Time:3 hours   **Marks: 80**

N.B.:1.Question number 1 is compulsory.

      2. Attempt any three of remaining 5 questions.

      3. Figures to the right indicate full marks.

Q1. 1. Define even and odd signals with their conditions and find even and odd   **(20M)**
    components of given signals:

    a) $x(t) = 1 + t + 3t^2 + 5t^3 + 9t^4$ **b)** $x(t) = (1 + t^3)cos^3(10t)$

  2. Explain the time shifting and differentiation property of Laplace transform.

  3. Find the Laplace transform of unit step signal with their ROC

  4. Find the inverse Z transform of the given signal

    $X(z) = \log\left(\frac{1}{1-az^{-1}}\right)$, $|z| > |a|$

Q2.

  1. Find the Fourier transforms of given functions.   **(10M)**

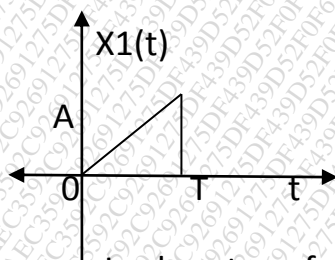   **a)** $x(t) = \frac{d}{dt}[2te^{-2t}u(t)]$ **b)** $x(t) = \int_{-\infty}^{t} e^{-a\tau}u(\tau)d\tau$

  2. Prove following properties: **(10M)**

    a) Convolution property of DT periodic sequences

    b) Parseval's relationship for Fourier series

Q3. 1. Find Laplace transform of following sawtooth pulses: **(8M)**

  2. Find inverse Laplace transform of: $X(S) = \frac{3S+4}{(S+1)(S+2)^2}$ **(6M)**

  3. Derive relationship between Fourier transform and Laplace transform.   **(6M)**

Q4. 1. Determine whether the following systems are memory less, causal, stable, **(10M)**

invariant and linear:

a) $y(n) = x(n) \sum_{k=-\infty}^{\infty} \delta(n - 2k)$ 　　　b) $y(n) = \frac{\sin[x(n)]}{x(n)}$

2. Define and prove properties of cross correlation of energy signals and find **(10M)**

Cross correlation of given signals: x(n)={2,3,4,5} and y(n)={3,2,1,4}

Q5.

1. State following properties of Z transform: **(8M)**

   a) Time shifting property
   b) Differentiation in Z-transform
   c) Time reversal
   d) Convolution in time domain

2. Determine the z-transforms, ROC and poles and zeros of: **(8M)**

   a) $x(n) = 2^n u(n) + 3^n u(-n - 1)$

   b) $x(n) = e^{-3n} u(n)$

3. State and prove relationship between Z transform and DTFT. **(4M)**

Q6.

1. Define and determine linear convolution of: **(6M)**

   $x(t) = u(t + 1) and \ h(t) = u(t - 2)$.

2. For a difference equation of the system is given as **(8M)**

   $y(n) = 0.5y(n - 1) + x(n),$ Determine

   a) System function   b) Pole zero plot of the system function

3. Define standard signals used for system analysis and derive relationship **(6M)**

   between unit step and ramp function.

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