COMPSCI 314 S1C 05 Assignment 2

Department of Computer Science
The University of Auckland
Due Wednesday 27 April 2005, 11:59pm

This assignment will contribute 40/300 = 13.3% to your coursework mark, and 4% to your overall course mark.

1. Using the applet at http://falstad.com/fourier/, compute the analogue signals

   a. $A(t) = \sin(t)$

   b. $A(t) = \sin(t) + 0.33 \sin(3t)$

   c. $A(t) = \sin(t) + 0.33 \sin(3t) + 0.20 \sin(5t)$

   d. $A(t) = \sin(t) + 0.33 \sin(3t) + 0.20 \sin(5t) + 0.14 \sin(7t)$

   e. $A(t) = \sin(t) + 0.33 \sin(3t) + 0.20 \sin(5t) + 0.14 \sin(7t) + 0.11 \sin(9t)$.

   What is the title of the lecture slide that best illustrates this series of signals? Do your signals have the same phase as the signals in this lecture slide? If not, what is the difference in phase? Note that you may use the "Phase Shift" button in the Java applet to see what happens to the Fourier components and the analogue waveform, as a result of a phase shift. (**2 marks**)

2. Using the applet at http://falstad.com/fourier/, compute the analogue signal $A(t) = 0.3 \sin(5t) + \sin(6t) + 0.3 \sin(7t)$. Describe this signal in your own words, using terms from your lecture notes and textbook. To receive full credit, you must make appropriate use of the terms "sideband", "carrier", "modulation", and "bandwidth". (**4 marks**)

3. Compute the channel capacity, in bits per second, of a signal with a 20 KHz bandwidth and a S/N ratio of 60 dB. (**2 marks**)

4. Repeat your calculation of problem #3 for S/N = −10 dB. (**1 mark**)

5. Consider the STM-1 frame definition given in the lecture slide entitled "Synchronous Digital Hierarchy: SDH, or SONET", taking care to note the corrections posted to the web at http://www.cs.auckland.ac.nz/compsci314s1c/lectures/85_Physical2.pdf. As noted in the lecture slides, an STM-1 channel has a raw data rate of 150.336 Mbps. What fraction of this raw data rate is available to carry user data, assuming that the protocol overheads shown in the lecture slide are the only overheads? (**1 mark**)

6. What is a parity bit? Give an example of odd parity. (**1 mark**)

7. Name the three key steps that occur during compression of bzip2. (**1/2 mark**)

8. Hamming codes were used to transmit the following messages

    a. 110011001101

    b. 001001011001

    For each message:

    - Draw up a Hamming code table.
    - Was there an error, and if so, at which position did the error occur? (Assume odd-parity)
    - What was the original message? (**6 marks**)

9. Solve the following modulo 2 polynomial division. (**2 marks**)

$$x^3 + x + 1 \overline{)\, x^7 + x^5 + x^4 + x^3 + x + 1}$$

10. Why is 1 + 1 = 0 using modulo 2 arithmetic? (**1/2 mark**)

11. The following message was received using a CRC: 0101101101. The generator polynomial was $(x^4 + x^3 + x^2 + 1)$. Was there an error in the message? If not, what was the original message? Show your working. (**4 marks**)

12. Encode the following message, using a Huffman tree: "the meaning of life". (**2 marks**)

13. Huffman codes have a unique property that makes them ideal to use under conditions where chunks of data may get corrupted or lost. What is this? (**1 mark**)

14. Encode the following message using LZW: "think this is history". Use a table. (**4 marks**)

15. Why is it secure to use RSA encryption if the cryptographic key is known? (**1 mark**)

16. What are two differences between gzip and bzip2? (**1 mark**)

17. Explain how ssh-based authentication would work. (**2 marks**)

18. What are the differences between DES, RSA and DSA. (**3 marks**)

19. Why are repeaters necessary in some networks? (**1 mark)**

20. What type of LAN is most commonly used today? (**1 mark**)