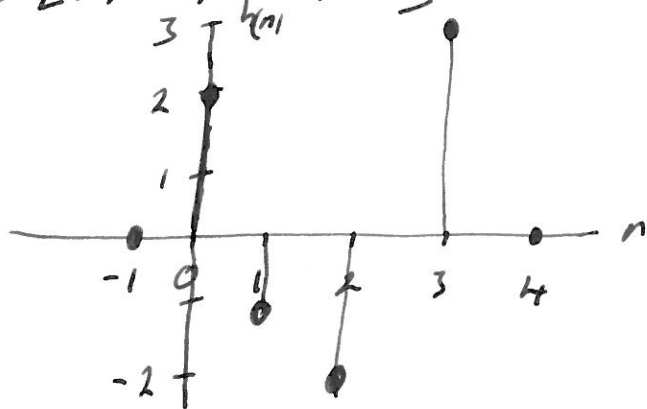
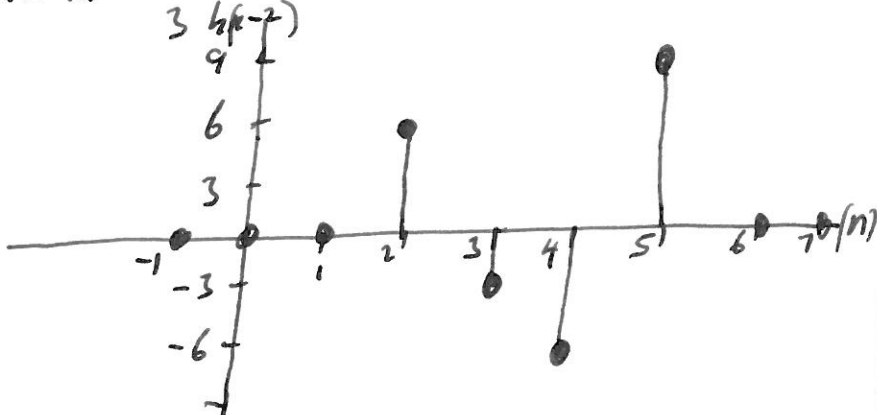


Template for Question 1 (Insert in Answer Booklet)

n	0	1	2	3	4	5	6	7	8	9	10				
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[illegible][illegible][illegible]

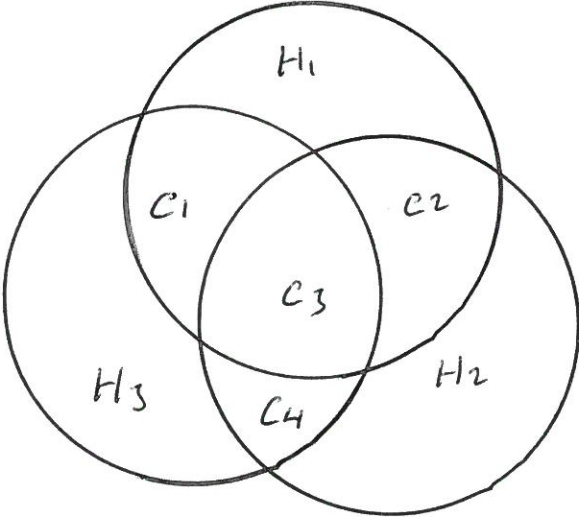
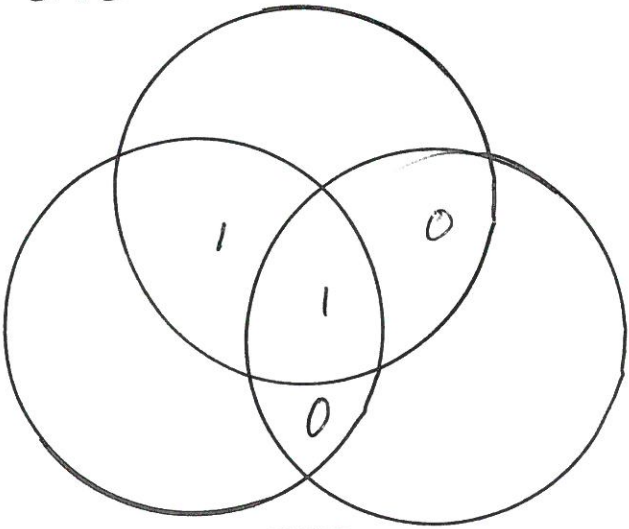
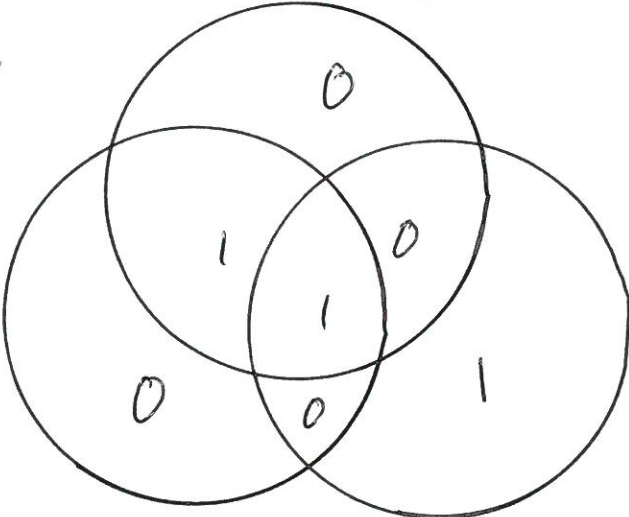
Student Name: _____

