Code No: R1621043 **R16** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2018
SIGNALS & SYSTEMS
(Com to ECE, EIE and ECC)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Determine whether the sequence is periodic or not. $x_2(n)$ = sin(n/8). (2M)
   b) Obtain the Fourier transform of the impulse function δ(t) (2M)
   c) Define aliasing. (2M)
   d) State the properties of power spectral density. (2M)
   e) Determine the function of time x(t) of the Laplace Transform and the ROC $\frac{s}{s^2+9}$ (3M)
   f) Find the Z-transform of the sequence u[n] (3M)

PART –B

2. a) Define orthogonal signal space and bring out clearly its application in representing a signal. (5M)
   b) Obtain the condition under which two signals f1(t) and f2(t) are said to be orthogonal to each other. Hence prove that Sin nw_ot and Cos mw_ot are orthogonal to each other for all integer values of m,n (9M)

3. a) Derive the necessary expression to represent the function f(t) using Trigonometric Fourier Series. (7M)
   b) Bring out the relationship between Trigonometric and Exponential Fourier series. (7M)

4. a) Explain briefly impulse sampling. (7M)
   b) Define sampling theorem for time limited signal and find the Nyquist rate for the following signals. (7M)
      i. rect300t
      ii. -10 sin 40πt cos 300πt

5. a) Explain how input and output signals are related to impulse response of a LTI system. (7M)
   b) Explain the characteristics of an ideal LPF. Explain why it can't be realized. (7M)
   c) Differentiate between signal bandwidth and system bandwidth. (7M)
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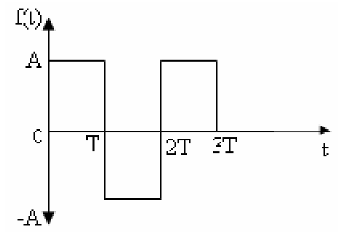
6. a) State and Prove Initial value and Final value theorem with respect to Laplace transform. (7M)

   b) Find the Laplace transform of the periodic rectangular wave shown in Figure. (7M)



Figure

7. a) State and prove the convolution and scale change properties in Z transform (6M)

   b) Prove that the final value of x(n) for X(z) = $z^2/[z-1][z-0.2]$ is 1.25 and its initial value is unity. (8M)

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PART –A

1. a) Determine the continuous time version of a sinusoidal signal and bring out the relation between sinusoidal and complex exponential signals. (2M)
b) State and represent the time differentiation property of Fourier transform. (2M)
c) Define flat top sampling. (2M)
d) State the relations between convolution and correlation. (2M)
e) Determine the function of time x(t) of the Laplace Transform and the ROC $\frac{1}{s^2+9}$ (3M)
f) Find the Z-transform of the sequence u[-n] (3M)

PART –B

2. a) Derive the expression for component vector of approximating the function $f_1(t)$over $f_2(t)$ and also prove that the component vector becomes zero if the $f_1(t)$ and $f_2(t)$ are orthogonal. (7M)
b) A rectangular function f(t) is defined by (7M)
f(t) = 1 for $0<t<\pi$
= -1 for $\pi<t<2\pi$
Approximate this function by a waveform *sin*t over the interval (0, 2π) such that the mean square error is minimum

3. a) Define Hilbert Transform. What is its significance. (7M)
b) Determine the Hilbert Transform of the signal x(t) = cost3t. (7M)

4. a) State and Prove the sampling theorem for Band limited signals. (7M)
b) Discuss the effect of aliasing due to under sampling (7M)

5. a) Determine an expression for the correlation function of a square wave having the values 1 or 0 and a period T. (6M)
b) The signal $V(t) = \cos \omega_o t + 2\sin 3\omega_o t + 0.5 \sin 4\omega_o t$ is filtered by an RC low pass filter with a 3 dB frequency, $f_c = 2f_o$. Find the output power S_o. (6M)
c) State Parseval's theorem for energy / power signals. (2M)
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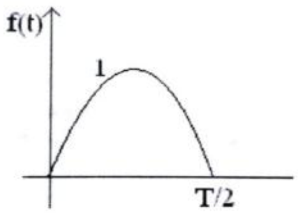
Code No: R1621043 **R16** SET - 2

6. a) Derive the relation between Laplace Transform and Fourier Transform. (7M)
   b) Determine the Laplace transform of signal shown in figure (7M)



7. a) Using scaling property determine the Z-transform of $a^n \cos\omega n$ and find its ROC. (6M)
   b) Using differentiation property find the Z-transform of $x(n) = n^2u(n)$. (4M)
   c) Obtain the Z-transform of $x(n) = -a^nu(-n-1)$ (4M)

