Q2a. (i) Explain the transformations done on the independent variable.

Answer: KEY: I [1(1.2) Page 7-10]

Q2a. (ii) Find out the power of the signal x(t) = A sin t

Answer: KEY: I [1(1.1) Page 5-7]

Power = $\frac{1}{T}\int_{-\infty}^{\infty} x(t)^2 = A^2/2$

Q2b. Define unit Impulse and unit Step functions. Give their relationship.

Answer: KEY: I [1(1.4) Page 32-38]

Q2c. Define Linearity. Find if the following systems are Causal and Linear?

i) y(t)= t x(t)

ii) y(n)= 2 x(n)+3

Answer: KEY: I [1(1.6) Page 53-56]

i) Causal, Linear

ii) Causal, Non-Linear

Q3a. Determine the Fourier Series coefficients of a periodic square wave

$x(t) = \begin{cases} 1 & |t| < T_1 \\ 0 & T_1 < |t| < T/2 \end{cases}$

Answer: KEY: I [Page 193]

$a_0 = ½$; $a_k = 0$ for k= even and for k= odd we have $a_1 = 1/\pi$; $a_3 = -(1/3\pi)$; $a_5 = 1/5\pi$…

Q3b. Give the criteria of convergence of continuous time Fourier series.

Answer: KEY: I [3(3.4) Page 195]

Q4a. Find the Continuous Time Fourier Transform of $x(t) = e^{-at}u(t);\ a > 0$

Answer: KEY: I [4(4.1) Page 290-291]

$X(j\omega) = \frac{1}{a+j\omega}$:

Q4b. Prove the Convolution property of CTFT.

Answer: KEY: I [4(4.4) Page 314-317]

Q5a. Find the DTFT of $x(n) = a^n u(n)$

Answer: KEY: I [5(5.1) Page 362-363]

$$X(j\omega) = \frac{1}{1 - ae^{-j\omega}}$$

Q5b. Find the frequency response of system that is characterized by the difference equation

y (n) - ¾ y (n-1) + 1/8 y(n-2) =2 x(n)

Answer: KEY: I [5(Example 5.19) Page 396-398]

$$H(j\omega) = \frac{1}{1 - \frac{3}{4}\, e^{-j\omega} + \frac{1}{8} e^{-2j\omega}}$$

$$H(j\omega) = \frac{1}{\left(1 - \frac{1}{2}\, e^{-j\omega}\right)\left(1 - \frac{1}{4}\, e^{-j\omega}\right)}$$

$$H(j\omega) = \frac{4}{\left(1 - \frac{1}{2}\, e^{-j\omega}\right)} - \frac{2}{\left(1 - \frac{1}{4}\, e^{-j\omega}\right)}$$

$$h(n) = 4(1/2)^n u(n) - 2(1/4)^n u(n)$$

Q6a. Construct the frequency response of Continuous time ideal low pass filter with that of Discrete time ideal low pass filter.

Answer: KEY: I [6(6.3) Page 439-444]

Q6b. Explain Sampling Theorem. Define Nyquist rate and Aliasing. Illustrate reconstruction of a continuous time signal from its samples.

Answer: KEY: I [7(7.1) Page 515-520]

Q7a. Find out the Laplace Transform of x (t) = δ (t)-4/3e $^{-t}$ u (t) +1/3 e ^{2t} u (t) and sketch the ROC in s plane.

Answer: KEY: I [9(Example 9.1) Page 661-662]

Q7b. Give the properties of ROC of Laplace Transforms.

Answer: KEY: I [9(9.2) Page 662-669]

Q8a. Find the z transform of x(n) = (1/ 3) ^{n} sin ($\frac{\pi}{4}$n)u(n)

Answer: KEY: I [Page 747]

Q8b. Explain the scaling property and Differentiation in z domain property of Z transforms.

Answer: KEY: I [10(10.5) Page 768,772]

Q9a. Give the mathematical definition of random process X(t).

Answer: KEY: II [1(1.2) Page 32-33]

Q9b. What is a Gaussian Process? Give its properties

Answer: KEY: II [1(1.8) Page 54-58]

Text Books

I Signal & Systems, A V Oppenhiem & A S Willsky with S H Nawab, Second Edition, PHI Private Ltd, 2006.

II "Communication Systems" by Simon Haykin, Fourth Edition, Wiley student edition, 7th Reprint 2007.