(3 Hrs)   Total Marks: 80

NOTE :
1) Question number 1 is compulsory.
2) Attempt any three questions from the remaining five questions.
3) Assume suitable data wherever necessary.

Q1 a   Check whether the following systems are linear, time variant, causal or otherwise: (5)
     i) $y(n) = x(n) + n * x(n-1)$
     ii) $y(t) = x(t) + 3 x(t+4)$

    b   What is autocorrelation and cross correlation? How is it related to ESD and PSD?   (5)

    c   Find the convolution of the sequences $x_1(n) = x_2(n) = \{1,1,1\}$ using convolution   (5)
     property of Fourier transform.

    d   Verify periodicity of the following continuous time signals. If periodic, find the   (5)
     fundamental period.
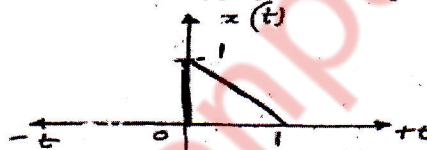   (i) $x(t) = 2 \cos(t/4)$
     (ii) $x(t) = e^{-j2\pi t /7}$

Q2 a   Determine power or energy of the following continuous time signal: (5)
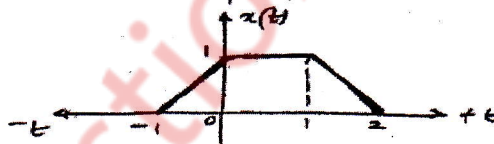
     (i) $x(t) = e^{-2t}.u(t)$
     (ii) $x(t) = 3 \cos(5mt)$

    b   Obtain Laplace transform by using properties of Laplace transform only.   (10)

    c   Explain Gibb's phenomenon.   (5)

**Q3** a   Find the natural response of the system described by the equation   (10)

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 5y(t) = \frac{dx(t)}{dt} + 4x(t) \ ;$$

$$\text{for } y(0) = 1 \ ; \ \left.\frac{dy(t)}{dt}\right| = -2 \text{ at } t=0$$

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b Consider the analog signal $x(t) = 5\cos50\pi t + 2\sin200\pi t - 2\cos100\pi t$. Determine the minimum sampling frequency and the sampled version of analog signal at this frequency. Sketch the waveform and show the sampling points. Comment on the result. **(10)**

Q4 a Convolve the following two signals in time domain and sketch the output: **(10)**
$X(t) = 2(t)*[u(t+2)-u(t-2)]$, $h(t) = u(t) - u(t-4)$

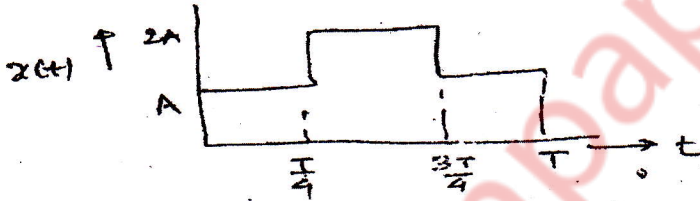b Determine the exponential Fourier series of the given signal. **(10)**
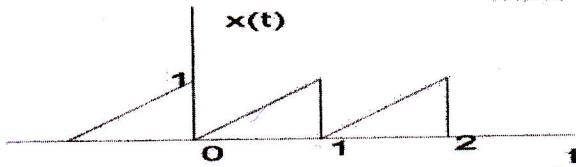
Q5 a Determine inverse Z transform for the following functions: **(10)**
$$X(z) = \frac{1+z^{-1}}{1-z^{-1}+0.5z^{-2}}$$
$$X(z) = \frac{1}{(1+z^{-1})(1-z^{-1})^2}$$

b Obtain Fourier transform by using properties of Fourier transform only. **(10)**

Q6 a) State Initial and Final value theorem of Z-transform and Laplace transform. **(5)**

b) Prove that Energy of a power signal is infinite and Power of an Energy signal is Zero. **(5)**

c) Determine h(n) for all possible ROC conditions. **(10)**

$$H(z) = \frac{z(z^2 - 3z + 11)}{\left(z-\frac{1}{4}\right)(z-4)(z+6)}$$

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