Question		marks																																
Q 1	$h(n) = [2, -1, -2, 3]$ a)  b) <table border="0"> <tr> <td>$n =$</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr> <tr> <td>$h(n) =$</td><td>2</td><td>-1</td><td>-2</td><td>3</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>$h(n-2) =$</td><td>0</td><td>0</td><td>2</td><td>-1</td><td>-2</td><td>3</td><td>0</td></tr> <tr> <td>$3h(n-2) =$</td><td>0</td><td>0</td><td>6</td><td>-3</td><td>-6</td><td>9</td><td>0</td></tr> </table>  c) SEE TEMPLATE. $y(n) = [4, -3, 2, 4, -6, 8, -3]$	$n =$	0	1	2	3	4	5	6	$h(n) =$	2	-1	-2	3	0	0	0	$h(n-2) =$	0	0	2	-1	-2	3	0	$3h(n-2) =$	0	0	6	-3	-6	9	0	(1) (1) (1) (1) (1)
$n =$	0	1	2	3	4	5	6																											
$h(n) =$	2	-1	-2	3	0	0	0																											
$h(n-2) =$	0	0	2	-1	-2	3	0																											
$3h(n-2) =$	0	0	6	-3	-6	9	0																											
		10 TOTAL																																

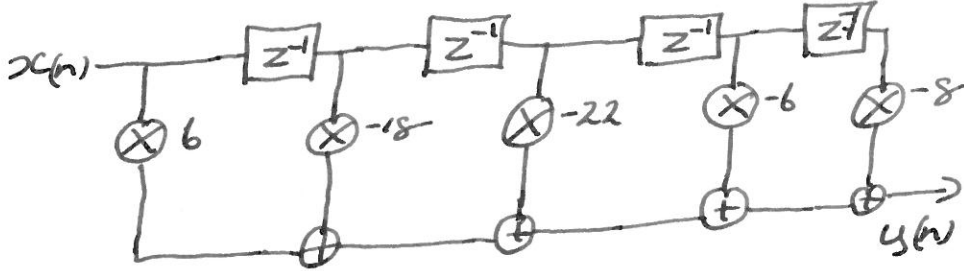
Question		marks
Q2a)	$F_p = 10 \text{ KHz.}$ NORMALISED. $F_p = \frac{10 \text{ K}}{40 \text{ K}} = 0.25$ $\Delta F = 300 \text{ Hz.}$ NORMALISED $\Delta F = \frac{300}{40000} = 0.0075$ RIPPLE = $0.1 \text{ dB} = 20 \log(1 + \delta_p)$ $\delta_p = 0.0116$ ATTENUATION = $A_s = 50 \text{ dB MIN.}$ THIS CAN BE ACHIEVED USING HAMMING WINDOW. GIVING. $\Delta F = \frac{3.3}{N} \therefore N = \frac{3.3}{7.5 \times 10^{-3}} = 440$ BUT MUST BE ODD SO $N = 441$	(1) (1) (1) (1) (1)
Q2b)	THE IMPULSE RESPONSE FOR. LOW PASS FIR FILTER $h_d(n) \quad (n \neq 0)$ $= 2F_c \frac{\sin(n\Omega_c)}{n\Omega_c}$ Ω_c IS THE ANGULAR NORMALISED CUT-OFF FREQUENCY. SO $\Omega_c = 2\pi(F_p + 0.5\Delta F)$ $= 2\pi(0.25 + 0.00375)$ $= 2\pi(0.25375)$	(1) (1) (1) (1)

