Signals and Systems VTU CBCS Question Paper Set 2018

CBCS Scheme

USN 15EC44

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Signals and Systems

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Find odd and even components of the following signals.
i) $x(t) = 1 + t\cos t + t^2 \sin t + t^3 \cos^2 t \sin t$
ii) $x(t) = 1 + t^2 \cos^2 t + t^3 \sin^2 t + t^4 \cos t$. **(08 Marks)**

b. For the signal x(t) shown in Fig.Q1(b) find and plot.
i) $x(-2t-4)$ ii) $x(-3t+2)$ iii) $x(2(-t-1))$. **(08 Marks)**

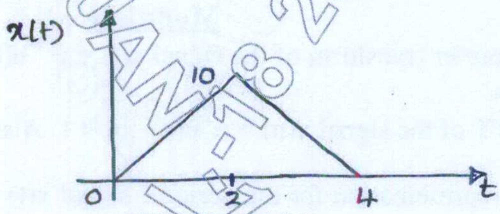

Fig.Q1(b)

OR

2 a. Determine whether the system described by the following input/output relationship is memoryless, causal, time – invariant or linear.

i) $y(n) = e^{x(n)}$ ii) $y(t) = \frac{1}{C}\int_{-\infty}^{t} x(\tau)d\tau$. **(08 Marks)**

b. Given the signal $x(n) = (8-n)[u(n) - u(n-8)]$. Find and sketch
i) $y_1(n) = x[4-n]$ ii) $y_2(n) = x[2n-3]$. **(08 Marks)**

Module-2

3 a. Find the convolution integral of $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = u(t+2)$. **(08 Marks)**

b. Find $y(n) = \beta^n u(n) * \alpha^n u(n)$. Given : $|\beta| < 1$ and $|\alpha| < 1$. **(04 Marks)**

c. Find $y(n) = x_1(n) * x_2(n)$

Where $x_1(n) = \left\{\underset{\uparrow}{1}, 2, 3\right\}$ and

$x_2(n) = \left\{1, 2, \underset{\uparrow}{3}, 4\right\}$. **(04 Marks)**

OR

4 a. Convolute the two continuous time signals $x_1(t)$ and $x_2(t)$ given below :
$x_1(t) = \cos \pi t[u(t+1) - u(t-3)]$ and $x_2(t) = u(t)$. **(08 Marks)**

b. Evaluate $y(n) = \beta^n u(n) * u(n-3)$ given: $|\beta| < 1$. **(04 Marks)**

c. Show that : i) $x(n) * \delta(n) = x(n)$ ii) $x(n) * \delta(n-n_0) = x(n-n_0)$. **(04 Marks)**

Module-3

5 a. Check the following systems for memory less, causality and stability :
i) $h(n) = (-0.25)^{|n|}$ ii) $h(t) = e^{2t}\, u(t-1)$. (06 Marks)

b. Find the step response of an LTI system whose impulse response is defined by $h(n) = \frac{1}{3}\sum_{k=0}^{2} \delta(n-k)$. (04 Marks)

c. Evaluate the DTFS representation for the signal $x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$. Also draw its magnitude and phase spectra. (06 Marks)

OR

6 a. Find the step response of an LTI system whose impulse response is given by
i) $h(t) = e^{-|t|}$ ii) $h(t) = t^2 u(t)$. (06 Marks)

b. State any six properties of DTFS. (06 Marks)

c. Determine DTFS of the signal $x(n) = \cos\left(\frac{\pi}{3}n\right)$. Also draw its spectra. (04 Marks)

Module-4

7 a. Obtain the Fourier transform of the signal $x(t) = e^{-at}u(t);\ a > 0$. Also draw its magnitude and phase spectra. (06 Marks)

b. Find the DTFT of the signal $x(n) = \alpha^n u(n);\ |\alpha| < 1$. Also draw its magnitude spectra. (04 Marks)

c. Find the FT representation for the periodic signal $x(t) = \cos \omega_0 t$ and also draw its spectrum. (06 Marks)

OR

8 a. Find the FT of the signum function $x(t) = s_g n(t)$. Draw the magnitude and phase spectra. (06 Marks)

b. Find the DTFT of $\delta(n)$ and draw the spectrum. (04 Marks)

c. Find the FT of the periodic impulse train $\delta_{T_0}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$ and draw the spectrum. (06 Marks)

