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Note : Remove "Table of Content" before including in CP Book

Each Course Plan shall be printed and made into a book with cover page

Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

17EC52: Digital Signal Processing

A. COURSE INFORMATION

1. Course Overview

Degree:	B.E	Program:	EC
Year / Semester :	2018/5	Academic Year:	2018-2019
Course Title:	DIGITAL SIGNAL PROCESSING	Course Code:	17EC52
52Credit / L-T-P:	4	SEE Duration:	180 Minutes
Total Contact Hours:	40	SEE Marks:	80 Marks
CIA Marks:	20	Assignment	1 / Module
Course Plan Author:	NAGARAJA M	Sign	Dt:
Checked By:	Dr. DEVANANDA S N	Sign	Dt:

2. Course Content

Module	Module Content	Teaching Hours	Module Concepts	Blooms Level
1	**Discrete Fourier Transforms (DFT)**: Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution.	10	Sampling analog signals DFT properties	L2
2	Additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method. Fast-Fourier-Transform (FFT) algorithms: .Direct computation of DFT,	10	DFT properties Radix 2	L2

	need for efficient computation of the DFT (FFT algorithms).		Algorithm	
3	Radix-2 FFT algorithm for the computation of DFT and IDFT-decimation-in-time computation of DFT and IDFT-decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform.	10	Radix2 DIT algorithm Radix2 DIF algorithm	L5
4	Structure for IIR Systems: Direct form, Cascade form, Parallel form structures. IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.	10	IIR structure IIR Filter design using analog filters	L5
5	Structure for FIR Systems: Direct form, Linear Phase, Frequency sampling structure, Lattice structure. FIR filter design: Introduction to FIR filters, design of FIR filters using – Rectangular, Hamming, Hanning and Bartlett windo	10	FIR structure IIR Filter design window	L5

3. Course Material

Module	Details	Available
1	Text books	
	Digital signal processing – Principles Algorithms & Applications, Proakis & Monalakis, Pearson education, 4th Edition, New Delhi, 2007.	In Dept Library
2	Reference books	
	1. Discrete Time Signal Processing, Oppenheim & Schaffer, PHI, 2003. 2. Digital Signal Processing, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010. 3. Digital Signal Processing, Lee Tan: Elsevier publications, 2007.	In Central Library
3	Others (CD,Web, Video, Simulation, Notes etc.)	Notes

4. Course Prerequisites

SNo	Course Code	Course Name	Module / Topic / Description	Sem	Remarks	Blooms Level
1	17EC44	Signals &	Module1 Elementary signals,	4		L1,L2

		Sytems	operations on signals			
2	17EC44	Signals & Sytems	Module2 TD representation of LTI s/m	4		L1,L2
3	17EC44	Signals & Sytems	Module4 Fourier Transforms	4		L1,L2

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

#	COs	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
CO1	Understand signal reconstruction from the samples at Nyquist rate	8	Sampling analog signals	Lecture	Assignment CIA	L2 Understand
CO2	Understand DFT behavior with input of Variable condition	7	DFT properties	Lecture	Assignment CIA	L2 Understand
CO3	Understand DFT behavior with input of Variable condition	10	DFT properties	Lecture	Assignment CIA	L2 Understand
CO4	Compare DFT with FFT on efficient Computation	2	Radix 2 Algorithm	Lecture/ PPT	Assignment CIA	L2 Understand
CO5	Develop DIT-FFT algorithm to find DFT for a given input length	6	Radix2 DIT algorithm.	Lecture	Assignment CIA	L2 Understand
CO6	Develop DIF-FFT algorithm to find DFT for a given input length	6	Radix2 DIF algorithm.	Lecture	Assignment CIA	L5 Evaluate
CO7	Implement IIR structures using DF-1 &2 from IIR filter co-efficients	5	IIR structure	Lecture/ PPT	Assignment CIA	L5 Evaluate
CO8	Design an IIR filter using analog filters to meet given specification	8	IIR Filter design using analog	Lecture	Assignment CIA	L5 Evaluate

			filters			
CO9	ImplementFIR structures using DF-1 &2 from IIR filter co-efficients	5	FIR structure	Lecture	Assignment CIA	L5 Evaluate
C10	Design an FIR filter using window method to meet given specification	8	FIR Filter design using windows	Lecture	Assignment CIA	L5 Evaluate
-		**62**	-	-	-	-

