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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100

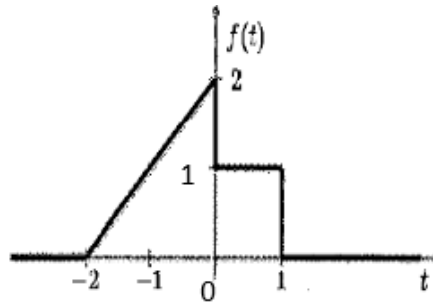
Duration: 3 Hours

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 $f(t)$.

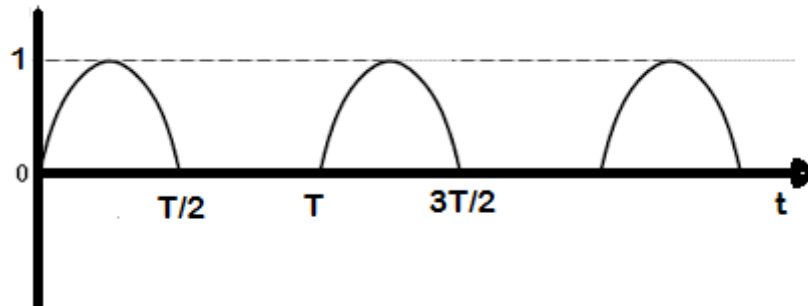


- c) Check whether the following systems are linear and stable. (6)
- (i) $y(t) = e^{x(t)}$
- (ii) $y[n] = x[n - 1]$
- 2 a) Let $f(t) = 2(u(t) - u(t - 2))$ and $g(t) = e^t(u(t) - u(t - 2))$
- (i) Sketch the functions $f(t)$ and $g(t)$ (2)
- (ii) Compute $f(t) * g(t)$. Here * denotes convolution. (7)
- 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)
- ↑
- 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) $x[n] = u[n]$

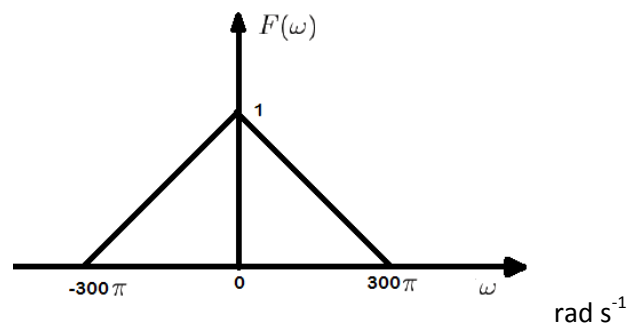
PART B

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.



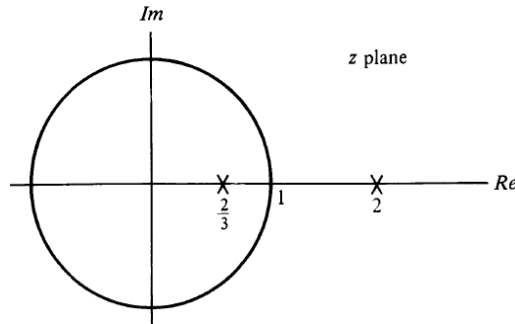
- (i) What is the Nyquist frequency (in Hz) of the signal $f(t)$? (6)
- (ii) Suppose the signal is sampled by an impulse train $\delta_{F_s}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT)$ where T is the sampling period and F_s is the sampling frequency. Sketch the spectrum of the sampled signals with (A) $F_s = 200$ Hz and (B) $F_s = 400$ Hz. (1)
- (iii) Specify whether the original signal can be recovered from samples in each case ($F_s = 200$ Hz and $F_s = 400$ Hz).
- b) An LTI system has $h(t)$ such that $\mathcal{L}\{h(t)\} = H(s) = \frac{1}{s+1}$, $\text{Re}\{s\} > -1$. 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 $F(\omega) = \mathcal{F}\{f(t)\}$. 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)
- $x[n] = 2^n u[n]$
 - $\delta[n]$

- 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.

- $x[n]$ is right sided
 - Fourier transform of $x[n]$ converges
 - $x[n]$ is left sided
- c) Determine the DTFS coefficients for the discrete time signal (9)
- $$x[n] = \cos\left(\frac{2\pi n}{3}\right) + \sin\left(\frac{2\pi n}{7}\right)$$

Also plot the magnitude and phase spectra.

- 8 a) Consider a LTI system characterised by input output relationship (2)
- $$y[n] - \frac{1}{4}y[n-1] = x[n] + \frac{1}{6}x[n-1]$$
- Compute the system function $H(z)$. (2)
 - Sketch the possible ROCs for $H(z)$.
 - Compute the impulse response $h[n]$ if it is known that impulse response is left sided. (4)
- b) Consider a system with impulse response $h[n] = (0.5)^n u[n]$.
- Determine the system function $H(e^{j\omega})$ (4)
 - If the input $x[n] = \cos\left(\frac{n\pi}{2}\right)$, 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 (4)

$$x[n+2] e^{j\frac{\pi}{2}n}$$

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