Module-5

9 a. Find Z.T of the following sequences and als sketch their RoC :
i) $x(n) = \sin\Omega_0 n\, u(n)$ ii) $x(n) = \left(\frac{1}{2}\right)^n u(n) + (-2)^n u(-n-1)$. (08 Marks)

b. Find IZT of the following sequence $x(z) = \frac{\left(\frac{1}{4}\right)z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}$ with RoC $\frac{1}{4} < |z| < \frac{1}{2}$. (08 Marks)

OR

10 a. State and prove the following properties of ZT
i) Time reversal property ii) differentiation property. (08 Marks)

b. Find IZT of the following sequence using partial fraction expansion method :

$$x(z) = \frac{z\left[2z - \frac{3}{2}\right]}{z^2 - \frac{3}{2}z + \frac{1}{2}}$$

Given : i) RoC : $|z| < \frac{1}{2}$; ii) RoC : $|z| > 1$; iii) RoC : $\frac{1}{2} < |z| < 1$. (08 Marks)

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CBCS Scheme

USN | | | | | | | | | | | **15EC44**

Fourth Semester B.E. Degree Examination, June/July 2017
Signals and Systems

Time: 3 hrs.   Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Sketch the even and odd part of the signals shown in Fig. Q1(a) and (b). **(08 Marks)**

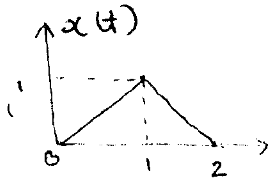

Fig. Q1(a)

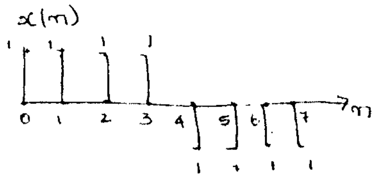

Fig. Q1(b)

b. Determine whether the following signal is periodic or not if periodic find the fundamental period. $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$ **(03 Marks)**

c. Express x(t) in terms g(t) if x(t) and g(t) are shown in Fig. Q1(c). **(05 Marks)**

Fig. Q1(c)

OR

2 a. Determine whether the following systems are memory less, causal, time invariant, linear and stable. i) $y(n) = n\,x(n)$ ii) $y(t) = x(t/2)$. **(08 Marks)**

b. For the signal x(t) and y(t) shown in Fig. Q2(b) sketch the following signals.
i) $x(t+1)\cdot y(t-2)$ ii) $x(t)\cdot y(t-1)$ **(08 Marks)**

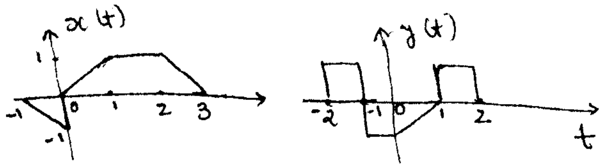

Fig. Q2(b)

Module-2

3 a. Prove the following :
i) $x(n)*[h_1(n)+h_2(n)] = x(n)*h_1(n)+x(n)*h_2(n)$
ii) $x(n)*u(n) = \sum_{k=-\infty}^{n} x(k)$. **(08 Marks)**

b. Compute the convolution sum of $x(n) = u(n) - u(n-8)$ and $h(n) = u(n) - u(n-5)$. **(08 Marks)**

OR

4 a. State and prove the associative, integral and commutative properties of convolution. **(08 Marks)**

b. Compute the convolution integral of $x(t) = u(t) - u(t-2)$ and $h(t) = e^{-t}\,u(t)$. **(08 Marks)**

Module-3

5 a. A system consists of several subsystems connected as shown in Fig. Q5(a). Find the operator H relating x(t) to y(t) for the following sub system operators. **(04 Marks)**

$H_1 : y_1(t) = x_1(t)\,x_1(t-1)$
$H_2 : y_2(t) = |x_2(t)|$
$H_3 : y_3(t) = 1+2x_3(t)$
$H_4 : y_4(t) = \cos(x_4(t))$

