Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: AE307

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) (i) Determine whether $x(t) = \cos\left(\frac{\pi}{3}t\right) + \sin\left(\frac{\pi}{4}t\right)$ is periodic or not. If it is periodic, determine its fundamental period. (5)

(ii) Find even and odd components of the following signal.

$$x(t) = (1 + tcos(t) + t^2 \sin(t) + t^3 \sin(t)\cos(t))$$

b) Determine whether the following signals are energy or power signal. (5)

(i) $x(t) = e^{-3t}u(t)$ (ii) $x(n) = \cos\left(\frac{\pi}{4}n\right)$

c) Sketch the waveforms of the following signals. (5)

(i) $x(t) = -u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$

(ii) $y(t) = r(t+1) - r(t) + r(t-2)$

2 a) Check whether the systems with followingimpulse responses are causal and stable (6)

(i) $h(t) = 3\delta(t)$(ii) $h(t) = \cos(\pi t)$

(iii)$h[n] = (1/2)^{|n|}$

b) Check whether the following systems are linear or not. (6)

(i)$y(n) = log_{10}(|x(n)|)$ (ii)$y(n) = \cos(2\pi x[n+1]) + x(n)$

(iii) $y(t) = \frac{d}{dt}\{e^{-t}x(t)\}$

c) Check whether the following systems are time variant or time invariant (3)

(i) $y(t) = tx(t)$ (ii)$y(n) = x(n) + nx(n-1)$

3 a) (i) Find the output of a system with impulse response $h(t) = e^{-3t}u(t)$ and the input signal $x(t) = u(t-3) - u(t-5)$. (7.5)

b) Determine the forced response for a system described by the difference equation $y(n) - 1.5y(n-1) + 0.5y(n-2) = x(n)$ for an input $x[n] = 2^n u[n]$ (7.5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Explain the condition for distortion-less transmission through an LTI system. (7.5)

b) Describe transmission of rectangular pulse through an ideal low pass filter. (7.5)

5 a) Define Hilbert transform. Write two of its properties. (7)

b) State sampling theorem for band-limited signals. Explain aliasing and reconstruction filter. (8)

6 a) Find the DTFS representation for $x[n] = \cos(\frac{\pi}{8}n + \emptyset)$ (5)

b) Determine the DTFT representation to determine the time domain signal of $X(e^{j\Omega}) = e^{-j\Omega} \ for \ -\pi \leq \Omega \leq \pi$ (5)

c) Use the defining equation for Fourier transform, to evaluate the frequency domain representations of$x(t) = e^{-4|t|}$. Sketch the magnitude and phase spectra. (5)

PART C

Answer any two full questions,each carries 20 marks.

7 a) Determine the Laplace transform X(s), ROC, and locations of poles and zeros of(i)$x(t) = e^{-2t}u(t) + e^{-3t}u(t)$ (ii) $x(t) = \sin(3t)u(t)$ (10)

b) Find the Z transform of the signal $x[n] = \left(n\left(\frac{-1}{2}\right)^n u[n]\right) * \left(\frac{1}{4}\right)^{-n} u[-n]$ (10)

8 a) Find the transfer function of the system described by the differential equation (5)

$$\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + y(t) = \frac{d}{dt}x(t) - 2x(t)$$

b) An LTI system has the transfer function $H(s) = \frac{2}{s+3} + \frac{1}{s-2}$.Find the impulse response by assuming that this system is causal. Also check whether it is stable or not. (5)

c) Explain the properties of Region of Convergence of X(z). (10)

9 a) Prove the following properties of the Unilateral Laplace transform (10)
(i) Linearity (ii) Time shifting (iii) Convolution

b) Find the Z-transform of the signal $x(n) = [sin\omega_0 n]u(n)$ and find ROC (5)

c) Find the inverse z-transform of $X(z) = \frac{1-z^{-1}+z^{-2}}{\left(1-\frac{1}{2}z^{-1}\right)(1-2z^{-1})(1-z^{-1})}; ROC \ 1 < |z| < 2$ (5)

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