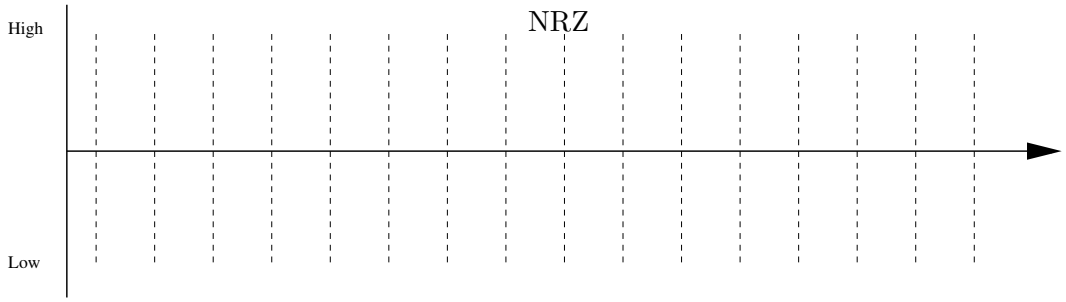
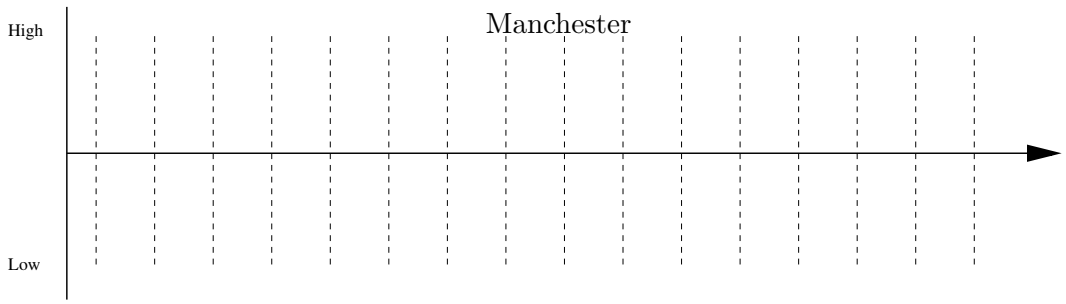
Tutorial Test on Lectures 1 to 6 - version (sample)

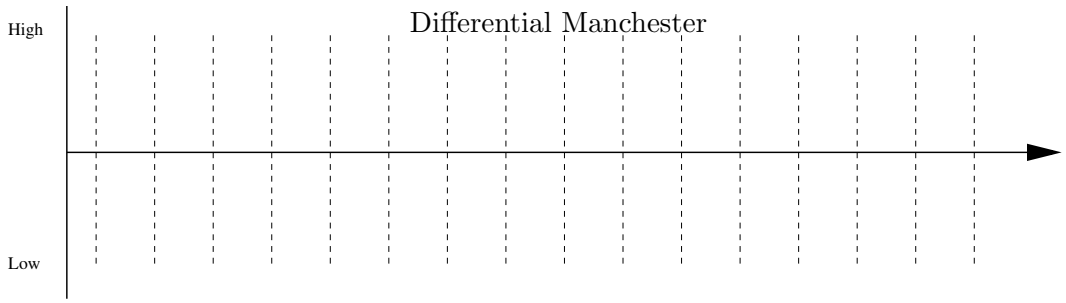
Student Name: **Student ID Number:**

This test contains seven questions, which have a total of 70 marks. It is worth 7% of your final mark. You should answer all questions. Please show your working in order to get full marks.

1. *(9 marks)* Draw the digital signals for the bit string `010 101 111 000 011` using each of the NRZ, Manchester, and differential Manchester digital encoding schemes. Assume a high value represents the quiescent state (no data transmitted). Include the bits sent under each encoding diagram.







2. (a) *(10 marks)* Compress the following bit stream using run length encoding.
Use 5 bits to code each run length (put a space after every 5^{th} bit). Parenthesized expressions indicate runs. There are a total of 148 bits in this data.

`1 (36 zeroes) 1 (23 zeroes) 111 (48 zeroes) 1 (31 zeroes) 1 (3 zeroes)`

(b) *(1 mark)* Express the length of the compressed stream as a fraction of the original. Do not simplify the fraction.

3. Using the following Huffman code:

Letter	Code
A	01
B	110
C	111
D	10
E	00

(a) *(3 marks)* Interpret this bit stream starting from the leftmost bit. Spaces are not significant.

```
0100 1101 1100 1100 1110 0100 1011 0111 111
```

(b) *(3 marks)* Encode the following character string. Put a space after every fourth bit.

```
A B E D C E D B A C
```

4. *(12 marks)* Design a Huffman code for the text

```
A B C E D C A A A B D D D D E B A A A A C D A A A A
```

so that the Huffman code representation is the shortest possible.

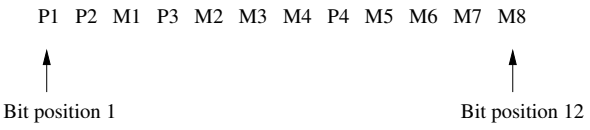
Note: When merging two trees always put the one with the lightest weight on the left-hand side. If weights are equal use alphabetic order.

5. *(12 marks)* Suppose you want to transmit the data, 1001 1100 101, and the generator polynomial is $x^6 + x^3 + 1$. What bit string is actually sent? (Put a space after every fourth bit.)

6. *(8 marks)* Assume a sender has the following data to send:

Frame Number	Data
1	10001110
2	01010110

Construct the Hamming code for each frame and show what is actually sent.

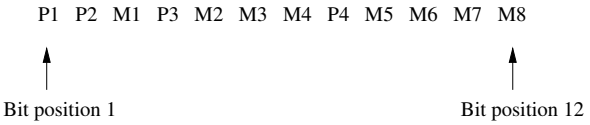


P1 – even parity for positions 1, 3, 5, 7, 9, 11
P2 – even parity for positions 2, 3, 6, 7, 10, 11
P3 – even parity for positions 4, 5, 6 ,7, 12
P4 – even parity for positions 8, 9, 10, 11, 12

7. *(12 marks)* Assume the following frames, which contain Hamming codes, are received.

Frame Number	Data
1	101001110110
2	010110111011

Apply error correction methods to the received data to correct it. What is the corrected original data? (Do not include the parity bits).



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