USN | | | | | | | | | | |

10EC44

Fourth Semester B.E. Degree Examination, June/July 2018

Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the following continuous time signals with examples: (i) Even and Odd (ii) Periodic and Non-periodic (iii) Energy and power. **(06 Marks)**

b. Test $y(t) = x(t)g(t)$ whether the system is,
(i) Linear (ii) Time variant (iii) Stable. **(06 Marks)**

c. Perform the following operation on the signal shown in Fig. Q1 (c).

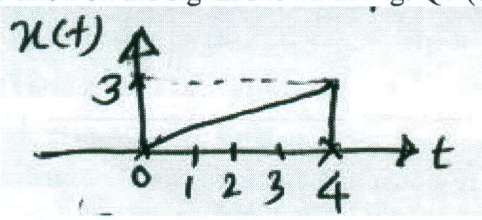

Fig. Q1 (c)

(i) $x(3t+2)$; (ii) $x(2(t+2))$; (iii) $x(-2t-1)$ (iv) $x(-2t+3)$ **(08 Marks)**

2 a. Prove the following properties of convolution sum:
(i) $x(n) * h(n) = h(n) * x(n)$.
(ii) $\{x(n) * h_1(n)\} * h_2(n) = x(n) * \{h_1(n) * h_2(n)\}$ **(06 Marks)**

b. Evaluate the following convolution integral: $y(t) = u(t+1) * u(t-2)$. **(06 Marks)**

c. Find the convolution of,
$x(n) = \{1 \ \underset{\uparrow}{2} \ 3 \ 4\}$ and $h(n) = \{5 \ \underset{\uparrow}{4} \ 3 \ 2 \ 1\}$ **(08 Marks)**

3 a. Determine LTI systems characterized by impulse response,
(i) $h(n) = \left(\frac{1}{2}\right)^n u(n)$
(ii) $h(t) = e^{-4|t|}$ are stable and causal. **(06 Marks)**

b. Find the natural response of the system,
$$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$$
with $y(-1) = 0$ and $y(-2) = 1$. **(06 Marks)**

c. Sketch direct form I and direct form II implementations for,
(i) $y(n) + \frac{1}{2}y(n-1) - 2y(n-3) = 3x(n-1) + 2x(n-2)$
(ii) $\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = 2\frac{dx(t)}{dt}$. **(08 Marks)**

4 a. State and prove (i) Time-shift and (ii) Frequency shift properties of Fourier series. **(06 Marks)**

b. Determine the DTFS of the signal, $x(n) = \cos\left(\frac{\pi}{3}n\right)$ and draw the spectrum. **(06 Marks)**

c. Evaluate the FS representation for the signal, $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectra. **(08 Marks)**

PART – B

5 a. State and prove the following properties of DTFT:(i)Frequency differentiation (ii)Linearity. **(06 Marks)**

b. Find the inverse Fourier transform of,

$$X(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}.$$ **(06 Marks)**

c. Find the DTFT of the signals:

(i) $x(n) = 2^n u(-n)$ (ii) $x(n) = \left(\frac{1}{4}\right)^n u(n+4)$. **(08 Marks)**

6 a. The system produces the output of $y(t) = e^{-t}u(t)$ for an input of $x(t) = e^{-2t}u(t)$. Determine the frequency response and impulse response of the system. **(06 Marks)**

b. State and prove sampling theorem for low pass signal. **(08 Marks)**

c. Find the Nyquist rate and Nyquist interval for the following signals:

(i) $m(t) = \frac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$

(ii) $m(t) = \frac{\sin 500\pi t}{\pi t}$. **(06 Marks)**

7 a. Write any six properties of ROC's. **(06 Marks)**

b. Determine the z-transform of,

(i) $x(n) = -a^n u(-n-1)$.

(ii) $x(n) = a^n \cos(\Omega_0 n) u(n)$ **(06 Marks)**

c. Determine the inverse z-transform of the following:

(i) $x(z) = \frac{1}{1 - az^{-1}}$, ROC : $|z| > |a|$

(ii) $x(z) = \frac{1}{1 - az^{-1}}$, ROC : $|z| < |a|$ **(08 Marks)**

8 a. Find the unilateral z-transform of the following x(n):

(i) $x(n) = a^n u(n)$.

(ii) $x(n) = a^{n+1} u(n+1)$ **(06 Marks)**

b. Determine the system function and unit sample response of the system described by the difference equation, $y(n) - \frac{1}{2}y(n-1) = 2x(n)$, $y(-1) = 0$. **(06 Marks)**

c. Solve the difference equation,

$y(n) - 3y(n-1) - 4y(n-2) = 0$, $n \geq 0$

If $y(-1) = 5$ and $y(-2) = 0$. **(08 Marks)**

* * * * *