Register Number:……..

KUMARAGURU
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B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Third Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

U18ECT3101: Signals and Systems

COURSE OUTCOMES

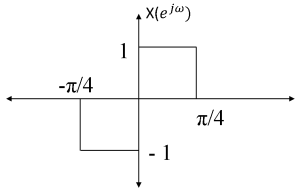
CO1: Distinguish different types of signals and systems.
CO2: Analyze periodic signals using Fourier series.
CO3: Evaluate Continuous Time signals and system by using Fourier Transform.
CO4: Explain sampling of continuous time signals.
CO5: Analyze Discrete Time signals and systems by using DTFT and Z Transform.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Find whether the following signal is periodic or not. If it is periodic find the period. $x[n] = cos\left(\frac{\pi}{2}n\right) cos\left(\frac{\pi}{4}n\right)$.	CO1	[K3]
2.	Impulse response of a LTI system is given by $h[n] = \left(-\frac{1}{3}\right)^n u(n)$. Discuss the causality and stability property of the system with justification.	CO1	[K3]
3.	What is the condition for the existence of Fourier Series of a continuous time signal?	CO2	[K2]
4.	Find and sketch the Fourier Transform of a periodic impulse train $x[n] = \sum_{k=-\infty}^{\infty} \delta[n - kN]$	CO5	[K3]
5.	For a real and odd periodic signal with period N=7 the spectral coefficients are a_K. Given that $a_1 = j, a_2 = 2j, a_3 = 3j$, determine the values of a_{-1}, a_{-2} *and* a_{-3}.	CO2	[K3]
6.	Find the CTFT of $\delta(t)$. Using duality property find the inverse FT of $\delta(\omega)$.	CO3	[K3]
7.	A signal represented by x(t) =5cos 400πt is sampled at a rate 300 samples/sec. The resulting samples are passed through an ideal low pass filter of cut-off frequency 150 Hz. Which frequencies will be present at the output of the LPF?	CO4	[K4]
8.	Let an input $[n]$ having discrete time Fourier transform $X(e^{j\Omega}) = 1 - e^{-j\Omega} + 2e^{-3j\Omega}$ be passed through an LTI system. The frequency response of the LTI system is $H(e^{j\Omega}) = 1 - \frac{1}{2}e^{-2j\Omega}$. Find the output y[n] of the system.	CO5	[K4]

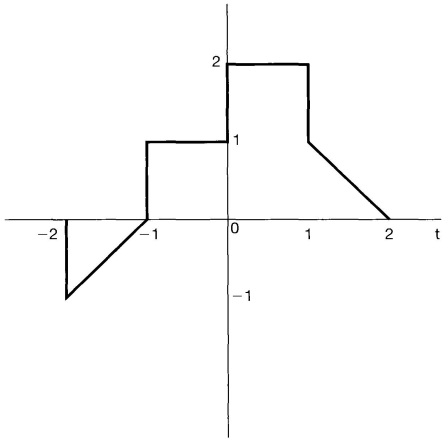
9. The DTFT of x[n] in the range [-π, π] is given in the figure. Find the energy of the signal CO5 [K4]

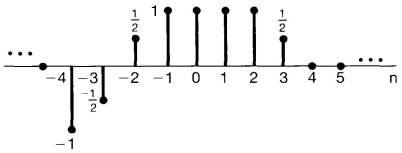


10. $x[n] = u[n-2] * \left(\frac{2}{3}\right)^n u[n]$, using convolution property find the Z transform of x[n] CO5 [K4]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) For the given signal x(t) and x[n] draw the following. 10 CO1 [K3]





i. $x[4-n]$ *ii.* $x[3n+1]$ *iii.* $x\left(4-\frac{t}{2}\right)$ *iv.* $x(t)\,\delta\left(t-\frac{3}{2}\right)$

v. Even and Odd components of x[n]

b) Sketch the waveform $x(t) = r(t+5) - r(t+4) - r(t-4) + r(t-5)$. The signal x(t) is applied to a differentiator given by $y(t) = \frac{d}{dt}x(t)$. Sketch y(t). Is y(t) energy signal or power signal. Justify. 6 CO1 [K4]

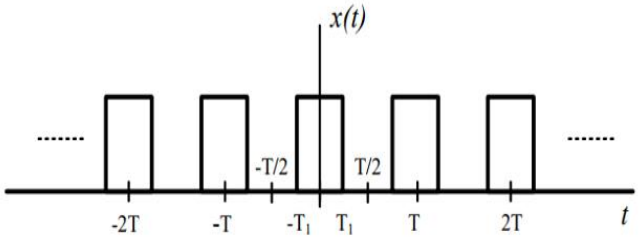
12. a) Two LTI systems are connected in cascade with the impulse response $h1[n] = \left(\frac{1}{2}\right)^{n-2} u(n-2)$ *and* $h2[n] = u(n+2)$. Find the output of this cascade system for the input $x(n) = \delta(n)$. 10 CO1 [K3]

b) For the following input output relationship, find the properties of the system. 6 CO1 [K3]

i) $y(t) = t^2 x(t-1)$ *ii)* $y[n] = x[n^2]$+x[n]

13. a) Determine the Fourier series coefficients for the periodic square wave x(t) shown in the Figure, which is defined over one period as: 8 CO2 [K3]

$$x(t)=\begin{cases} 1, & |t| < T1 \\ 0, & T1 < |t| < T/2 \end{cases}$$



b) A causal LTI system is defined by the frequency response $H(j\omega) = \frac{j\omega+4}{6-\omega^2+5j\omega}$ 8 CO3 [K4]

i. Find the impulse response h(t) of the System.
ii. Find the differential equation representing the system
iii. Find the output of the system for $x(t) = e^{-5t}u(t)$

14. a) The signal $x(t) = \cos(30000\pi t)$ is to be converted to digital using ADC with Sampling frequency 10 CO4 [K4]

1. 40 KHz
2. 60 KHz
3. 20 KHz

Draw the spectrum of the sampled signal. This of these samples will lead to a proper reconstruction. Why?

b) State and Prove sampling theorem for a band limited signal. 6 CO4 [K2]

15. a) Find the DTFT of the signal 8 CO5 [K3]

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

$$x[n]=a^n\cos(\omega_0 n)u(n) \quad |a|<1$$

b) Consider a system consisting of cascade of two LTI systems with over all frequency response 8 CO5 [K3]

$$H(e^{j\omega})=\frac{1}{1-\frac{7}{12}e^{-j\omega}+\frac{1}{12}e^{-j2\omega}}$$

Find the following

i) impulse response of the overall system

ii) impulse response $h_2(n)$ given $h_1[n] = \left(\frac{1}{4}\right)^n u[n]$

16. a) A second order system is described by a difference equation $y[n] - 0.6y[n-1] - 0.16y[n-2] = 5x[n]$. Find (Using ƶ - transform) — 10 — CO5 — [K4]

i. The system function

ii. Impulse Response

iii. Output of the system for the input $x[n] = (0.2)^n u[n]$

iv. Discuss the causality and stability property of the system.

b) What is Region of Convergence? Discuss the properties of RoC — 6 — CO5 — [K2]

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