



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

**LOCATION: GOWER COLLEGE
SWANSEA**

LLEOLIAD:

LEVEL 5

LEFEL 5

**EXAMINATION PERIOD
MAY 2019**

**CYFNOD ARHOLIADAU
MAI 2019**

MODULE CODE:

M2X8515

DSP and Communications

TIME: 2 HOURS

ANSWER ALL 5 QUESTIONS

Equipment or materials required –

Adnoddau neu ddefnyddiau sydd eu hangen -

Scientific Calculators are allowed

1. First Exam Question (10 marks)

For the system defined by the difference equation

$$y(n) - \frac{3}{5} y(n-1) + \frac{1}{8} y(n-2) = \frac{3}{5} x(n) + \frac{1}{4} x(n-1) + \frac{1}{2} x(n-2)$$

- a) Produce an expression for it's transfer function
(expressed using z notation) (3 marks)
- b) A block diagram in Direct Form I. (3 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 one disadvantage of IIR filters compared with FIR filters. (1 mark)

2. Second Exam Question (10 marks)

- a) Explain the difference between channel coding and source coding as applied to data transmission. (1 mark)
- b) A data stream with an even parity Hamming code applied is decoded as:-

1	0	1	0	1	0	0	1	1	0	0	1
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Find and correct any error that may have occurred in transmission.

(4 marks)

- c) For the text "slow down now" show how a Huffman code could improve transmission efficiency.

(5 marks)

3. Third Exam Question (10 marks)

Consider the analogue signal :-

$$x(t) = 4 \cos(4000\pi t) + 5 \cos(10000\pi t) + 2 \sin(6000\pi t)$$

- a) Determine the minimum sampling rate in order to avoid aliasing (3 marks)
- b) If the signal is sampled at 4000Hz determine the DT signal obtained (3 marks)
- c) Determine the potential recoverable analogue signal recoverable from sampling at 4000Hz and compare with the original. (3 marks)
- d) In order to avoid the generation of alias signals what pre-processing step is normally taken. (1 mark)

4. Fourth Exam Question (10 marks)

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

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

- a) Sketch the impulse response of the filter (1 mark)
- b) Sketch the signals $2h(n-1)$, $h(-n+2)$ (4 marks)
- c) For the filter described above, given an input $x(n)$
where $x(n) = [2, -1, 2, -1]$ produce an expression for $y(n)$
where $y(n) = h(n) * x(n)$
(* denotes convolution)
show all calculations. (5 marks)

5. Fifth Exam Question (10 marks)

An IEEE 802.11 data channel has a centre frequency 2437 MHz and occupies a band from 2427 MHz to 2447 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 +6dB

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 1km and the only interference is from Gaussian White Noise (10 marks)

Totals (50 marks)

Diwedd/End