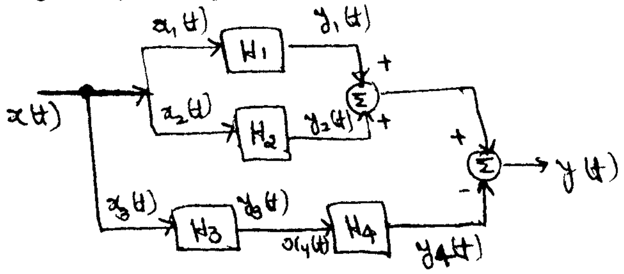

Fig. Q5(a)

b. Determine whether the following systems defined by their impulse responses are causal, memory less and stable.
i) $h(t) = e^{-2t}\,u(t-1)$ ii) $h(n) = 2u[n] - 2u(n-5)$ **(06 Marks)**

c. Evaluate the step response for the LTI systems represented by the following impulse responses. i) $h(t) = u(t+1) - u(t-1)$ ii) $h(n) = \left(\frac{1}{2}\right)^n u(n)$. **(06 Marks)**

OR

6 a. State the following properties of CTFS. i) Time shift ii) Differentiation in time domain iii) Linearity iv) Convolution v) Frequency shift vi) Scaling. **(06 Marks)**

b. Determine the DTFS coefficients for the signal shown in Fig.Q6 (b) and also plot $|x(k)|$ and $\arg\{x(k)\}$. **(10 Marks)**

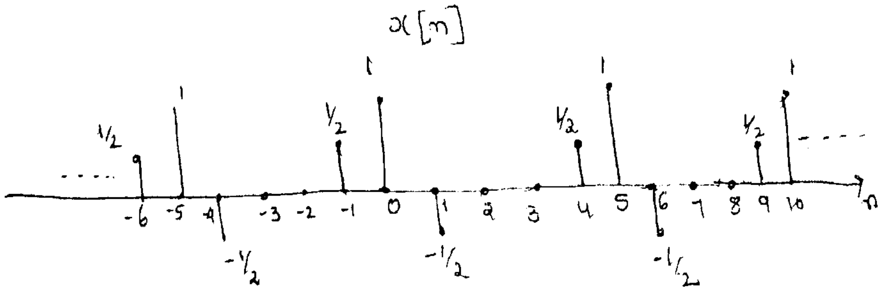

Fig. Q6(b)

Module-4

7 a. State and prove the following properties :

i) $y(t) = h(t) * x(t) \xleftrightarrow{FT} y(jw) = x(jw)H(jw)$

ii) $\frac{d}{dt}x(t) \xleftrightarrow{FT} jw\,x(jw)$ **(06 Marks)**

b. Find DTFT of the following signals.

i) $x(n) = \{1, 2, \underset{\uparrow}{3}, 2, 1\}$ ii) $x(n) = \left(\frac{3}{4}\right)^n u[n]$. **(10 Marks)**

OR

8 a. Specify the Nyquist rate for the following signals
i) $x_1(t) = \sin(200\pi t)$ ii) $x_2(t) = \sin(200\pi t) + \cos(400\pi t)$. **(04 Marks)**

b. Use partial fraction expansion to determine the time domain signals corresponding to the following FTs.

i) $x(jw) = \frac{-jw}{(jw)^2 + 3jw + 2}$

ii) $x(jw) = \frac{jw}{(jw+2)^2}$ **(08 Marks)**

c. Find FT of the signal $x(t) = e^{-2t} u(t-3)$. **(04 Marks)**

Module-5

9 a. Explain properties of ROC with example. **(06 Marks)**

b. Determine the z-transform of the following signals

i) $x(n) = \left(\frac{1}{4}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(-n-1)$

ii) $x(n) = n\left(\frac{1}{2}\right)^n u(n)$ **(10 Marks)**

OR

10 a. Find the time domain signals corresponding to the following z-transforms.

$$x(z) = \frac{\left(\frac{1}{4}\right)z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)} \text{ with ROC } \frac{1}{4} < |z| < \frac{1}{2}.$$ **(06 Marks)**

b. Determine the transfer function and the impulse response for the causal LTI system described by the difference equation

$$y(n) - \frac{1}{4}y(n-1) - \frac{3}{8}y(n-2) = -x(n) + 2x(n-1)$$ **(10 Marks)**

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