Indian Institute of Information Technology Sri City, Chittoor

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Subject: Signals and Systems Max.Marks: 60 Exam Type: UG1 sem 2 End sem
Date: 15th July 2022 Time: 9:00 AM Duration: 3 Hours
Instructions:

1. Each question carries 10 marks.
2. Closed Book exam, no formula sheets are allowed.
3. No mobile phones and electronic gadgets are allowed.
4. Calculators are allowed, exchange of the same during the examination is not allowed.
5. All parts of the question must be written in one location.
6. *Attach the question paper with the answer sheet.*

Q1.(a) The signal $x(t) = 4(\frac{1}{2})\left(e^{j0.5t} + e^{-j0.5t}\right) + 2(\frac{1}{2})\left(e^{jt} + e^{-jt}\right)$, determine the fourier coefficients and compute the average power using Parseval's theorem. [5]

(b) The Fourier coefficient of a continuous periodic signal with period T = 10 sec is expressed as

$$a_k = \sum_{k=-5}^{5} |k|\, j^{-k}$$

- Determine the continuous time signal. [5]

Q2. Justify in detail whether the following signals exist Fourier Series/Fourier Transform/Laplace Transform. [10]

(a) $x(t) = \begin{cases} 1 - \frac{|t|}{\tau} & ; |t| < \tau \\ 0 & ; else \end{cases}$

(b) $x(t) = 2\cos(\frac{2}{3}t) + \sin(\frac{2\pi}{5}t)$

(c) $x(t) = t^2 + 2\sin(4t)$

(d) $x(t) = \sin\left(\frac{2\pi}{5}t\right)\cos\left(\frac{4\pi}{3}t\right)$

(e) For $a = 1$ in Fig. 1,

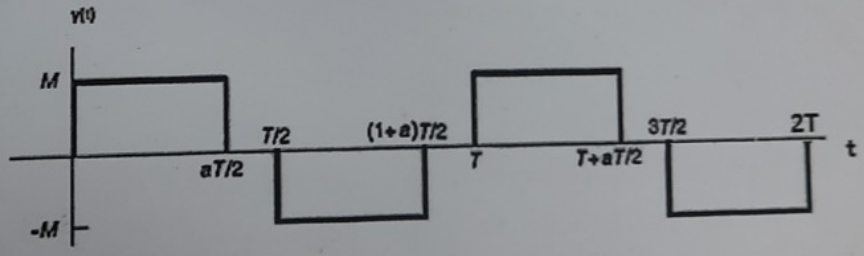

Fig. 1.

Q3.(a). A given signal $g(t) = x(t) + \alpha x(-t)$, where $x(t) = \beta e^{-t}u(t)$. If the Laplace transform of $g(t)$ is $G(s) = \frac{s}{s^2-1}$, -1 < Re{s} < 1, determine the values of α and β. [5]

(b) Determine the Inverse Laplace transform of $X(s) = \frac{2(s+2)}{s^2+7s+12}$ for ROC $Re\{s\} > -3$. [5]

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Q4.(a) For a given signal $y(t) = 12\,cos(600\pi t)\,cos^2(1600\pi t)$, determine the required sampling rate for the ideal reconstruction of the signal at the receiver. Further, if the signal is sampled at a rate of 4600 samples/second, what is the cut-off frequency for the ideal lowpass filter to be considered for ideal reconstruction of the signal at the receiver. [5]

(b) In a sampling system, signals are sampled ideally at the frequency $4\,kHz$ and transmitted over a communication channel. If the input signal is expressed as

$$x(t) = 10\,cos(3000\pi t) + 15\,cos(6000\pi t)$$

(i) Determine the sampled discrete signal. [3]

(ii) What will be the reconstructed analog signal from samples with ideal interpolation? [2]

Q5.(a.) Classify the following signals/systems (Justify in detail): [6]

(i) The input-output of a initially relax LTI system is expressed as $y' - 100y = x' - 100x$. System is stable/not?

(ii) The impulse response of a system is defined as $h(n) = 0.6\,u(n) + u(n+1)$. System is causal/not?

(iii) Write the even and odd component of signal $x[n] = \{0, \frac{2}{\uparrow}, -3, 6\}$.

(b) The input-output of a LTI system is shown in the following Fig.2. Determine the Fourier-Transform of the output. [4]

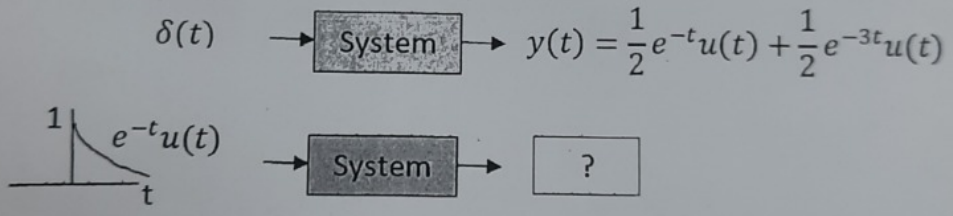

Fig. 2

Q6. Suppose a Seismic signal is represented by $y(t) = A\,rect(\frac{t}{T})\,cos(\omega_c t)$.

Assume that $T.f_c >> 1$.

(a) Evaluate its positive analytic signal. [5]

(b) The spectrum (Fourier-transform) of the analytic signal (a). [5]

— End —