

ECE 1250 homework # P0

If you learn to use the complex math feature of your calculator, you may use that to work the following problems. In that case you may report the answers without showing any work. Otherwise, you'll need more space than is provided here.

1. Convert the following complex numbers to polar form (m/θ or me<sup>jθ</sup>).

a)  $1 + j$   $A = \sqrt{1^2 + 1^2} = \sqrt{2}$   $\angle = 45^\circ$   $\therefore = 1.414 \cdot e^{j45 \text{ deg}}$   
 b)  $2.6 + 8.7j$   $A = \sqrt{2.6^2 + 8.7^2} = 9.08$   $\angle = 73.4 \text{ deg}$   $\therefore = 9.08 e^{j73.4 \text{ deg}}$   
 c)  $3 + 4j$   $A = 5$   $\angle = 53.1 \text{ deg}$   $\therefore = 5 \cdot e^{j53.1 \text{ deg}}$   
 d)  $3 - 4j$   $A = 5$   $\angle = -53.1 \text{ deg}$   $\therefore = 5 \cdot e^{-j53.1 \text{ deg}}$   
 e)  $-3 + 4j$   $A = 5$   $\angle = 126.9 \text{ deg}$   $\therefore = 5 \cdot e^{j126.9 \text{ deg}}$   
 f)  $-3 - 4j$   $A = 5$   $\angle = -126.9 \text{ deg}$   $\therefore = 5 \cdot e^{-j126.9 \text{ deg}}$

2. Convert the following complex numbers to rectangular form (a + bj).

a)  $10 \cdot e^{-j60 \text{ deg}}$   $10 \cdot \cos 60 = 5$   $10 \cdot \sin 60 = 8.66$   $\therefore = 5 + 8.66j$   
 b)  $0.4 \cdot e^{j12 \text{ deg}}$   $0.4 \cdot \cos 12 = 0.391$   $0.4 \cdot \sin 12 = 0.083$   $\therefore = 0.391 + 0.083j$   
 c)  $1500 \cdot e^{j2}$   $1500 \cdot \cos 2 = 1500$   $1500 \cdot \sin 2 = 51.76$   $\therefore = 1500 + 51.76j$   
 d)  $10 \cdot e^{-j45 \text{ deg}}$   $10 \cdot \cos 45 = 7.071$   $10 \cdot \sin 45 = 7.071$   $\therefore = 7.071 - 7.071j$   
 e)  $20 \cdot e^{j120 \text{ deg}}$   $20 \cdot \cos 120 = -10$   $20 \cdot \sin 120 = 17.32$   $\therefore = -10 + 17.32j$   
 f)  $30 \cdot e^{j210 \text{ deg}}$   $30 \cdot \cos 210 = -25.98$   $30 \cdot \sin 210 = -15$   $\therefore = -25.98 - 15j$

3. Perform the following additions and subtractions of complex numbers.

a)  $(3 + 2j) + (6 + 9j) = 3 + 6 + j(2 + 9) = 9 + 11j$   
 b)  $(9 - 10j) - (9 + 10j) = 9 - 9 + j(-10 - 10) = -20j$   
 c)  $(-2 - 2j) + (-6 + 9j) = -2 - 6 + j(-2 + 9) = -8 + 7j$   
 d)  $(3 + 0j) - (0 + 9j) = 3 - 0 + j(0 - 9) = 3 - 9j$   
 e)  $(5 + 6j) + 5 \cdot e^{j53 \text{ deg}}$   $5 \cdot \cos 53 = 3.009$   $5 \cdot \sin 53 = 3.993$   $\therefore = 8.009 + 9.993j$   
 f)  $(-2 + 3j) - 8 \cdot e^{-j37 \text{ deg}}$   $8 \cdot \cos 37 = 6.389$   $8 \cdot \sin 37 = 4.815$   $\therefore = -8.389 + 7.815j$

4. Perform the following multiplications of complex numbers.

a)  $(8 + j) \cdot 3 = 24 + 3j$   
 b)  $(3 + 2j) \cdot j = 3j + 2j^2 = -2 + 3j$   
 c)  $(20 \cdot e^{j40 \text{ deg}}) \cdot (10 \cdot e^{j60 \text{ deg}}) = 20 \times 10 \cdot e^{j(40 + 60) \text{ deg}} = 200 e^{j100 \text{ deg}}$   
 d)  $(-6 + 9j) \cdot (10 \cdot e^{j60 \text{ deg}})$   $10 \cdot \cos 60 = 5$   $10 \cdot \sin 60 = 8.66$   $\therefore = 108 e^{-j176 \text{ deg}}$   
 e)  $(-2 - j) \cdot (-6 - 9j) = (-2) \cdot (-6) + (j \cdot 9j) = 12 - 9 = 3$

5. Perform the following divisions of complex numbers.

a)  $\frac{20 \cdot e^{j40 \text{ deg}}}{10 \cdot e^{j60 \text{ deg}}} = \frac{20}{10} \cdot e^{-j(60 - 40) \text{ deg}} = 2 \cdot e^{-j20 \text{ deg}}$   
 b)  $\frac{9 - 10j}{3 \cdot e^{-j20 \text{ deg}}}$   $9 - 10j = A = \sqrt{9^2 + 10^2} = 13.45$   $\angle = -50.7 \text{ deg}$   $\therefore = 4.483 e^{-j30.7 \text{ deg}}$   
 c)  $\frac{3 + 0j}{0 + 9j} = \frac{3 + 0j}{0 + 9j} \cdot \frac{0 - 9j}{0 - 9j} = \frac{0 + 0 + j(0 - 27)}{81} = \frac{-27j}{81}$   
 d)  $\frac{-2 - 2j}{-6 + 9j} = \frac{-2 - 2j}{-6 + 9j} \cdot \frac{12 + 18j}{12 + 18j} = \frac{-24 - 36j - 24j - 36}{36 + 81} = \frac{-60 - 60j}{117}$

Answers

1. a)  $1.414 \cdot e^{j45 \text{ deg}}$  b)  $9.08 \cdot e^{j73.4 \text{ deg}}$  c)  $5 \cdot e^{j53.1 \text{ deg}}$  d)  $5 \cdot e^{-j53.1 \text{ deg}}$  e)  $5 \cdot e^{j126.9 \text{ deg}}$  f)  $5 \cdot e^{-j126.9 \text{ deg}}$   
 2. a)  $5 + 8.66j$  b)  $0.391 + 0.083j$  c)  $1500 + 51.76j$  d)  $7.071 - 7.071j$  e)  $-10 + 17.321j$  f)  $-25.981 - 15j$   
 3. a)  $9 + 11j$  b)  $-20j$  c)  $-8 + 7j$  d)  $3 - 9j$  e)  $8.009 + 9.993j$  f)  $-8.389 + 7.815j$   
 4. a)  $24 + 3j$  b)  $-2 + 3j$  c)  $200 \cdot e^{j100 \text{ deg}}$  d)  $108 \cdot e^{-j176 \text{ deg}}$  e)  $24.2 \cdot e^{j82.9 \text{ deg}}$   
 5. a)  $2 \cdot e^{-j20 \text{ deg}}$  b)  $4.485 \cdot e^{-j30.7 \text{ deg}}$  c)  $0.333 \cdot e^{-j90 \text{ deg}}$  d)  $-0.051 + 0.256j$