

ECE 111: Handout #3

Week #3: Trigonometry & Robot Kinematics

1) Convert the following numbers to rectangular or polar form

$$P = (x, y) = r\angle\theta$$

1a) $P = (2, 5)$

1b) $P = (4, -1)$

1c) $P = 5\angle 20^\circ$

1d) $P = 6\angle -67^\circ$

2) Determine the position of P(x,y)

$$P = 3\angle 20^\circ + 4\angle 30^\circ + 5\angle 60^\circ$$

3) Determine the tip position of a 3-link RRR robotic arm, with each link 1.0m long

- $\theta_1 = 120^\circ$
- $\theta_2 = -50^\circ$
- $\theta_3 = -60^\circ$

Handout Solutions

Week #3: Trigonometry

1) Convert the following numbers to rectangular or polar form

1a) $P = (2, 5)$

$$r = \sqrt{x^2 + y^2} = \sqrt{2^2 + 5^2} = 5.3852$$

$$\theta = \arctan\left(\frac{5}{2}\right) = 68.198^\circ$$

$$(2, 5) = 5.3852 \angle 68.198^\circ$$

1b) $P = (4, -1)$

$$r = \sqrt{x^2 + y^2} = \sqrt{4^2 + 1^2} = 4.1231$$

$$\theta = \arctan\left(\frac{-1}{4}\right) = -14.036^\circ$$

$$(4, -1) = 4.1231 \angle -14.036^\circ$$

1c) $P = 5 \angle 20^\circ$

$$x = r \cos \theta = 4.6985$$

$$y = r \sin \theta = 1.7101$$

1d) $P = 6 \angle -67^\circ$

$$x = r \cos \theta = 2.3444$$

$$y = r \sin \theta = -5.5230$$

2) Determine the position of P(x,y)

$$P = 3\angle 20^\circ + 4\angle 30^\circ + 5\angle 60^\circ$$

In Matlab

```
>> q1 = 20*pi/180;  
>> q2 = 30*pi/180;  
>> q3 = 60*pi/180;  
>> x = 3*cos(q1) + 4*cos(q2) + 5*cos(q3)
```

x =

8.7832

```
>> y = 3*sin(q1) + 4*sin(q2) + 5*sin(q3)
```

y =

7.3562

```
>>
```

3) Determine the tip position of a 3-link RRR robotic arm, with each link 1.0m long

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In Matlab

```
>> q1 = 120*pi/180;  
>> q2 = -50*pi/180;  
>> q3 = -60*pi/180;  
>> x = cos(q1) + cos(q1+q2) + cos(q1+q2+q3)
```

x =

-0.8008

```
>> y = sin(q1) + sin(q1+q2) + sin(q1+q2+q3)
```

y =

2.5718

```
>>
```