Roll. No.: .....

Name: .....

GOVT. COLLEGE OF ENGINEERING, KANNUR.

Department of Electronics and Communication Engineering

Fourth Semester Second Series Examination July- 2022 (2019 Scheme)

Course code: ECT 204

Course Name: Signals and Systems

Max. Marks: 50 Duration: 1.5 Hours

PART A

Answer all questions. Each question Carries 3 marks

1. Using Laplace Transform, check the causality and stability of the following system having impulse response

   $h(t) = -e^{t}u(-t)$ [CO2]

2. Define the sampling theorem, Nyquist rate and Nyquist frequency [CO5]

3. Derive the relationship between Laplace Transform and Fourier Transform [CO2]

4. Define and derive the Parseval's theorm of DTFS [CO2]

5. Compute the Laplace Transform of the signal

   $x(t) = e^{-a(t-1)}u(t-1)$ [CO2]

PART B

Answer one question from each module. Each question carries 14 marks

Module 3

6 a) Determine a differential equation description for a system with the following transfer function

$$\frac{2(s-2)}{(s+1)^2\ (s+3)}$$ [CO4] (6)

b) A stable system has the indicated input x(t) and output y(t). Use Laplace Transform to determine the transfer function and impulse response of the system

$x(t) = e^{-2t}u(t)$, $y(t) = -2e^{-t}u(t) + 2e^{-3t}u(t)$

OR [CO4] (8)

7 a) An arbitrary band-limited Continuous signal x(t) is sampled with an impulse train. With spectral details, explain how the original signal is reconstructed from the sampled signal. [CO5] (8)

b) Determine whether the system described by the following system is

1) Both causal and stable .

2) Whether a causal and stable inverse systems exist or not?

H(s) =

$$\frac{(s+1)(s+2)}{(s+1)(s^2+2s+10)}$$

ROC: Re(s) > -1

{Hint: For an inverse system, all zeroes should be in LHP} [CO2] (6)

Module 4

8 a) Evaluate the DTFS coefficients for the following signal by the method of inspection.

$$x[n] = 2\sin\left(\frac{4\pi}{19}n\right) + \cos\left(\frac{10\pi}{19}n\right) + 1$$

[CO2] (7)

b) Determine frequency response and impulse response for the system described by the following difference equation

$$y[n] - (1/4)\,y[n-1] - (1/8)\,y[n-2] = 3x[n] - (3/4)\,x[n-1]$$ [CO4] (7)

OR

9 a) Compute the time domain signal represented by the following DTFS coefficients by the method of inspection

$$X[k] = 2j\sin\left(\frac{4\pi}{19}k\right) + \cos\left(\frac{10\pi}{19}k\right)$$

[CO2] (7)

b) We have

$$x[n] = n(3/4)^{|n|} \xleftrightarrow{\text{DTFT}} X(e^{j\Omega}),$$

Without evaluating $X(e^{j\Omega})$, find y[n], if $Y(e^{j\Omega})$ is given by

1) $Y(e^{j\Omega}) = \frac{d}{d\Omega}X(ej\Omega)$

2) $Y(e^{j\Omega}) = X(e^{j\Omega}) * X(e^{j(\Omega - \pi/2)})$

[CO2] (7)

Module 2

10. Use the duality property to evaluate Inverse FT of

$e^{-2\omega}u(\omega)$ [CO2] (7)

OR

11 Determine the bilateral Laplace transform and the corresponding ROC for the following signal , $x(t) = e^{-t/2}u(t) + e^{-t}u(t) + e^{t}u(-t)$

[CO2] (7)

Course Outcome (CO)

Sl No.	Description	Questions No.s
ECT204.CO1	Apply properties of signals and systems to classify them	
ECT204.CO2	Represent the signal with the help of series and transforms	1,3,4,5,7b,8a, 9,10 and 11
ECT204.CO3	Describe the orthogonality of the signal and convolution integral	
ECT204.CO4	Apply transfer function to compute the LTI response to input signals	6,8b

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Pages: 4

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination June 2022 (2019 scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1. Sketch the signal $x(t) = [e^{-t}u(t)] \sum_{n=-\alpha}^{\alpha} \delta(t - nT)$ where T is any positive integer. 3

2. What is the output sequence of an LTI system with impulse response h(n)=[2 , 2] to the input x(n)=[1, 2,3, 1]? 3

3. State the Dirichlet's conditions for the convergence of Fourier series. 3

4. Prove time-shifting property of Laplace transform. 3

5. A continuous time signal $x(t) = cos\, 40t - cos\, 60t$ is sampled with a time period T. Can $x(t)$ be recovered from the samples $x(nT)$ for $= \pi/30$? State the reason for the same. 3

6. Find the frequency response $H(\omega)$ and impulse response of an LTI system characterized by the differential equation 3

$$\frac{dy(t)}{dt} + ay(t) = x(t); a > 0$$

7. Define Energy Spectral Density of a discrete time signal? How can you relate it to the DTFT of the signal? 3

8. Determine the Fourier series coefficients of the signal 3

$x(n) = 2 + \cos\left(\frac{\pi}{3}n + \frac{\pi}{4}\right)$.

