Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

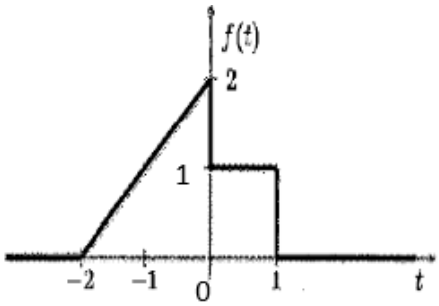
Answer any two questions, each carries 15 marks Marks

1 a) Determine whether the signal $x[n] = 1 + \sin\left(\frac{5\pi n}{3} + \frac{\pi}{2}\right)$ is periodic. Find the fundamental period if it is periodic. (2)

b) For the signal *f(t)* shown below: (7)

i) Sketch *f(3-2t)*

ii) Find the energy of the signal *f(t).*



c) Check whether the following systems are linear and stable. (6)

(i) $y(t) = e^{x(t)}$

(ii) $y[n] = x[n-1]$

2 a) Let $f(t) = 2(u(t) - u(t-2))$ and $g(t) = e^{t}(u(t) - u(t-2))$

(i) Sketch the functions *f(t)* and *g(t)* (2)

(ii) Compute *f(t)*g(t).* Here * denotes convolution. (7)

b) Define the cross correlation function $\Phi_{xy}(\tau)$ for two signals $x(t)$ and $y(t)$. What is its connection with convolution? (2)

c) Consider an LTI system with impulse response $h[n] = u[n]$. Determine the stability and causality of this system. (4)

3 a) Find the convolution of a signal $x[n] = \{1, -1, 1, -1\}$ with itself. (6)

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b) Check whether the system described by the input output relationship $y[n] = x^2[n]$ is time invariant. (3)

c) Determine the power and energy of the following signals. Classify them as energy/power signals. (6)

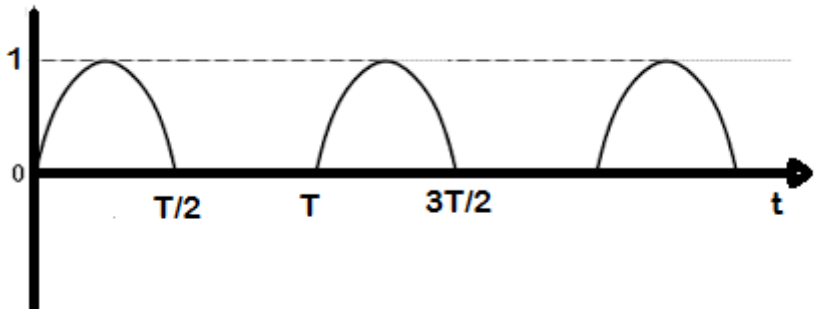
(i) $x(t) = A\sin(\Omega t)$

(ii) $x[n] = u[n]$

PART B

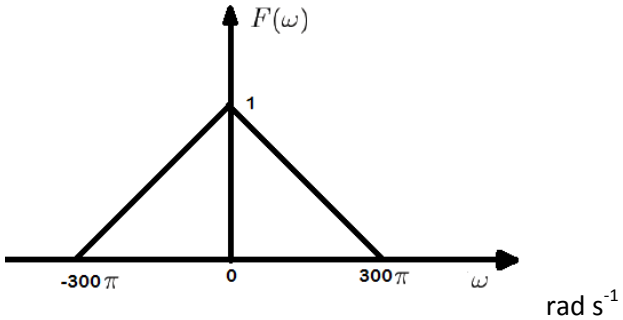
Answer any two questions, each carries 15 marks

4 a) Determine the exponential Fourier series representation of half wave rectified sine wave as shown in the figure below. (10)



b) State and prove the Parseval's theorem for continuous time Fourier transforms. (5)

5 a) Let f(t) be a signal with the spectrum as shown below.



(2)

(i) What is the Nyquist frequency (in Hz) of the signal f(t)? (6)

(ii) Suppose the signal is sampled by an impulse train $\delta_{Fs}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT)$ where T is the sampling period and Fs is the sampling frequency. Sketch the spectrum of the sampled signals with (A) Fs = 200 Hz and (B) Fs=400 Hz. (1)

(iii) Specify whether the original signal can be recovered from samples in each case (Fs=200 Hz and Fs=400 Hz).

b) An LTI system has $h(t)$ such that $\mathcal{L}\{h(t)\} = H(s) = \frac{1}{s+1}$, $Re\{s\} > -1$. Determine the system output y(t) if the input is x(t) = $(e^{-t/2} + 2e^{-t/3})\, u(t)$. (6)

6 a) Find the Laplace transform and ROC of the following signals. (9)

(i) $e^{-a|t|}, a > 0$

(ii) $\sin(\omega_0 t + b)e^{-at}u(t)$ a, b *real numbers*

b) Let $\mathbf{F}(\omega) = \mathcal{F}\{f(t)\}$. Determine the Fourier transform of $g(t) = f(at - b)$ in terms of $F(\omega)$ where $a \neq 0$, a, b *real*. Handle the cases for $a > 0$ *and* $a < 0$ separately. (6)

PART C

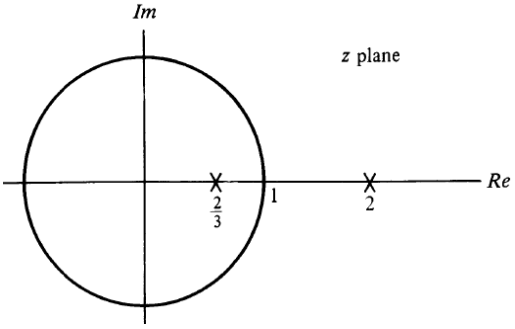
Answer any two questions, each carries 20 marks

7 a) Find the Z transform and ROC of the following signals. (5)

(i) $x[n] = 2^n u[n]$

(ii) $\delta[n]$

b) Pole zero plot for Z transform X(z) of a discrete time signal x[n] shown below. (6)



Determine the ROC in each of the following cases.

(i) x[n] is right sided

(ii) Fourier transform of x[n] converges

(iii)x[n] is left sided

c) Determine the DTFS coefficients for the discrete time signal (9)

$x[n]=\cos(\frac{2\pi n}{3})+ \sin(\frac{2\pi n}{7})$

Also plot the magnitude and phase spectra.

8 a) Consider a LTI system characterised by input output relationship

$$y[n] - \frac{1}{4}y[n-1] = x[n] + \frac{1}{6}x[n-1]$$ (2)

(i) Compute the system function H(z). (2)

(ii) Sketch the possible ROCs for H(z).

(iii)Compute the impulse response h[n] if it is known that impulse response is left sided. (4)

b) Consider a system with impulse response $h[n] = (0.5)^n u[n]$.

(i) Determine the system function $H(e^{j\omega})$ (4)

(ii) If the input $x[n] = \cos(\frac{n\pi}{2})$, determine the output y[n]. (8)

9 a) List any four properties of Z-transform, state and prove the convolution property of Z transforms. (10)

c) A signal $x(n)$ has DTFT $X(e^{j\omega}) = \frac{1}{1-ae^{-j\omega}}$, |a|<1. Determine the DTFT of $x[n+2]\ e^{j\frac{\pi}{2}n}$. (4)

d) Determine the DTFT of the signal x[n]=u[n]-u[n-N] (6)

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