



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

**LOCATION: SWANSEA ( GOWER  
COLLEGE SWANSEA)**

**LLEOLIAD: : SWANSEA (GOWER  
COLLEGE SWANSEA)**

**LEVEL 5**

**LEFEL 5**

**EXAMINATION PERIOD  
MAY 2018**

**CYFNOD ARHOLIADAU  
MAI 2018**

**MODULE CODE: M2X8518**

**DIGITAL SIGNAL PROCESSORS  
AND COMMUNICATIONS**

**TIME: 2 HOURS**

**ANSWER ALL QUESTIONS**

*Equipment or materials required – Template for question 1*

*Formula sheet*

*Adnoddau neu ddefnyddiau sydd eu hangen -*

**Calculators are allowed**

## ANSWER ALL QUESTIONS

### 1. First Exam Question (10 marks)

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

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

- a) Sketch the impulse response of the filter (1 marks)
- b) Sketch the signal  $3h(n - 2)$  (3 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  $y(n) = h(n) * x(n)$  (\* is convolution, you may use the template provided) show all calculations. (6 marks)

### 2. Second Exam Question (15 marks)

Design an FIR low pass filter using the Window method.

Requirement:-

- 1. Pass band edge frequency  $f_p = 10$  kHz
  - 2. Transition band  $\Delta f = 300$  Hz
  - 3. Pass Band ripple  $A_p = 0.1$  dB
  - 4. Minimum stop band attenuation  $A_s = 50$  dB
  - 5. Sampling frequency  $f_s = 40$  kHz
- a) Find the appropriate number of filter coefficients to design the filter (5 marks)
  - b) Find the filter coefficient value  $h(n)$  for  $n = 6$  (10 marks)

### 3. Third Exam Question (10 marks)

A signal is sent with a hamming code. The following was received:-

10100011010001

- a) Find and correct any errors in transmission (6 marks)
- b) Apply a 7/4 Hamming code to the following code-word:-  
1010 (4 marks)

#### 4. Fourth Exam Question ( 10 marks)

Consider the analogue signal :-

$$x(t) = 3 \cos(2000\pi t) + 6\cos(14000\pi t) - 4 \sin(4000\pi t)$$

- Determine the minimum sampling rate in order to avoid aliasing (3 marks)
- If the signal is sampled at 6000Hz determine the DT signal obtained (4 marks)
- Determine the potential recoverable analogue signal resulting from sampling at 6000Hz and compare with the original. (3 marks)

#### 5. Fifth Question (15 marks)

- Produce a system block diagram in direct form for an FIR system described by the transfer function

$$H(z) = (3 + z^{-2})(1 - 4z^{-1})(2 + 2z^{-1})$$

(5 marks)

- For the system shown in figure 1 below where ( $a_1 = 2$ ,  $a_2 = 4$ ,  $a_3 = 2$ ,  $a_4 = 2$ ,  $a_5 = 3$ ) produce expressions for:-

- It's difference equation (6 marks)
- It's transfer function (4 marks)

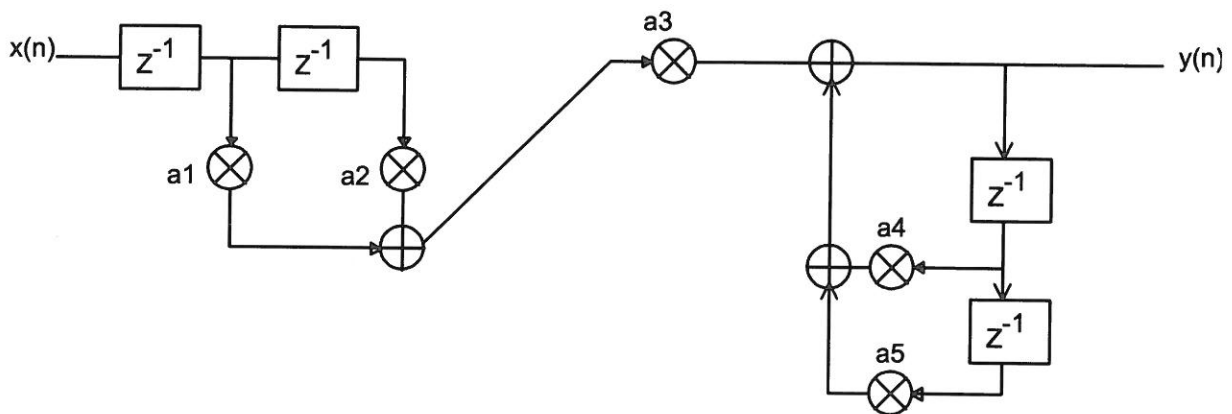


Figure 1

Totals (60 marks)

Diwedd/End

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