COMP 3721: Assignment #1

General Instruction

- To receive any credit, the answers for this assignment must be **handwritten** and need to be legible by the grader.
- When you solve a problem, show all the steps and add comments as necessary to make sure your answers are clear and unambiguous to the grader.
- You may discuss questions in broad terms with others but ultimately your answers should demonstrate your own individual thought process and effort.
- All work submitted is subject to the standards of conduct as specified in BCIT Policy 5104.

Submission

- This assignment is due on **January 31, 2018** by **1300** at the latest. No late assignments will be accepted.
- Submit your completed assignment to your lab instructor's assignment box in the SW2/SW3 connector.
- Your submissions must include a **cover page** clearly specifying your **name**, **student number** and **set**.

Marking

- This assignment consists of **5 questions** totaling **35 marks**.

Problems

(1) [8 marks] Determine the value of x, for $x > 0$, in each of the following:

a) [2 marks] $\log_2 4x = 5$

b) [2 marks] $\log_2 \frac{x}{3} = 4$

c) [2 marks] $\log_b(x-1) + \log_b 3 = \log_b x$

d) [2 marks] $\log_{b^2} \frac{1}{4} + \log_b 8x^2 = \log_b(12x - 9)$

(2) [4 marks] Given $x = \log_{10} 8$ and $y = \log_{10} 3$, express each of the following in terms of x and y.

a) [2 marks] $\log_{10} \frac{8}{9}$

b) [2 marks] $\log_{10} 720$

(3) [11 marks] Consider a composite signal defined by

$$s(t) = 4 \sin 2t\,(1 - 2\sin^2 t) + 3 - 6\sin^2\left(\frac{t}{2} - \frac{\pi}{2}\right).$$

a) [4 marks] Using trigonometric identities, decompose the composite signal, $s(t)$, into a linear combination of simple sine functions, i.e., $A_1 \sin(2\pi f_1 t + \theta_1) + A_2 \sin(2\pi f_2 t + \theta_2) + \ldots$.

b) [3 marks] Determine the peak amplitude, A, frequency, f, and phase, θ, of each simple sine function in (a).

c) [2 marks] Plot each simple sine function in (a) for $t = [0, 2\pi]$.

d) [2 marks] Plot the composite signal by summing the simple sine functions in (a) over t.

(4) [2 marks] Determine the highest data rate that can be attained with each of the following transmission channels:

a) [1 mark] A channel with a SNR of 18 dB and a bandwidth of 500 Hz.
b) [1 mark] A channel with a SNR of 180 and a bandwidth of 4 kHz.

(5) [10 marks] Ernest, a CST student at BCIT is designing an autonomous drone for delivery of uncompressed 4K video (4096 x 2160 pixels, 10 bits for each of red, green and blue components, 30 fps, 60 mins), from the BCIT Burnaby campus to the Downtown campus. Assume that the distance between the two campuses is 15 km. Determine the minimum speed the drone must travel at such that the drone, loaded with a single SATA II 2 TB hard drive, can deliver the video faster than gigabit Ethernet (GbE).

Recall that latency is made of four components: propagation time, transmission time, queuing time and processing delay. Assume that both the queuing time and processing delay are negligible and that there is no data transmission time at the receiver. The propagation speed of electromagnetic signals in guided media is 2×10^8 m/s.