

**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:				
	$H(z) = \frac{1 - \frac{3}{4}z^{-1}}{1 + \frac{1}{4}z^{-1} - \frac{1}{8}z^{-2}}$	2	L1	CO4	PO1
	Draw the direct form-I structure.				
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

- 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 9 L2 CO4 PO2
 - ii) Bartlett window
 - ii) Hamming window
- 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,
 $0.8 \leq |H(j\Omega)| \leq 1; 0 \leq \Omega \leq 0.2\pi$
 $|H(j\Omega)| \leq 0.2; 0.6\pi \leq \Omega \leq \pi$ 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 form realization of the following system: 9 L4 CO4 PO2
 $y(n) = 0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$
- b. For the given impulse response draw direct form, cascade and linear phase. 9 L4 CO4 PO2
 $h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$
- c. Obtain a parallel form realization for the system 9 L4 CO4 PO2
 $H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$. Also find the difference equation for the transfer function.