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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; July / August - 2022

Digital Signal Processing

Time: 3 hrs *Max. Marks: 100*

Course Outcome

The Students will be able to:

*CO1: **Apply** mathematical knowledge to understand DFT, FFT and Filters*

*CO2: **Analyze** discrete systems using DFT, FFT and filtering formulation*

*CO3: **Design** the FIR & IIR filters for given specification*

*CO4: **Implement** the discrete–time systems using various approaches*

*CO5: **Understand** role of DSP in various applications*

***Note**: i) **PART-A** is compulsory. One question from each unit for maximum of 2 marks.*
*ii) **PART-B** Answer any **TWO** sub questions (from a, b, c) from each unit for a Maximum of 18 marks.*

Q. No.	Questions	Marks	BLs	COs	POs
	I:PART - A	**10**			
I a.	State periodicity and linearity properties of DFT.	2	L1	CO1	PO1
b.	What is the total number of complex multiplications and complex additions required in case direct computation of DFT?	2	L1	CO1	PO1
c.	What are the advantages of FIR filter?	2	L1	CO1	PO1
d.	List any two advantages of IIR filter.	2	L1	CO1	PO1
e.	The T.F. of a discrete causal system is given as follows: $H(z)=\frac{1-\frac{3}{4}z^{-1}}{1+\frac{1}{4}z^{-1}-\frac{1}{8}z^{-2}}$ Draw the direct form-I structure.	2	L1	CO4	PO1
	II:PART - B	**90**			
	UNIT - I	**18**			
1 a.	Find the N-point DFT of the sequence $x(n)=u(n)-u(n-N)$	9	L2	CO1	PO1
b.	Find the output $y(n)$ of a filter whose impulse response $h(n)=\{1,2,3,4\}$ and input signal to the filter is $x(n)=\{1,2,1,-1,3,0,5,6,2,-2,-5,-6,7,1,2,0,1\}$ using over-lap add method with 6 point circular convolutes.	9	L2	CO1	PO2
c.	State and prove Circular time shift and circular frequency shift properties of DFT.	9	L2	CO2	PO2
	UNIT - II	**18**			
2 a.	Develop the Radix-2 Decimates in frequency-FFT (DIF-FFT) algorithm for N = 8 and draw the signal flow graph.	9	L3	CO2	PO2

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b.	Find the sequence $x(n)$ using DIF-FFT algorithm, if the DFT of the sequence is $x(k)=\{0,2+j2,-4j,2-2j,0,2+2j,4j,2-2j\}$	9	L2	CO1	PO2
c.	What is Goertzel algorithm and obtain the direct form-II realization? If $x(n)=\{1,0,1,0\}$ find $x(2)$ using Goertzel algorithm.	9	L2	CO2	PO2

UNIT - III **18**

3 a.	Design a LPF FIR filter using rectangular window with M = 7 and with a cutoff frequency of 1 rad/sec. Also obtain the magnitude response of the system.	9	L4	CO4	PO2
b.	Explain the following: i) Rectangular window ii) Bortlett window ii) Hamming window	9	L2	CO4	PO2
c.	Explain frequency sampling technique of FIR filter design.	9	L2	CO4	PO2

UNIT - IV **18**

4 a.	For the given specification find the system function of a Butterworth LPF, $0.8 \le \lvert H(j\Omega)\rvert \le 1;\ 0 \le \Omega \le 0.2\pi$ $\lvert H(j\Omega)\rvert \le 0.2;\ 0.6\pi \le \Omega \le \pi$	9	L4	CO4	PO2
b.	Explain how an analog filter is mapped onto a digital filter using Impulse Invariance Method (IIM). What are the limitations of this method?	9	L3	CO3	PO2
c.	Design a digital low pass Butterworth filter using bilinear transformation with pass band and stop band frequency are 200 Hz and 500 Hz respectively. Pass band and stop band attenuation are −5 dB and −12 dB respectively. Sampling frequency is 5 KHz.	9	L5	CO3	PO2

UNIT - V **18**

5 a.	Obtain the DF-I, DF-II, cascade and parallel from realization of the following system: $y(n)=0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2)$	9	L4	CO4	PO2
b.	For the given impulse response draw direct form, cascade and linear phase. $h(n)=\left(\frac{1}{2}\right)^n\left[u(n)-u(n-4)\right]$	9	L4	CO4	PO2
c.	Obtain a parallel form realization for the system $H(z)=\frac{8z^3-4z^2+11z-2}{\left(z-\frac{1}{4}\right)\left(z^2-z+\frac{1}{2}\right)}$. Also find the difference equation for the transfer function.	9	L4	CO4	PO2

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