EE469/969/869/669 Semester 1 MOCK in-class test.

You have 1h to answer all questions.

The workings and description for answers needs to be shown when applicable. Where applicable marks will not be awarded for correct answers unless related workings that justify the answers are included.

Q1. The following Matlab code has been written to convolve two digital signals, is the code correct? If not, what is wrong?

```
a  = 10;
f1 = 20;
f2 = 30;
fs = 1000;
T=2;
t = 0:1/fs:T-1/fs;
x = a*cos(2*pi*f1*t);
y = a/2*sin(2*pi*f2*t);
z  = conv(x, y);
```

3 Marks

Q2. Explain what the following lines of code are doing

```
a  = 10;
f1 = 20;
f2 = 30;
fs = 1000;
T=2;
t = 0:1/fs:T-1/fs;
y = a/2*sin(2*pi*f2*t);
y1  = awgn(y, 10);
z  = xcorr(y, y1);
```

3 Marks

Q3. How can we write the impulse response of the cascade of two discrete LTI systems?

3 Marks

Q4. What is the Nyquist rate for the following signal ?

$$x(t) = 1000\cos(2\pi 100t) + 13\sin(2\pi\ 321\ t) + sin(\pi)^2\ \cos(2\pi\ 500\ t)$$

3 Marks

Q5. A full period of a sinusoid with amplitude 1 is sampled with 8 samples. Assuming that the first sample is taken when the value is 0, sketch the sampling and quantization process and write the sequence after sampling and after quantization (M = 8, 3 bits, two's complement code).

4 Marks

Q6. Using the matrix method compute the convolution sum between x[n] = [4 3 2 1] and h[n] = [2 4 6].

4 Marks

Q7. Calculate the 8 points FFT using the signal x[n], n = 0, 1, 2, 3 4, 5, 6, 7 ,8; where x[n] is composed by the first 8 digits of your registration number. (e.g. if the registration number is Reg = [20011234] then x[n] = [2 0 0 1 1 2 3 4]).

30 Marks

Q8. A LTI digital filter is characterised with system function

$$H(z) = \frac{z}{(z-0.5)(z+1)}$$

(i) Write out the Linear Difference Equation that describes this LTI Digital Filter.
(ii) Write the expression of $H(\Omega)$;
(iii) Plot the zero pole diagram of the system;
(iv) Sketch the magnitude response of the system.
(v) Compute the zero state response when the input is

$$x[n] = r\,u[n]$$

Where r is the last digit of your registration number (if the last digit is 0 then use r=9).

50 Marks