



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

**LOCATION: GOWER COLLEGE
SWANSEA**

LLEOLIAD:

LEVEL 5

LEFEL 5

**EXAMINATION PERIOD
MAY 2021**

**CYFNOD ARHOLIADAU
MAI 2021**

MODULE CODE:

M2X8515

DSP and Communications

TIME: 2 HOURS

ANSWER ANY 5 QUESTIONS ONLY

Equipment or materials required –

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Scientific Calculators are allowed

1. First Exam Question (10 marks)

For the system defined by the difference equation

$$y(n) + 0.45x(n) - 0.85x(n - 1) - 0.6x(n - 3) - 0.4y(n - 1) + .02y(n - 2) = 0$$

- a) Produce an expression for it's transfer function
(expressed using z notation) (4 marks)
- b) A block diagram in Direct Form I. (2 marks)
- c) An equivalent diagram in Direct Form II (2 marks)
- d) Give one advantage for an implementation using direct form II (1 mark)
- e) Give one advantage and two disadvantages of IIR filters compared with FIR filters. (1 mark)

2. Second Exam Question (10 marks)

- a) Apply a 4/7 hamming code with even parity to the following data :- 1011
(2 mark)
- b) A data stream with an even parity Hamming code applied is decoded as:-
101100101010010

Find and correct any error that may have occurred in transmission.

(3 marks)

- c) For the text “poor people pay” show how a Huffman code could improve transmission efficiency.

(5 marks)

3. Third Exam Question (10 marks)

Consider the analogue signal :-

$$x(t) = 4 \cos(6000\pi t) + 2 \cos(16000\pi t) - 2 \cos(8000\pi t)$$

- a) Determine the frequency components and the Nyquist sampling frequency
(3 marks)
- b) If the signal is sampled at 10000Hz determine the potential recoverable analogue signal recoverable and compare with the original.
(6 marks)
- c) In order to avoid the generation of alias signals what two system design features are normally employed.
(1 mark)

4. Fourth Exam Question (10 marks)

A causal discrete time (DT) linear phase FIR filter is described by the impulse response

$$h(n) = [3, -1, 2, 1]$$

- a) Sketch the impulse response of the filter
(1 mark)
- b) Determine the signals $2h(n-1)$, $h(-n+2)$
(4 marks)
- c) For the filter described above and shown in figure 1, given an input $x(n)$ where $x(n) = [1, 1, -3, -1, 2]$ produce an expression for $y(n)$

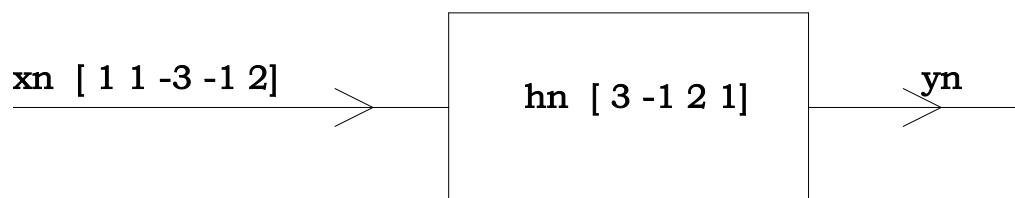


Figure1

(5 marks)

5. Fifth Exam Question (10 marks)

A data channel has a centre frequency 3512MHz and occupies a band from 3500 MHz to 3524 MHz.

Given:-

- Boltzmann's constant 1.38×10^{-23} W/K /Hz
- An average temperature of 25°C
- Initial Transmit power = 1 Watt
- An overall transmit antenna gain of +9dB
- A free space path loss of $= 20\log_{10}(d) + 20\log_{10}(f) + 32.44$
(Where d = km, f = frequency in MHz)

Determine the maximum theoretical channel data capacity if the signal Is transmitted over a distance of 15km and the only interference is from Gaussian White Noise

(10 marks)

6. Sixth Exam Question (10 marks)

Using a window technique design a Low pass FIR filter that has the following specifications:-

- Pass band ripple = 0.1dB
- Minimum attenuation in stop band = 50 dB
- Pass Band 0 to 300Hz
- Transition Band 100Hz
- Sample rate 8000Hz

Find

- a) The number of taps required
- b) The value of $h[n]$ (filter impulse response) where $n = 5$

(10 marks)

Totals (50 marks)

Diwedd/End