Department of ECE

B. Tech Mid Question Bank (R22 Regulation)

Academic Year: 2024-25 **Semester: III**

Subject Name: Signals and Systems

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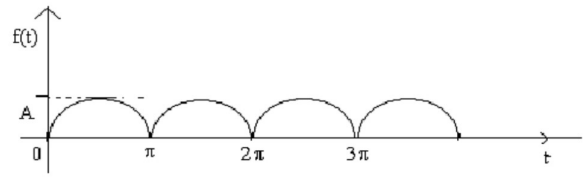
PART-A

MID-I Questions					
Q.No	**Questions**	**Marks**	**BL**	**CO**	**Unit No**
1	Define Complete or closed set of signals.	2M	L1	CO1	1
2	Show that the following signals $f1(t) = sin(nwt)$ and $f2(t) = cos(mwt)$ are orthogonal over an interval [0 2π].	2M	L1	CO1	1
3	Approximate a Rectangular signal in terms of sin(t). So, that the energy of the error signal is minimum.	2M	L1	CO1	1
4	List methods of representing discrete time signals.	2M	L1	CO1	1
5	Define Nyquist rate and Nyquist interval with one example.	2M	L1	CO1	1
6	Calculate the Nyquist's frequency of the signal x(t)=3cos(50Πt) + 10sin(300Πt) – cos(100Πt)	2M	L1	CO1	1
7	Distinguish between Trigonometric Fourier series and Cosine Fourier series.	2M	L1	CO2	2
8	State Dirichlet's conditions.	2M	L1	CO2	2
9	Compute the Fourier transform of $x(t) = cos(wt)\, u(t)$	2M	L1	CO2	2
10	State and prove duality property of Fourier transform.	2M	L1	CO2	2
11	Obtain the Fourier transform of u(t).	2M	L1	CO2	2
12	The Fourier series expansion of an odd function contains only sine terms. Justify.	2M	L1	CO2	2
13	Derive the Laplace transform of parabolic function.	2M	L1	CO3	3
14	Define Laplace transform and inverse Laplace transform and write its formulas.	2M	L1	CO3	3
15	The signal "Signum function sgn(t)" is Laplace transformable or not. If not, State the reason.	2M	L1	CO3	3
MID-II Questions					
16	Derive the relation between the Laplace Transform and the Fourier transform of a signal.	2M	L1	CO3	3
17	Define ROC in Laplace Transform and find the ROC for e^{-at} U(t).	2M	L1	CO3	3
18	Find the ROC of x(t) = e^{-2t} u(t) + e^{-3t} u(t).	2M	L1	CO3	3

19	Find the Z-transform and ROC for the signal $x(n)=a^n u(n)$	2M	L1	CO4	4
20	Compare the stability with poles and zeros in the Laplace transform and Z-transform.	2M	L1	CO4	4
21	Obtain the Z-transform of x(n)=u(n-1)	2M	L1	CO4	4
22	Derive the relationship between Z-transform and discrete time Fourier transform.	2M	L2	CO4	4
23	Compare Laplace transform and Z-transform	2M	L1	CO4	4
24	Find the Z-transform and ROC for the signal $x(n)=n(1/3)^n u(n)$	2M	L1	CO4	4
25	Define a linear time variant system and discuss how it differ from an LTI system.	2M	L1	CO5	5
26	Define System bandwidth and Signal bandwidth	2M	L1	CO5	5
27	Explain distortion less transmission through a system.	2M	L1	CO5	5
28	List the operations required in convolution.	2M	L1	CO5	5
29	y (t) =ax(t) +b. Test for linearity and time variance.	2M	L1	CO5	5
30	Define a system and list the various systems.	2M	L1	CO5	5

PART-B

MID-I Questions					
Q.No	**Questions**	**Marks**	**BL**	**CO**	**Unit No**
1	Explain the orthogonality between two signals f1(t) and f2(t) and derive the approximation coefficient.	4M	L3	CO1	1
2	Define orthogonality. Show that the set of sin and cosine signals are orthogonal.	4M	L3	CO1	1
3	Derive the expression for Mean square Error in approximating a function f(t) by a set of **N** orthogonal functions.	4M	L3	CO1	1
4	(a) Find the fundamental period of the signal $x(t) = sinc(100\pi t) + \left(\frac{1}{3}\right) sinc(300\pi t)$ (b) Find the even and odd components of the signal $x(t) = \cos(t) + \sin(t) + \cos(t)\sin(t)$	4M	L3	CO1	1
5	Verify whether the following signals are energy or power signals (i) $x(t)= e^{-5t} u(t)$ (ii) $x(t)= \cos(t)$	4M	L3	CO1	1
6	Compare impulse sampling, Natural Sampling and Flat Top Sampling methods in detail	4M	L3	CO1	1
7	Define orthogonality. Show that the set of sin and cosine signals are orthogonal.	8M	L3	CO1	1
8	Explain the classification of signals with neat sketches	8M	L3	CO1	1

