

## 0.1 Physics for Smart Systems, 1st week

1. (a) Write the angle  $\theta = 15^\circ$  in radians.  
(b) Write the angle  $\theta = \frac{5\pi}{2}$  in degrees.
2. (a) Sketch the graphs of the functions  $y_1 = \sin(\theta)$  and  $y_2 = \sin(\theta + \frac{\pi}{2})$ ,  
(b) Sketch the graphs of the functions  $y_1 = \cos(\theta)$  and  $y_2 = \cos(\theta - \frac{\pi}{2})$ .
3. (a) Sketch the graph of the function  $y_1 = \sin(2\theta)$ ,  
(b) Sketch the graph of the function  $y_2 = \cos(\frac{1}{2}\theta)$ .
4. (a) Sketch the graph of the function  $y_1 = \sin(\omega t)$ , when  $\omega = 2\pi/1s$ . Where  $s$  now is the unit seconds and  $t$  is the time in seconds. The variable on the horizontal axis is now the time.  
(b) Sketch the graph of the function  $y_2 = \cos(\omega t + \frac{\pi}{2})$ , when  $\omega = 2\pi/1s$ .
5. State the amplitude, angular frequency, frequency, phase angle and the time displacement of the following waves:  
(a)  $3 \sin(2t)$ , (b)  $4 \cos(\pi t - 20)$ .
6. A voltage source produces a time-varying voltage,  $v(t)$ , given by

$$v(t) = 15 \sin(20\pi t + 4), \quad t \geq 0.$$

- (a) State the amplitude of  $v(t)$ .
  - (b) State the angular frequency of  $v(t)$ .
  - (c) State the period of  $v(t)$ .
  - (d) State the phase of  $v(t)$ .
  - (e) State the time displacement of  $v(t)$ .
  - (f) State the minimum value of  $v(t)$ .
7. Find 1st and 2nd derivatives for the functions:  
(a)  $f_1(t) = e^{-t}$  and  $f_2(t) = \sin(t)$ ,  
(b)  $g_1(t) = A \sin(\omega t)$  and  $g_2(t) = A \cos(\omega t)$ .
  8. Show that if  $y(t) = A \sin(\omega t) + B \cos(\omega t)$ , where  $\omega$  is a constant, then

$$y''(t) + \omega^2 y(t) = 0.$$

This means that  $y(t) = A \sin(\omega t) + B \cos(\omega t)$  is a solution to the differential equation (Simple Harmonic Motion).