2+2*j*

since e^{j\theta} = \cos \theta + 𝑗 \sin \theta*ejθ*=cos*θ*+*j*sin*θ* and 𝑧 = 𝑟 (\cos \theta + 𝑗 \sin \theta) = 𝑟𝑒^{j\theta}*z*=*r*(cos*θ*+*j*sin*θ*)=*rejθ*

* \dfrac{5}{2} + j\dfrac {5}{2}\sqrt 325​+*j*25​3​
* \sqrt2 + j\sqrt 22​+*j*2​

Question 3. For the two complex numbers given below, find the equivalent polar and exponential forms. Then, calculate Z\_1Z\_2*Z*1​*Z*2​ and \dfrac{Z\_1}{Z\_2}*Z*2​*Z*1​​ for each of the 3 forms and show that they are equal.

* Z\_1 = 2 + 3j*Z*1​=2+3*j* and Z\_2 = −1 + 4j*Z*2​=−1+4*j*

**Rectangular Form**

Z\_1Z\_2 = -14 + 5j*Z*1​*Z*2​=−14+5*j* and \dfrac{Z\_1}{Z\_2} = \dfrac{-14 + 5j}{17}*Z*2​*Z*1​​=17−14+5*j*​

**Polar Form**

z = r(\cos \theta + j \sin \theta)*z*=*r*(cos*θ*+*j*sin*θ*) where;

r = \sqrt{x^2+y^2}*r*=*x*2+*y*2​ and

\theta = \tan^{-1} (\dfrac {y}{x})*θ*=tan−1(*xy*​)

\approx Z\_1 = \sqrt 13(\cos 56.31 + j \sin 56.31)≈*Z*1​=1​3(cos56.31+*j*sin56.31) and Z\_2 = \sqrt 17(\cos -75.96 + j \sin -75.96)*Z*2​=1​7(cos−75.96+*j*sin−75.96)

Z\_1Z\_2 = \sqrt 13 \times \sqrt17 (\cos -19.65 + j \sin-19.65)*Z*1​*Z*2​=1​3×1​7(cos−19.65+*j*sin−19.65) and \dfrac{Z\_1}{Z\_2} = \dfrac{\sqrt13}{\sqrt17}(\cos 132.27 + j \sin 132.27)*Z*2​*Z*1​​=1​71​3​(cos132.27+*j*sin132.27)

**Exponential Form**

z = r\ e^{j\theta}*z*=*r* *ejθ* where \theta*θ* is in radians

\approx Z\_1 = \sqrt 13e^{j0.98}≈*Z*1​=1​3*ej*0.98 and Z\_2 = \sqrt17 e^{j-1.32}*Z*2​=1​7*ej*−1.32

Z\_1Z\_2 = \sqrt 13 \times \sqrt17 e^{j-0.34}*Z*1​*Z*2​=1​3×1​7*ej*−0.34 and \dfrac{Z\_1}{Z\_2} = \dfrac{\sqrt13}{\sqrt17}e^{j2.3}*Z*2​*Z*1​​=1​71​3​*ej*2.3

Prove

Given: Z\_1Z\_2 = -14 + 5j*Z*1​*Z*2​=−14+5*j* and \dfrac{Z\_1}{Z\_2} = \dfrac{-14 + 5j}{17}*Z*2​*Z*1​​=17−14+5*j*​

in polar form; z = r (\cos \theta + j \sin \theta)*z*=*r*(cos*θ*+*j*sin*θ*) r = \sqrt {14^2 + 5^2} = \sqrt221 == \sqrt 13 \times \sqrt 17 (Proved)*r*=142+52​=2​21==1​3×1​7(*Proved*)

\dfrac{Z\_1}{Z\_2} = \sqrt {{\dfrac{-14}{17}}^2 + {\dfrac{5}{17}}^2} = \sqrt \dfrac{13}{17} (Proved)*Z*2​*Z*1​​=17−14​2+175​2​=1713​​(*Proved*)

\theta = \tan^{-1}(\dfrac{y}{x}) = \tan^{-1}(\dfrac{5}{-14}) = -19.65 (Proved)*θ*=tan−1(*xy*​)=tan−1(−145​)=−19.65(*Proved*)

\dfrac{Z\_1}{Z\_2} = \tan^{-1}(\dfrac{\dfrac{5}{17}}{\dfrac{-14}{17}}) = -19.65 (Proved)*Z*2​*Z*1​​=tan−1(17−14​175​​)=−19.65(*Proved*)

in exponential form; z = r\ e^{j\theta}*z*=*r* *ejθ* where \theta*θ* is in radians

Z\_1Z\_2 = {\sqrt13}{\sqrt17} e^{-0.34} (Proved)*Z*1​*Z*2​=1​31​7*e*−0.34(*Proved*)

\dfrac{Z\_1}{Z\_2} = {\sqrt13}{\sqrt17}e^{-2.3} (Proved)*Z*2​*Z*1​​=1​31​7*e*−2.3(*Proved*)