Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

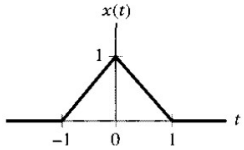
USN											Course Code	2	1	E	C	3	2

Third Semester B.E. Degree Examinations, April/May 2023

BASIC SIGNAL PROCESSING

Duration: 3 hrs **Max. Marks: 100**

Note: ***1. Answer any* FIVE *full questions, choosing* ONE *full question from each module.***
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)
		MODULE – 1		
1.	a.	Define Signal and System. Explain them with at least two examples each.	06	(1 :1 : 1.3.1)
	b.	Determine whether the signals are periodic or not. If periodic, find its period. (i) $x(n)=\sin(145\pi n)+\cos(170n)$ (ii) $x(t)=4\cos\left(\frac{\pi}{100}t\right)+2\cos\left(\frac{2\pi}{180}t\right)$	08	(2 :1 : 2.1.3)
	c.	Write the MATLAB program to plot cosine signal $x(n)$, where $x(n)=\cos(\Omega n) \quad 0\le n\le 20$ and $\Omega=\frac{\pi}{4}$.	06	(3 :1 : 5.1.1)
		OR		
2.	a.	Derive expression for even and odd part of signal $x(t)$ when $x(t)=x_e(t)+x_0(t)$.	06	(1 :1 : 1.3.1)
	b.	For the signal $x(t)$ shown in Fig. Q2 (b), sketch the following signals. (i) $y(t)=x(3t-2)$ (ii) $y(t)=x\left(\frac{t}{3}\right)$  **Fig. Q2(b)**	08	(2 :1 : 2.1.3)
	c.	Write the MATLAB program to find $y(t)=x_1(t)+x_2(t)$ where $x_1(t)=\cos(5t)$ and $x_2(t)=\sin(2t)$. Plot output $y(t)$.	06	(3 :1 : 5.1.1)
		MODULE – 2		
3.	a.	State and prove commutative and distributive property of convolution.	06	(1 :2 : 2.1.3)
	b.	Evaluate the convolution sequence $y(n)$, when $y(n)=\alpha^n u(n)*\beta^n u(n) \quad \lvert\alpha\rvert<1, \lvert\beta\rvert<1$.	07	(2 :2 : 1.3.1)
	c.	Write the MATLAB program to find convolution of $y(n)=x(n)*h(n)$ when $x(n)=\left[\underset{\uparrow}{4} \quad 2 \quad -3 \quad 1\right]$ and $h(n)=\left[3 \quad \underset{\uparrow}{1} \quad -1 \quad 3\right]$	07	(3 :2 : 5.1.1)
		OR		

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

4.	**a.**	Explain the properties of LTI system in terms of impulse response $h(n)$ or $h(t)$. (i) Stability (ii)Memory	**06**	(1 :2 : 2.1.3)
	b.	Investigate causality, stability and memory of the LTI System. $h(n)=2^n u(n-1)$	**07**	(2 :2 : 1.3.1)
	c.	Write the MATLAB program to find whether given system is linear or not when $x_1(t)=u(t)-u(t-1)$ and $x_2(t)=u(t)-u(t-2)$ be input signals to the system described by the input/output relationships $y(t)=x^2(t)$.	**07**	(3 :2 : 5.1.1)

MODULE – 3

5.	**a.**	Find the signal $x(t)$ corresponding to the spectrum shown in Fig Q5(a).	**07**	(1 :3 : 2.1.3)

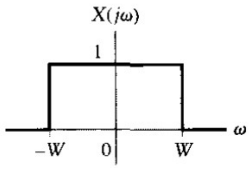


Fig. Q5 (a).

	b.	State and prove the time differentiation of CTFT.	**06**	(2 :3 : 1.3.1)
	c.	Write the MATLAB Program to find Fourier transform of $x(t)=2\ rect\left(\frac{t}{2}\right)$. Width = 2. Plot its spectrum $X(j\omega)$.	**07**	(3 :3 : 5.1.1)

OR

6.	**a.**	Determine the Fourier transform of the signum function $x(t)=\text{sgn}(t)$. Draw the magnitude and phase spectra.	**07**	(1 :3 : 2.1.3)
	b.	State and prove the modulation property of CTFT.	**06**	(2 :3 : 1.3.1)
	c.	Write the MATLAB program to perform amplitude modulation when message signal $m(t)=\sin(2\pi t)$ and $c(t)=\sin(10\pi t)$.	**07**	(3 :3 : 5.1.1)

MODULE – 4

7.	**a.**	Determine the DTFT of the following signals (i) $x(n)=a^n \sin(\Omega_0 n)u(n)$ (ii) $x(n)=u(n)-u(n-6)$	**08**	(1 :3 : 2.1.3)
	b.	State and prove linearity property of DTFT.	**06**	(2 :3 : 1.3.1)
	c.	Using appropriate properties, find the DTFT of signal $x(n)=\left(\frac{1}{2}\right)^n u(n-2)$.	**06**	(2 :3 : 1.3.1)

OR

8.	**a.**	Find the inverse DTFT of $X\left(e^{j\Omega}\right)=\frac{6}{e^{-j2\Omega}-5e^{-j\Omega}+6}$	**08**	(1 :3 : 2.1.3)
	b.	State and prove time shift property of DTFT.	**06**	(2 :3 : 1.3.1)
	c.	Determine the time domain signal corresponding to DTFT $X\left(e^{j\Omega}\right)=\cos^2(\Omega)$	**06**	(2 :3 : 1.3.1)

MODULE – 5

9.	**a.**	Define ROC. Explain the properties of ROC with examples.	**06**	(1 :4 : 1.3.1)

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

b. Find the Z-transform of the following signals and indicate their ROC **08** (2 :4 : 2.1.3)

(i) $x(n)=u(n)$ (ii) $x(n)=\left(\frac{1}{2}\right)^n u(n)$

c. Find the inverse Z-transform for the given $X(z)=\dfrac{1-\frac{1}{2}z^{-1}}{1+\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$; **06** (2 :4 : 2.1.3)

$|z|>\frac{1}{2}$

OR

10. a. State and prove differentiation property in Z –domain. **06** (1 :4 : 1.3.1)

b. A causal LTI system has $x(n)$ and $y(n)$ are the input and output respectively. **08** (2 :4 : 2.1.3)

(i) Find the Transfer function $H(Z)$ (ii) Find the impulse response $h(n)$

if $x(n)=\delta(n)+\frac{1}{4}\delta(n-1)-\frac{1}{8}\delta(n-2)$, $y(n)=\delta(n)-\frac{3}{4}\delta(n-1)$.

c. Find the Z-transform of the signal using appropriate property. **06** (2 :4 : 2.1.3)

$$x(n)=n\left[\left(\frac{1}{2}\right)^n u(n)*\left(\frac{1}{2}\right)^n u(n)\right]$$

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