TOTAL: 50 MARKS Answer **all** questions.

This assignment contributes 5% of your overall course mark. Submit your assignment as a single PDF file to Assignment Drop Box. Include all workings and explanations. Marks will be deducted for ambiguous solutions. Zero marks are awarded if the answers contain no explanation. Also, refer to the Departmental policy on cheating and plagiarism. Cut-and-paste without acknowledgment of the source is not acceptable.

Assignment Drop Box (https://adb.ec.auckland.ac.nz/adb/).

Departmental Policy on Cheating on Assignments: see Assignments page of the course web site.

Due date: Friday 19 August 2011, time 10:00 pm

1. a) What is the minimum number of redundancy bits r required to correct n bits of data? **[3 marks]**
b) What is the minimum number of redundancy bits r required to correct $n = 10$ bits of data? **[2 marks]**
c) What is the maximal number n of bits of data that can be corrected with r redundancy bits? **[3 marks]**
d) What is the maximal number n of bits of data that can be corrected with $r = 4$ redundancy bits?**[2 marks]**

2. a) Is the assignment $1 \longrightarrow a, 0 \longrightarrow b, 10 \longrightarrow c, 01 \longrightarrow d$ a code?**[2 marks]**
b) What is a prefix code? **[2 marks]**
c) For each set of natural numbers:
i) 2, 1, 2, 133333, **[2 marks]**
ii) 3, 3, 3, 3, 3, 3, 3, 3, **[2 marks]**
iii) 3, 5, 4, 1, **[4 marks]**
check whether there is a prefix binary code whose codewords lengths are exactly the provided numbers. In each case justify your yes or no answer; in case of affirmative answer construct a code with the specified requirements and indicate whether the code constructed is unique (if not, provide another code).

3. Devise two correct Huffman trees and their corresponding codewords for the letters A, B, C, D, E with frequencies given in the following table:

Letter	Frequency
A	15%
B	15%
C	10%
D	10%
E	50%

[**10 marks**]

4. Assume that you wish to email a large file consisting entirely of strings of lower-case letters (26), the digits 0,1,2,3,4,5,6,7,8,9, and extra 10 characters.

(a) How many bits do you need to store a file with n characters using a 7-bit code? [**2 marks**]

(b) Can you do it better? Present your solution and calculate the size of the compressed file. [**4 marks**]

(c) How much size reduction (percentage) have you obtained? [**3 marks**]

5. (a) What is a two-dimensional parity check? [**2 marks**]

(b) Calculate the two-dimensional parity check for the data shown below, by specifying all the blocks transmitted. [**3 marks**]

0	1	0	0	0	0	0	0
0	0	0	0	1	1	1	0
0	0	0	0	1	0	1	0
0	1	1	0	0	0	0	0
1	1	1	1	1	1	0	0
1	1	1	1	1	1	0	1
1	1	1	1	1	1	1	0
1	1	1	1	0	0	0	0

(c) Calculate the increase in size – in absolute value and percentage – of the transmitted data using two-dimensional parity check. [**4 marks**]