Question	marks
Q2b). $F_c = \text{NORMALISED } f_c \text{ (Hz)}.$ $= (F_p + 0.5 \Delta F) = 0.25375.$	(1)
So $h_D[n] = \frac{\sin(n \Omega_c)}{n \pi}.$	(1)
THE HAMMING WINDOW FUNCTION $W[n] = 0.54 - 0.46 \cos\left[\frac{2\pi n}{N-1}\right].$	(1)
TIME DOMAIN TRUNCATION IS ACHIEVED BY MULTIPLYING $h_D[n] \times W[n].$	(1)
SO FOR COEFFICIENT (6).	
~~$h_D[6] = \frac{\sin(6 \cdot 2\pi \cdot 0.25375)}{6 \cdot \pi}$~~	
$h_D[6] = \left(\frac{\sin(6 \cdot 2\pi \cdot 0.25375)}{6 \cdot \pi} \right) \left(0.54 - 0.46 \cos\left(\frac{2\pi \cdot 6}{440}\right) \right)$	(1)
$= \left(\frac{\sin(9.56615)}{18.8496} \right) \left(0.54 - 0.46 \cos(0.08568) \right)$	(1)
~~$h_D[6] = \frac{\sin(9.56615)}{18.8496} \cdot 0.081$~~	
$= 17.28 \times 10^{-4}$	
$- 7.475 \times 10^{-3} \times 0.081$	(1)
$= 6.106 \times 10^{-4}.$	

Question		marks
Q3(a)	RX SIGNAL 1 0 1 0 0 0 1 1 0 1 0 0 0 1 n = 1 2 3 4 5 6 7 8 9 10 P P P P n = 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1 0 1 0 0 0 1 1 0 1 0 0 0 1 TEST PARITY 1 = 1, 3, 5, 7, 9, 11, 13 1 1 0 1 0 0 0 = ODD. PARITY BIT 1 IS INCORRECT. TEST PARITY BIT 2. 2 = 2, 3, 6, 7, 10, 11, 14 0 1 0 1 1 0 1 = EVEN PARITY BIT 2 IS OK. TEST PARITY BIT 4. 4 = 4, 5, 6, 7, 12, 13, 14. 0 0 0 1 0 0 1 = EVEN PARITY BIT 4 IS OK. TEST PARITY BIT 8. 8 = 8, 9, 10, 11, 12, 13, 14. 1 0 1 0 0 0 1 = ODD SO BIT 8 IS INCORRECT. BIT 1 + 8 = 9 SO BIT 9 IS ERRORED. 9 SHOULD BE 1 CORRECT SEQUENCE IS 1 0 1 0 0 0 1 1 1 0 0 0 1 RECOVERED DATA = 1 0 0 1 1 1 0 0 0 1	(1) (1) (1) (1) (1)

