KUMARAGURU
college of technology
character is life

B.E / B.TECH DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Fourth Semester

U13MAT402: SIGNALS AND SYSTEMS

(Common to CSE/EIE/MCT&IT)

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. If the system output doubles with doubling of input, the system is -------

    a) Time-varying   b) Non-linear

    c) memoryless   d) linear

2. The signal   x(t) = 5.cos(2πt)   has ……….. power.

3. The differential equation governing a system with Rand C in parallel is -------

    a) $RC\dfrac{dv(t)}{dt} + v(t) = 0$ b) $C\dfrac{dv(t)}{dt} + v(t) = 0$

    c) $RC\dfrac{dv(t)}{dt} = 0$ d) $RC\displaystyle\int_{-\infty}^{t} v(t)dt + v(t) = 0$

4. The response of a series connected RL circuit to step input is ……………..

5. The spectrum of a periodic signal with fundamental frequency 5 kHz has a line spacing of 0.2ms. If the signal frequency is doubled, the spacing between the lines is -------

    a) 0.1ms   b) 0.4ms

    c) increased   d) decreased

6. The property that states that energy of a time domain signal is equal to the energy of its Fourier coefficients is ……………..

7. If a signal is linearly time shifted, its Fourier transform undergoes --------

    a) Frequency shift   b) Time shift

    c) Phase shift   d) No change

8. ……………..condition has to be satisfied for existence of Fourier transform.

9. The response of a LTI system with impulse response h(t) to an input signal x(t) can be obtained by -------

a) $\int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$

b) $\int_{-\infty}^{\infty} x(t)h(t-\tau)d\tau$

c) $\int_{0}^{\infty} x(\tau)h(t-\tau)d\tau$

d) $\int_{0}^{\infty} h(\tau)x(t-\tau)d\tau$

10. Translation of the spectrum of a signal is equivalent to ……………..in the time domain.

PART B (10 x 2 = 20 Marks)
(Not more than 40 words)

11. The discrete time signal is given by $x(n) = \cos(2\pi n) + \sin(\pi n)$. Find whether it is periodic.

12. Determine whether the given system is time-invariant: $y(t) = x^2(t)$.

13. How will you represent a mechanical spring in a system model?

14. Distinguish between free and forced response of a system.

15. Sketch the spectrum of the signal : $x(t) = 2\cos^2(t)$.(without calculating values)

16. What is the relationship between trigonometric and exponential Fourier series.

17. If the Fourier transform of x(t) is $X(j\omega)$, what is the Fourier transform of x(2t)?

18. A signal $x(t) = \delta(t) + 2 + e^{-t}$. Does Fourier transform exist for x(t)?

19. The differential equation representing a CT system is :

$$\frac{d^2 y(t)}{dt^2} + \frac{dy(t)}{dt} + 5\frac{dx(t)}{dt} = 0$$

Find the transfer function of the system.

20. What is the connection between a linear system stability and its pole locations?

PART C (5 x 14 = 70 Marks)
(Not more than 400 words)

Q.No. 21 is Compulsory

21. Develop the exponential Fourier series for a half wave rectifier output given by

$$x(t) = \begin{cases} A\sin\omega t & 0 \le t < \dfrac{T}{2} \\ 0 & \dfrac{T}{2} \le t < T \end{cases}$$ Sketch the spectrum.

22. a) (i) How will you identify a linear time-invariant system from a non-linear time-variant system using properties? (6)

(ii) Calculate the energy and power in the signal $x(t) = \cos(\pi t)\sin(3\pi t)$. (8)

<div align="center">**(OR)**</div>

b) (i) An open tank with water filled to height H has a control valve at the bottom (8) whose area of opening is varied as a sinusoidal function of time. Analyze the behavior of water flow through the valve.

(ii) A signal x(n) = {0, 1, 2, 3, 4, 4, 4}. Sketch x(n) and x(2n+1). (6)

23. a) (i) Find the state variable representation of a series connected RLC circuit. (8)

(ii) Obtain the time response of the above system. When it is suddenly connected to (6) a DC power source.

<div align="center">**(OR)**</div>

b) (i) Use state variable techniques to find the impulse response of the system (10) described by :

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + x(t)$$

(ii) Write the state equations for a series connected RL circuit. (4)

24. a) Determine the Fourier transform of $x(t) = \begin{cases} 1-|t|, & |t| \leq 1 \\ 0 & , otherwise \end{cases}$ and hence calculate power of the signal using Parseval's theorem.

<div align="center">**(OR)**</div>

b) (i) Determine the inverse Fourier transform of : (8)

$$X(j\omega) = \frac{-j\omega}{(j\omega)^2 + 3j\omega + 2}$$

(ii) State and prove differentiation and integration properties of Fourier transform. (6)

25. a) (i) Determine the impulse response of the system if the output of the system is (8)

$$y(j\omega) = \frac{1/4}{(j\omega+1)} + \frac{1/2}{(j\omega+1)^2} - \frac{1/4}{(j\omega+3)} \text{ and input is}$$

$$x(j\omega) = \frac{1}{(j\omega + 1)}$$

(ii) Summarize the properties of analog filters. (6)

<div align="center">**(OR)**</div>

b) (i) Sketch the Bode diagram for the following transfer function : (8)

$$H(s) = \frac{10}{(s + 1)(s + 2)(s + 5)}$$

(ii) Is the above system stable? Justify your answer. (6)

<div align="center">*************</div>