



B.E DEGREE EXAMINATIONS: NOV/DEC 2022

(Regulation 2018)

Third Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

U18ECT3101: Signals and Systems

PART A (10 x 2 = 20 Marks)

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|--|-----|-------------------|
| 1. Find whether the given signal $x(n) = \sin\left(\frac{3\pi}{7}n\right) + \cos\left(\frac{\pi}{3}n\right)$ is periodic or aperiodic. | CO1 | [K ₁] |
| 2. Classify the unit step signal as power or energy signal. | CO1 | [K ₂] |
| 3. Show that $x[n] * u[n] = \sum_{k=-\infty}^n x[k]$ | CO1 | [K ₂] |
| 4. List the Dirichlet's conditions for convergence of Fourier Series. | CO2 | [K ₁] |
| 5. Evaluate the CTFT of $x(t) = 7\delta(t-2) + 7\delta(t+2)$ | CO3 | [K ₃] |
| 6. Find the CTFT of $y(t) = x(t) \cos(\omega_0 t)$. | CO3 | [K ₂] |
| 7. What is the Nyquist sampling frequency of a band limited signal $x(t) = 3\cos(200\pi t)$. | CO4 | [K ₁] |
| 8. List any two properties of ROC. | CO5 | [K ₁] |
| 9. Find the Inverse DTFT of $X(e^{j\omega}) = e^{j\omega} + 1 + 3e^{-j\omega} + 7e^{-2j\omega}$ | CO5 | [K ₁] |
| 10. Determine the Z Transform and ROC of $x(n) = (0.3)^n u(n)$ | CO5 | [K ₄] |

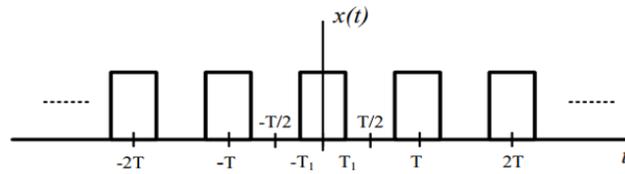
Answer any FIVE Questions:-

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

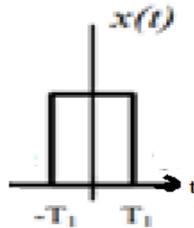
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|---|---|-----|-------------------|
| 11. a) Examine the Linearity, Time invariant, Causality and Stability properties of the system $y(t) = [A+x(t)] \cos(2\pi f_0 t)$. | 8 | CO1 | [K ₄] |
| b) Apply convolution integral to obtain the output response of the system with impulse response $h(t) = u(t)$ for the input $x(t) = e^{-2 t }$. | 8 | CO1 | [K ₃] |
| 12. a) Apply the Fourier Series analysis for the periodic square wave signal $x(t)$ as sketched in Figure shown below, which can be defined over one period as: | 8 | CO2 | [K _L] |

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



- b) Demonstrate the following properties of the Discrete Time Fourier Series with appropriate proofs. 1. Linearity 2. Time Shifting 3. Convolution (8) CO2 [K₃]

13. a) (i) Choose appropriate transform to obtain the frequency domain representation of the signal x(t) shown below. (4+4) CO3 [K₃]



(ii) The Fourier Transform $X(j\omega)$ of a signal $x(t)$ is obtained as a rectangular pulse with amplitude A over a range of frequency from $-\omega_1$ to ω_2 . Extend the Fourier Transform concept to synthesize $x(t)$ from $X(j\omega)$.

- b) A system is described by the differential equation (8) CO3 [K₂]

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$$

Solve this equation to obtain the Frequency Response and Impulse Response of this system.

14. a) Recall Sampling Theorem. Make use of mathematical analysis and proper illustrations, demonstrate, and prove the Sampling Theorem for band limited signal. (8) CO4 [K₂]

- b) Explain how the analog signal is reconstructed from its samples. (8) CO4 [K₂]

15. a) A causal LTI system whose input $x(n)$ and output $y(n)$ are related through the second-order difference equation (16) CO5 [K₃]

$$y[n] - \frac{1}{6}y[n-1] - \frac{1}{6}y[n-2] = x[n]$$

- (i) Find the transfer function $H(Z)$
(ii) Evaluate the impulse response $h[n]$ of the system.
(iii) Find the output response for input $x(n)=u[n]$

16. a) Find the inverse Z transform of $X(z) = \frac{z}{(2z^2 - 3z + 1)}$ for ROC $|z| > 1$ using 8 CO5 [K₂]

Long Division method.

b) 1. Given $x(n) = \{1, 2, 3, 4, 7\}$. Find Z transform and ROC of $x(n)$ and Z transform of $x(n-2)$ using properties of ZT. 4+4 CO5 [K₃]

2. Find the Z transform and its ROC for the discrete sequence given below.

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