

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

**Course Code: EE307**

**Course Name: SIGNALS AND SYSTEMS (EE)**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 5 marks*

Marks

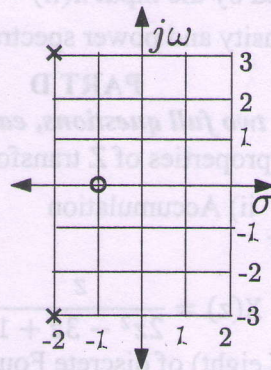
- 1 Check the Linearity and Time-invariance of the system  $y(t) = t^2x(t)$ , where  $y(t)$  and  $x(t)$  are the output and input respectively. (5)
- 2 Define Laplace transform and show that  $\mathcal{L}\left(\frac{df(t)}{dt}\right) = s\mathcal{L}(f(t)) - f(0)$  (5)
- 3 State and prove the following properties of Fourier transform: (5)
  - i) Time shift
  - ii) Time scaling
- 4 Find the solution of the difference equation. (5)
 
$$y(n+1) + 2y(n) = n, y_0 = \frac{8}{9}$$
- 5 Find Z transform of the sequences: (5)
  - i)  $x_1[n] = \{3, -2, 0, 4, 2\}$
  - ii)  $x_2[n] = a^{-n}u(-n-2)$
- 6 Find inverse Z transform of  $X(Z) = \log\left[\frac{1}{1-az^{-1}}\right]$  (5)
- 7 What is a random signal? Explain with an example. (5)
- 8 State and prove the discrete Fourier transform property phase shifting. (5)

**PART B**

*Answer any two full questions, each carries 10 marks*

- 9 a) The pole-zero plot of a system is shown in Figure 1. Obtain the differential equation model of the system. (3)

Figure 1.



- b) Obtain the unit step response of the system represented by Figure 1. (No plot is required). (7)



- 10 a) Obtain the differential equation representation of the circuit shown in Figure 2. (4)

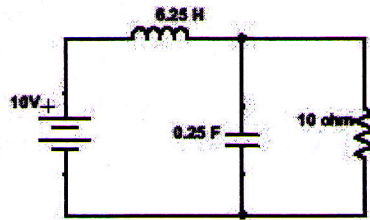


Figure 2.

- b) Using Laplace transform, solve the differential equation obtained for Qn. 10(a) and get voltage across the capacitor. (Assume all initial conditions are zeros). (6)
- 11 a) Find  $x(t) * h(t)$  where,  $x(t) = u(t) - u(t - 2)$ ,  $h(t) = e^{-2t}u(t)$  and  $*$  represents the convolution operator. (5)
- b) How will you determine the stability of a system from its transfer function? Comment on the stability of the following systems: (5)
- i)  $G_1(s) = \frac{s-2}{s^2+6s+18}$       ii)  $G_1(s) = \frac{s-2}{s^2+18}$

### PART C

*Answer any two full questions, each carries 10 marks*

- 12 a) Obtain complex exponential Fourier series of the signal  $x(t)$  shown in Figure 3. (5)

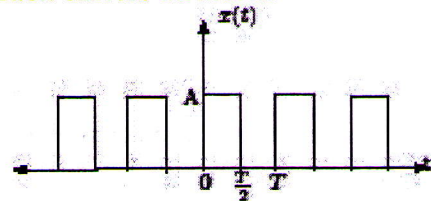


Figure 3.

- b) Find the Fourier transform of  $e^{-a|t|}$  (5)
- 13 State and prove sampling theorem. (10)
- 14 a) The impulse response of a system is given by  $h(n) = [2 \ 3 \ 1]$ . Find the response of the system when it is excited by the input  $x(n) = u(n - 1) - u(n - 5)$  (6)
- b) Explain energy spectral density and power spectral density. (4)

### PART D

*Answer any two full questions, each carries 10 marks*

- 15 a) State and prove following properties of Z transform: (6)
- i) Multiplication by n      ii) Accumulation      iii) Convolution
- b) Find inverse z transform of (4)
- $$X(z) = \frac{z}{2z^2 - 3z + 1}, |z| < \frac{1}{2}$$
- 16 a) State the properties (atleast eight) of discrete Fourier transform (no proof is required). (6)
- b) Obtain Discrete Fourier transform of the following signals: (4)
- i)  $x[n] = 0.5^n u[n]$       ii)  $x[n] = 0.5^{|n|}$
- 17 a) Determine the stability of the following discrete transfer function: (5)
- i)  $H_1(z) = \frac{z}{z^2 + 0.7z + 0.1}$       ii)  $H_2(z) = \frac{z}{z^2 + 2.5z + 1}$
- b) Give any five properties of nonlinear systems. (5)

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