BITS, Pilani-Dubai
Dubai International Academic City
Second Year, Second Semester, 2007-2008
Comprehensive Examination
EEE/INSTR C272 Circuits & Signals
Duration: 3 hours Marks: 80 Weightage: 40%

Note:

1. *This question paper consists of two pages.*
2. *Answer all questions.*
3. *Appropriate assumptions may be made if required.*

1. The *transmission* (*ABCD*) *parameters* for a two-port network are $\begin{bmatrix} 5 & 10\Omega \\ 0.4S & 1 \end{bmatrix}$. A 14-volt DC source in series with a 2Ω resistor is connected across the input port and a 10Ω resistor serves as the load across the output port. Draw the setup and find I_1 and I_2, where the currents have the usual meaning as associated with a two-port network. (2+8)
   Explain the term *network synthesis*. (2)

2. Obtain and sketch the Fourier transform of the periodic impulse train $x(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$. What interesting property do you observe based on this signal and its Fourier transform? (6+2+2)

3. Using the z-transform find the convolution of the following two sequences: $h(n) = \{1, 2, 0, -1, 1\}$ and $x(n) = \{1, 3, -1, -2\}$. Assume that the first term in each sequence corresponds to $n = 0$. (6)
   Distinguish between the operations involved in linear convolution and circular convolution. (3)

4. Explain the conditions that a linear system satisfies. (4)
   An LTI system has an impulse response $h(t) = e^{-at}u(t)$ and output $y(t) = \{e^{-bt} - e^{-ct}\}u(t)$. Find the input $x(t)$. (8)

5. Determine the z-transform of $x[n] = -u[-n-1] + \left(\frac{1}{2}\right)^n u[n]$. Sketch the ROC and pole and zero locations of $X[z]$ in the z-plane. (6+3)

6. Sketch the magnitude and phase responses of an ideal low-pass filter as well as an ideal band-pass filter. Also briefly explain with further sketches

how the corresponding responses for practical filters deviate from the ideal. (4+2)
Explain the distinction between FIR and IIR filters. (4)

7. It is desired to use the N-point DFT to find the spectrum of an analog signal that has been prefiltered by a low-pass filter with a cutoff frequency of 10 kHz. The desired frequency resolution is 0.1 Hz. Find the required value of N (assuming a power of 2) as well as the duration of the data window. (4+2)
   State the sampling theorem for low-pass signals. (2)

8. Using the decomposition-in-time FFT technique, show how the 4-point DFT can be *derived* from the 2-point DFT. Illustrate your answer with appropriate mathematical expressions as well as signal-flow graphs. (10)

BITS, PILANI-DUBAI
Dubai International Academic City

II Year, II Semester, 2007-2008
Test-II (Open Book)
Course No.: EEE/INSTR UC272 Course Title: Circuits & Signals
Duration: 50 min Marks: 40 Weightage: 20%

Answer all questions

Find the inverse Laplace transform of the following:

a) $X(s)=\frac{1}{s(s+1)^2}$, $\mathrm{Re}(s)<-$

b) $Y(s)=\frac{s}{s^3+2s^2+9s+18}$, $\mathrm{Re}(s)>-2$ (4+5)

2 Obtain the (a) impulse response and (b) step response of a filter having the transfer function $H(z)=\frac{1}{1+0.4z^{-1}}$ (4+5)

3 Consider a filter described by the difference equation $y[n]=x[n]-x[n-1]$.

(a) Find the frequency response $H(\Omega)$ of the system.

(b) Sketch the magnitude response $|H(\Omega)|$ and the phase response $\theta(\Omega)$.

(c) Comment on the nature of the filter. (4+4+1)

4 Obtain the linear convolution of the two sequences $x[n]=\{2,1,2,1\}$ and $y[n]=\{1,2,3,4\}$. (6)

5 Give the block diagram realizations for the following

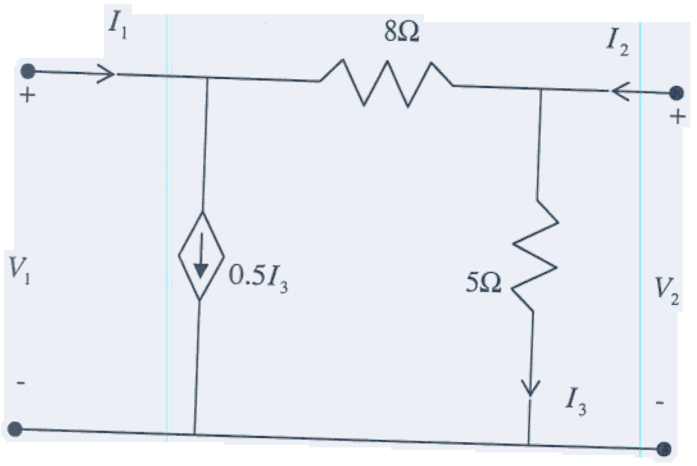
(a) $y[n]=0.5x[n]+0.5x[n-1]$

(b) $Y(z)=0.25z^{-1}Y(z)+0.5X(z)+0.75z^{-1}X(z)$ (3+4)

BITS, PILANI-DUBAI
Dubai International Academic City, Dubai
BE (Hons.), Second Year, Second Semester, 2007-2008
Test I (Closed Book)
EEE UC272 / INSTR UC272 – Circuits & Signals
Date: Mar 23, 2008 **Duration:** 50 min **Max. Marks:** 50 **Weightage:** 25%

Answer all questions. Appropriate assumptions may be made if required.

1. Obtain the z-parameters of the following circuit: (12 marks)



2. Sketch the following signals. (4 + 3 = 7 marks)
   a) $x(t) = 3u(t-5) - u(t-7) - 2u(t-9)$
   b) $y[n] = 2^n u[-n]$
3. Evaluate the integral $\int_{-\infty}^{\infty} 5(\cos t)u(t-2)\delta(t)dt$. (5 marks)
4. Let $y(t) = x(t) * h(t)$, where * is the convolution operation. Obtain $x(t-t_1) * h(t-t_2)$ in terms of $y(t)$. (8 marks)
5. Find the fundamental period of the signal $x(t) = \sin^2 t$. Determine the complex exponential Fourier series representation of $x(t)$. (2 + 6 = 8 marks)
6. Find the Fourier transform of the signal $x(t) = e^{-at}\sin(\omega_o t)u(t)$, $a > 0$. (10 marks)