2002 Paper 9 Question 10

Information Theory and Coding

(*a*) (*i*) A Hamming Code allows reliable transmission of data over a noisy channel with guaranteed error correction as long as no more than one bit in any block of 7 is corrupted. What is the maximum possible rate of information transmission, in units of (data bits reliably received) per (number of bits transmitted), when using such an error correcting code? [2 marks]

(*ii*) In such a code, what type of Boolean operator on the data bits is used to build the syndromes? Is this operator applied before transmission, or upon reception? [2 marks]

(*b*) (*i*) For each of the four classes of signals in the following table,

Class	*Signal Type*
1.	continuous, aperiodic
2.	continuous, periodic
3.	discrete, aperiodic
4.	discrete, periodic

identify its characteristic spectrum from the following table:

Class	*Spectral Characteristic*
A.	continuous, aperiodic
B.	continuous, periodic
C.	discrete, aperiodic
D.	discrete, periodic

(Give your answer just in the form 1-A, 2-B, etc. Note that you have 24 different possibilities.) [8 marks]

(*ii*) For each case, name one example of such a function and its Fourier transform. [4 marks]

(*c*) Give two reasons why Logan's Theorem about the richness of zero-crossings for encoding and recovering all the information in a one-octave signal may not be applicable to images as it is for one-dimensional signals. [4 marks]