9. If the ROC of system function of an LTI system is |z| >0.8, comment on the stability and causality of the system with proper justification. 3

10. Give the relation between DTFT and z-transform of a discrete time signal. 3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Determine whether the following system is static , time invarient, linear and causal. (x and y denote input and output respectively). Give explanation for each. 8

$$y(t) = t^2\, x(t) + x(t-2)$$

b) Check whether the following signals are energy or power signals. 6

i) $x(t) = e^{-a|t|}$; a>0

ii) $x(t) = tu(t)$

12 a) Find the output of an LTI system with impulse response h(t) to the input x(t). 8

Given $x(t) = u(t) - u(t-2)$ and h(t) is shown in Figure 1.

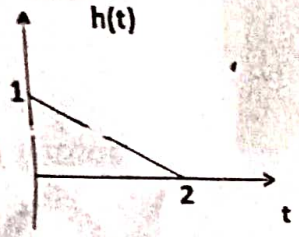

Figure 1

b) Sketch the signals (i) $y(t) = u(0.5t + 2)$ (ii) $y(n) = u(n) + u(n-5)$ 6

Module -2

13 a) 8

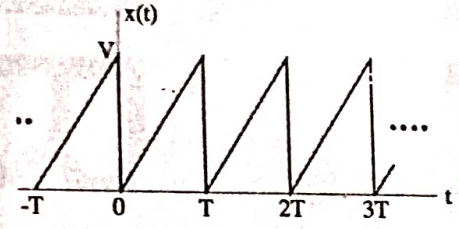

Figure 2

Find the complex exponential Fourier series of the periodic signal shown in Figure 2.

b) If $x(t)$ has a Fourier Transform , find the Fourier Transform of 6

i) $x_1(t) = x(4t-3)$

ii) $x_2(t) = \frac{d}{dt}x(t-3)$

14 a) Find the Fourier Transform of the signal $x_1(t)$ shown in Figure 3 using convolution property and time shift property of Fourier Transform. 8

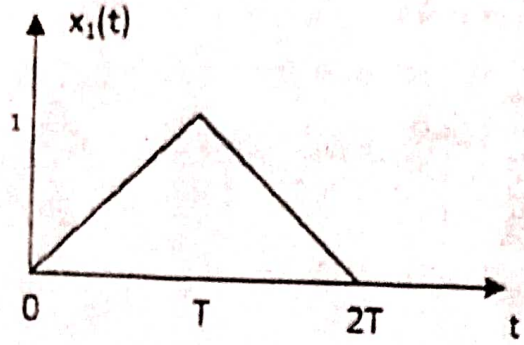

Figure 3

b) Find the Laplace Transform and ROC of the signal 6

$$x(t) = (e^{-2t} + 3e^{-3t})u(t)$$

Module -3

15 a) Find the impulse response and step response of a system with transfer function 7

$$H(s) = \frac{3s}{2s^2 + 10s + 12}$$

b) Determine the Nyquist rate of sampling for the signals 7

i) $x(t) = cos\ (150\pi t)\sin\ (50\pi t)$

ii) $x(t) = sin(150\pi t) + sinc^2\ (150\pi t)$

16 a) A continuous time LTI system is described by the differential equation 7

$$\frac{dy(t)}{dt} + 5y(t) = x(t)$$

Determine the response of the system to the input $x(t) = e^{-2t}u(t)$using Fourier Transform.

b) Consider the continuous time signal $(t) = cos\ (200\pi t) + \sin\ (320\pi t)$. What will be the Nyquist rate of sampling for the signal? If the signal is sampled at 300samples/sec, write the discrete time signal $x[n]$ obtained after sampling. What will be the frequency components at the output if the sampled signal is passed through an ideal low pass filter with cut off frequency 250Hz? 7

Module -4

17 a) Find the DTFT of the following sequences using properties given $x(n)$ has a DTFT $X(e^{j\omega})$ 7

(i) $x_1(n) = x(1-n)$

(ii) $x_2(n) = e^{j\frac{\pi}{4}n}x(n-2)$

b) Consider an LTI system that is characterized by the difference equation 7

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$$

Find the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system.

18 a) Find the DTFT of the given signal $x(n)$ 7

$$x[n] = \begin{cases} 1, & |n| \leq N_1 \\ 0, & |n| > N_1 \end{cases}$$

b) State and prove the convolution property of DTFT. 7

Module -5

19 a) Determine the z-transform for the following signal. Sketch the pole-zero plot and indicate the ROC. 7

$$x(n) = \left(\frac{1}{2}\right)^{n-1} u(n+3)$$

b) For the LTI system with system function H(z) find the impulse response so that the system is stable. 7

$$H(z) = \frac{5 - 10z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Can this system be both stable and causal?

20 a) Find the inverse z-transform of 10

$$X(z) = \frac{2z^2 + 16}{(z+1)(z-2)}$$

for all possible ROCs.

b) Write down any four properties of ROC for Z transform. 4

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