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2. Answer **ALL** the question in **Part-A**
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PART –A

1. a) Write short notes on orthogonal functions. (2M)
b) Obtain the Fourier transform of the DC signal (2M)
c) What is the effect of under sampling. How can it be reduced. (2M)
d) Differentiate between causal and non causal systems. (2M)
e) State the initial value theorem of Laplace Transform. (3M)
f) Distinguish between one sided and two sided z transforms. (3M)

PART –B

2. a) Define and sketch the following signals (8M)
i) Truncated Exponential signal
ii) Delayed Unit impulse function
iii) Unit parabolic function
iv) Sinc function.
b) Define and sketch the unit step function and signum function. Bring out the relation between these two functions (6M)

3. a) Compute the Fourier Transform of (7M)
i) $f(t) = (1/2)\text{-}nu(-n-1)$
ii) $f(t) = \sin(n\pi/2)+\cos(n)$
b) State all the properties of Fourier Transform. (7M)

4. a) The signal $x(t)$ with Fourier transform $X(j\omega) = u(\omega + \omega_0) - u(\omega - \omega_0)$ can undergo impulse train sampling without aliasing, provided that the sampling period $T < \pi/\omega_0$. Justify. (7M)
b) A signal $x(t)= 2 \cos 400\pi t + 6 \cos 640\pi t$ is ideally sampled at $f_s = 500$Hz. If the sampled signal is passed through an ideal low pass filter with a cut off frequency of 400 Hz, what frequency components will appear in the output. (7M)

5. a) Explain the process of detection of periodic signals by the process of correlation. (7M)
b) Determine the cross correlation between the two sequences $x(n) = \{1,0,01\}$ and $h(n) = \{ 4,3,2,1\}$ (7M)
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6. a) State the properties of the ROC of LT (6M)

   b) Determine the function of time x(t) for each of the following Laplace Transforms and their associated regions of convergence (8M)

      i) $\frac{(s+1)^2}{s^2-s+1}$ Re$\{S\} > ½$

      ii) $\frac{s^2-s+1}{(s+1)^2}$ Re$\{S\} >$ -1

7. a) Determine inverse Z Transform of x(z) = $\frac{1}{2-4z^{-1}+2z^2}$ by long division method when i) ROC : $|Z| > 1$ ii) ROC : $|Z| < 1$ (7M)

   b) Determine Z Transform of the following (7M)

      i) $(1/4)^4\, u(n) - cos(n\pi/4)\, u(n)$

      ii) $2^n\, u(n-2)$

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Determine whether the sequence is periodic or not. $x_1(n) = \sin(6\pi\ n/7)$. (2M)
   b) Obtain the Fourier transform of the unit step function. (2M)
   c) Define impulse sampling. (2M)
   d) What are the characteristics of an ideal LPF. (2M)
   e) State the properties of Laplace transforms (3M)
   f) Find the Z-transform of the sequence $\delta[n]$. (3M)

PART –B

2. a) Define and sketch the following signals (6M)
   i) Unit Step function
   ii) Unit impulse function
   iii) Signum function
   b) Explain the analogy of vectors and signals in terms of orthogonality and evaluation of constant. (9M)

3. a) Determine the Fourier transform of a two sided exponential pulse $x(t) = e^{-|t|}$ (7M)
   b) Find the Fourier transforms of an even function $x_e(t)$ and odd function $x_o(t)$ of $x(t)$. (7M)

4. Determine the Nyquist sampling rate and Nyquist interval for the given signals.
   a) Sin $c(100\Pi t)$ (3M)
   b) Sin τ $(100\Pi t)$ (3M)
   c) Sin $c(100\Pi t)$ + Sin $c(50\Pi t)$ (4M)
   d) Sin $c(100\Pi t)$ + 3Sin $c^2(60\Pi t)$ (4M)

5. a) What are the requirements to be satisfied by an LTI system to provide distortionless transmission of a signal? (7M)
   b) Bring out the relation between bandwidth and rise time? (7M)
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Code No: R1621043 **R16** SET - 4

6. a) Find inverse Laplace Transforms of the following (8M)
   i) $\frac{s^2+6s+7}{s^2+3s+2}$ Re$\{S\}$ > -1
   ii) $\frac{s^3+2s^2+6}{s^2+3s}$ Re$\{S\}$ > 0
   b) Find the Laplace transform of cos ωt (6M)

7. a) State and prove the properties of the Z-transform (7M)
   b) Find the Z-transform of the following sequence (7M)
   x[u] = a^n u[n]