Question		marks
Q36	CODEWORD = 1010  APPLY CODE  APPLY PARITY  SO COMPLETE CODE + HAMMING = 1010010.	(i) (i) (i) (i)

Question		marks
Q4	$x(t) = 3 \cos(2000\pi t) + 6 \cos(14000\pi t) - 4 \sin(4000\pi t)$ 1000 Hz 7000 Hz 2000 Hz	(1)
a).	HIGHEST FREQUENCY COMPONENT $= 6 \cos(14000\pi t).$ $f = 7000 \text{ Hz}.$ NYQUIST SAMPLE FREQUENCY $= 2 \times 7000 = 14000 \text{ Hz}$	(1)
b)	$x[n] = 3 \cos\left(\frac{2000\pi n}{6000}\right) + 6 \cos\left(\frac{14000\pi n}{6000}\right) - 4 \sin\left(\frac{4000\pi n}{6000}\right)$ $= 3 \cos 2\pi\left(\frac{1}{6}\right)n + 6 \cos 2\pi\left(\frac{7}{6}\right)n - 4 \sin 2\pi\left(\frac{2}{6}\right)n$ $= 3 \cos 2\pi\left(\frac{1}{6}\right)n + 6 \cos 2\pi\left(1 + \frac{1}{6}\right)n - 4 \sin 2\pi\left(\frac{2}{6}\right)n$ $= 9 \cos 2\pi\left(\frac{1}{6}\right)n - 4 \sin 2\pi\left(\frac{2}{6}\right)n$	(1)
c).	$= 9 \cos 2\pi \frac{6000}{6} t - 4 \sin 2\pi \frac{1200}{6} t$ $= 9 \cos 2000\pi t - 4 \sin 4000\pi t$ COMPARED TO THE ORIGINAL WE HAVE LOST THE HIGH FREQUENCY COMPONENT AND INCREASED THE SIZE OF THE 1000 Hz COMPONENT.	(1)

Question		marks
Q5 a)	$H(z) = (3 + z^{-2})(1 - 4z^{-1})(2 + 2z^{-1})$ $H(z) = (3 - 12z^{-1} + z^{-2} - 4z^{-3})(2 + 2z^{-1})$ $= 6 - 24z^{-1} + 2z^{-2} - 8z^{-3} + 6z^{-1} - 24z^{-2} + 2z^{-3} - 8z^{-4}$ $= 6 - 18z^{-1} - 22z^{-2} - 6z^{-3} - 8z^{-4}$ 	(1) (1) (3)
b)	$a_4 y[n] + a_5 y[n-2] + a_3 (a_1 x[n-1] + a_2 x[n-2])$ $y[n] = a_4 y[n] Z^{-1} + a_5 y[n] Z^{-2} + a_3 (a_1 x[n] Z^{-1} + a_2 x[n] Z^{-2})$	
ia)	$y[n] = a_4 y[n] Z^{-1} + a_5 y[n] Z^{-2} + a_3 (a_1 x[n] Z^{-1} + a_2 x[n] Z^{-2})$ $y_n = 2 y[n-1] + 3 y[n-2] + 4 x[n-1] + 8 x[n-2]$ $y[n] - 2 y[n-1] - 3 y[n-2] = 4 x[n-1] + 8 x[n-2]$	(3) (2) (1)
ii a).	$H(z) = \frac{Y(z)}{X(z)}$ TRANSFORM $Y(z) - 2 Y z^{-1} - 3 Y z^{-2} = 4 X z^{-1} + 8 X z^{-2}$ $Y z (1 - 2 z^{-1} - 3 z^{-2}) = X z (4 z^{-1} + 8 z^{-2})$ $\frac{Y_z}{X_z} = \frac{4 z^{-1} + 8 z^{-2}}{(1 - 2 z^{-1} - 3 z^{-2})}$	(1) (1) (1) (1)