T.Y.BSc

Sem VI

Subject: Elective: Digital Signals and system

T.Y.I.T. - Digital signal system 2016-17

sem-VI - A.T.K.T

2016-17

QP Code : 78183

(2½ hours)

Total Marks: 75

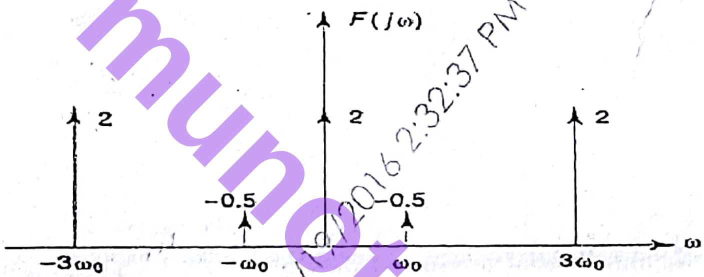
N. B.: (1) All questions are compulsory.
(2) Make suitable assumptions wherever necessary and state the assumptions made.
(3) Answers to the same question must be written together.
(4) Numbers to the right indicate marks.
(5) Draw neat labeled diagrams wherever necessary.
(6) Use of Non-programmable calculators is allowed.

1. Attempt *any two* of the following: 10

a. With illustration, explain shifting, folding and time scaling operation on discrete-time signals.

b. How are continuous and discrete time systems classified? Explain.

c. Determine the inverse Fourier transform of the spectrum shown in fig.



d. Find the Fourier transform of $f(t) = t \cos at$ and $f(t) = e^{-at} \sin bt$

2. Attempt *any two* of the following: 10

a. Find the Laplace transform of the following functions

(i) $f(t) = \frac{1-e^{t}}{t}$

(ii) $f(t) = \cos^3 3t$

b. Derive from the principals, the laplace transform of a unit step function. Hence or otherwise determine the Laplace transform of a unit ramp function and a unit impulse function

c. If L{ $f_1(t)$} = $F_1(s)$ and L{ $f_2(t)$} = $F_2(s)$, show that L{ $f_1(t) \cdot f_2(t)$} = $F_1(s) \cdot F_2(s)$

d. Discuss initial value and final value theorem in Laplace transform domain.

3. Attempt *any two* of the following: 10

a. A system has an impulse response $h(n) = \{1,2,3\}$ and output response $y(n) = \{1,1,2,-1,3\}$. Determine the input sequence x(n).

b. Define and explain cross-correlation and auto-correlation of sampled signals.

c. Using residue method find the inverse z-transform of

$X(z) = \frac{1}{(z-0.25)(z-0.5)}$; ROC: $|z| > 0.5$

d. Using convolution find $x(n)$ if $X(z)$ is given by:

$$X(z) = \frac{1}{\left(1-\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{4}z^{-1}\right)}$$

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4. Attempt *any two* of the following: 10

a. Explain the Paley – Wiener criteria.

b. The discrete time systems are represented by the following difference equations in which $x(n)$ is input and $y(n)$ is output.

i. $y(n) = 3y^2(n-1) - nx(n-1) - 2x(n+1)$ and

ii. $y(n) = x(n+1) - 3x(n) + x(n-1); n \geq 0$

Are these systems linear? Shift-invariant? Causal? In each case justify your answer.

c. Consider a causal and stable LTI system whose input x(n) and output y(n) are related through the second order difference equation

$$y(n) - \frac{1}{12}y(n-1) - \frac{1}{12}y(n-2) = x(n)$$

Determine the step response for the system.

d. Find the convolution of the two signals

$x(n) = u(n)$ and $h(n) = a^n u(n)$, ROC: $|a| < 1; n \geq 0$

5. Attempt *any two* of the following: 10

a. Find the circular periodic convolution using DFT and IDFT of the two sequences:

$x(n) = \{1, 1, 2, 2\}$ and $h(n) = \{1, 2, 3, 4\}$

b. Derive the DFT for the sample data sequence $x(n) = \{1, 1, 2, 2, 3, 3\}$ and compute the corresponding amplitude and phase spectrum.

c. Find the discrete time Fourier transform for the following finite duration sequence of length L:

$x(n) = A$ for $0 \leq n \leq L-1$

$= 0$ otherwise.

Also find the inverse DTFT to verify $x(n)$ for L = 3 and A = 1V.

d. Find the 4-point DFT of the sequence $x(n) = \cos\frac{n\pi}{4}$.

6. Attempt *any two* of the following: 10

a. Design an analog BPF to satisfy the following specifications:

(i) 3 dB upper and lower cut-off frequencies are 100 Hz and 3.8 kHz

(ii) stop band attenuation of 20 dB at 20 Hz and 8 kHz.

(iii) No ripple with both passband and stopband.

b. A low pass filter has the desired response as given below

$H_d(e^{j\omega}) = e^{-j3\omega} \quad 0 \leq \omega \leq \frac{\pi}{2}$

$= 0 \quad \frac{\pi}{2} \leq \omega \leq \pi$

Determine the filter coefficient h(n) for M=7, using Type-I frequency sampling technique.

c. Design a bandpass filter to pass frequencies in the range 1-2 rad/sec using Hanning window N = 5.

d. Design a digital Chebyshev filter to satisfy the constrains

$0.707 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq \omega \leq 0.2\pi$

$|H(e^{j\omega})| \leq 0.1, \quad 0.5\pi \leq \omega \leq \pi$

Using bilinear transformation and assuming T = 1s.

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7. Attempt *any three* of the following: 15

a. State and prove that convolution theorem for Fourier transform.

b. In the parallel RLC circuit. $I_0 = 5$ A, L = 0.2 H, C = 2 F and R = 0.5 Ω. Switch S is opened at time t=0. Obtain the complete particular solution for the voltage v(t) across the parallel network. Assume zero current through inductor L and zero voltage across capacitor C before switching.

c. For a low pass RC network, R = 1 MΩ and C = 1 μF. Determine the output response for n in the range $0 \leq n \leq 3$ when input has a step response of magniture 2 V and the sampling frequency $f_s = 50$ Hz.

d. Distinguish between IIR and FIR systems.

e. An FIR digital filter has the unit impulse response sequence, h(n) ={2,2,1}. Determine the output sequence in response to the input sequence x(n) = {3,0,-2,0,2,1,0,-2,-1,0} using the overlap-add convolution method.

f. Design a Finite Impulse Response low pass filter with a cut-off frequency of 1kHz and sampling rate of 4kHz with eleven samples using Fourier series.