9	State and prove sampling theorem for band-limited signals. Draw its spectrum for all frequencies	8M	L3	CO1	1
10	Calculate the Fourier Series coefficients of half wave rectified sine wave $x(t) = Asin(Wt)$ for T=2π	4M	L3	CO2	2
11	Derive the exponential Fourier series coefficients form the cosine Fourier series and show that $A_n=2\|C_n\|$	4M	L3	CO2	2
12	Find the Fourier transform of x(t)=cos(wt) and draw its magnitude and phase spectrum	4M	L3	CO2	2
13	State and Prove convolution and Parsavel's Theorems for Fourier transform.	4M	L3	CO2	2
14	State and prove any four properties of Fourier Transform.	4M	L3	CO2	2
15	Explain the Hilbert Transform with an example	4M	L3	CO2	2
16	Derive the Trigonometric Fourier series expansion of a rectified Sine wave shown below. 	8M	L3	CO2	2
17	Find the Fourier transform of the following functions $x(t) = e^{-a\|t\|}$ $x(t) = sgn(t)$	8M	L3	CO2	2
18	Discuss the concept of Cosine Fourier series and derive the expressions for coefficients.	8M	L3	CO2	2
19	Obtain Laplace transform of the following signals: x(t)=cos(wt)u(t) $x(t) = 3e^{-2t}u(t) - 2e^{-t}u(t)$	4M	L3	CO3	3
20	State and prove the Laplace transform initial value theorem, final value theorem, time shifting and differentiation in time domain properties.	4M	L3	CO3	3
21	Find the inverse Laplace transform of $(s) = ln\frac{s+a}{s+b}$	4M	L3	CO3	3
	MID-II Questions				
22	Obtain inverse Laplace transform of the following s-domain signal: $X(s) = \frac{3s+7}{s^2-2s-3}$	4M	L3	CO3	3
23	Find the Laplace transform of the following signals using properties of L.T (1) $x(t)=t\,e^{-2t}u(t)$. $x(t)=t\,e^{-t}\sin(2t)\,u(t)$.	4M	L3	CO3	3

24	Solve the differential equation $\frac{d}{dt}^2 y(t) + 6\frac{d}{dt}y(t) + 5y(t) = x(t)$ With initial condition $y(0^+) = -2$, $dy(0)/dt=2$ and input $x(t) = 3e^{-2t}u(t)$. Find y(t)	4M	L3	CO3	3
25	Define Z-transform, state its properties and prove any four properties.	4M	L3	CO4	4
26	Determine the Z-transform and ROC of $x(n)=(1/2)^n u(-n)- (2)^n u(-n-1)$. Also indicate the pole-zero locations.	4M	L3	CO4	4
27	Explain the Properties of ROC in Z-transform	4M	L3	CO4	4
28	Determine Z-transform of $x(n)= (1/4)^n u(n)+ (1/2)^n u(n)$.. Find its ROC and also plot pole zero representation.	4M	L3	CO4	4
29	Using Scaling property determine the Z-transform of $x(n) = a^n \cos(wn)u(n)$ and find its ROC	4M	L3	CO4	4
30	Determine the inverse Z- transform of $X(Z)=Z^{-1}/(3-4Z^{-1}+Z^{-2})$, ROC: $\|Z\| >1$ and $\|Z\|<1/3$	4M	L3	CO4	4
31	Define Z-Transform, state and prove initial value theorem, final value theorem. Find x(0) if X(Z) is given by (Z2+2Z+2)/(Z+1)(Z+0.5)	8M	L3	CO4	4
32	How the pole zero plot decides the system stability? Find the Z-transform and ROC of the discrete signal $x[n] = n[3(2)^n -4(3)^n] u(n)$.	8M	L3	CO4	4
33	Given $H(z) = \frac{\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}$ find h(n) for ROC (i) $\|z\|>1/2$ (ii) $\|z\|<1/4$ (iii) $1/4 <\|z\|<1/2$	8M	L3	CO2	4
34	Explain in detail about linearity and time invariance properties of a system with one example each.	4M	L3	CO5	5
35	Derive the expression for the transfer function of a LTI system. Find the transfer function of the system given as $\frac{d^2}{dt^2}y(t) + 4\frac{d}{dt}y(t) + 5y(t) = \frac{d}{dt}x(t) + 5x(t)$	4M	L3	CO5	5
36	Draw and Explain the characteristics of Ideal LPF, HPF and BPF	4M	L3	CO5	5
37	Consider an LTI system with impulse response $h(t)=e^{-2t} U(t)$. Find the response of the system to an input signal $x(t)=\sin(3t)U(t)$.	4M	L3	CO5	5
38	A system produces an output $y(t)= e^{-3t} u(t)$ for an input of $x(t)= e^{-5t} u(t)$. Determine its frequency response and impulse response.	4M	L3	CO5	5
39	Find the convolution between two signals using FT method x(t)=cos(t) u(t) ;y(t)=u(t)	4M	L3	CO5	5
40	Obtain the relationship between the bandwidth and rise time of ideal low pass filter	8M	L3	CO5	5
41	Find the convolution of two functions and represent them graphically.	8M	L3	CO5	5

	X(t) = 2 for -2≤t≤2 and h(t) = 4 for 0≤t≤2 = 0 otherwise = 0 otherwise				
42	Obtain the conditions for the distortion less transmission through a system? And also justify why ideal filter are not physically unrealizable.	8M	L3	CO5	5