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Analog to Digital Conversion	CO1	L2
2	Digital to Analog conversion	CO2	L2
3	Ease of DFT Computation	CO3	L2
4	Real time Processing	CO4	L2
5	Telecommunication	CO5	L5
6	Biomedical Signal Processing, image / speech / video Processing	CO6	L5
7	Design of IIR filter where linear phase is not a constraint	CO7	L5
8	Communication Application.	CO8	L5
9	Design of FIR filter where linear phase is a requirement.	CO9	L5
10	Communication application.	CO10	L5

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO – PO MAPPING)

-	Course Outcomes	Program Outcomes												
#	COs	PO 1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	Level
1	Understand signal reconstruction from the samples at Nyquist rate	x	x	x	x	x					x			L2
2	Understand DFT behavior with input of Variable condition	x	x	x		x								L2
3	Understand DFT behavior with	x	x	x		x								L2

	input of Variable condition													
4	Compare DFT with FFT on efficient Computation	x	x	x		x								L3
5	Develop DIT-FFT algorithm to find DFT for a given input length	x	x	x		x								L2
6	Develop DIF-FFT algorithm to find DFT for a given input length	x	x	x		x								L2
7	Implement IIR structures using DF-1 &2 from IIR filter co-efficients			x	x	x								L3
8	Design an IIR filter using analog filters to meet given specification			x	x	x								L2
9	ImplementFIR structures using DF-1 &2 from IIR filter co-efficients			x	x	x								L2
10	Design an FIR filter using window method to meet given specification			x	x	x								
CS501PC.	Average													
Note: Mention the mapping strength as 1, 2, or 3														

4. Mapping Justification

Mapping		Justification	Mapping Level
CO	**PO**	**-**	**-**
CO1	PO1	Apply the Knowledge of sampling to understand the concept of A-D & D-A conversion	L1
CO1	PO2	To formulate the sampling rate of any digital system requires the Knowledge of Signal reconstruction	L3
CO1	PO3	Sampling rate conditionsare used to build a digital system for aliasing error.	
CO1	P04	Investigate other sampling method to minimize the sampling errors	
CO1	P05	Tools:MATLAB,Scilab	
CO1	P10	Communicate the algorithm to other programs as concept of signal is interdisciplinary.	

CO2 & CO3	P01	Apply the knowledge of basic signals to study the behavior of DFT for varying input.	
CO2 & CO3	P02	Analyzing complex digital sytems requires the knowledge of fundamental DFT properties.	
CO2 & CO3	P03	The DFT functionalities are used to analyze and implement efficient system.	
CO4	P01	Apply the knowledge of DFT to formulate more efficient DFT computation algorithm .	
CO4	P02	Analyzing digital sytem in computationally efficient manner requires the knowledge of Fast Fourier algorithm.	
CO4	P03	FFT algorithms are used to implement real time system like live telecasting	
CO5&CO6	P01	Apply the knowledge of Periodicity to understand and develop DIT-FFT algorithm	
CO5&CO6	P02	For Analysis of complex digital system effectively and efficiently requires the Knowledge of DIT-FFT algorithm.	
CO5&CO6	P03	DIT-FFT algorithms are used in real time applications.	
CO8&CO10	P03	Design of FIR filter to meet the given specification are used in communication,Health monitoring system etc.	
CO8&CO10	P04	Conducting/Investigating filter design to meet the given specification accurately, improvises the system	
CO8&CO10	P05	Modern tools SCILAB,MATLAB can be used to simulate for better performance	
CO7&CO9	P03	Design of IIR filter to meet the given specification are used in communication,Health monitoring system etc.	
CO7&CO9	P04	Conducting/Investigating filter design to meet the given specification accurately, improvises the system	
CO7&CO9	P05	Modern tools SCILAB, MATLAB can be used to simulate for better performance	

Note: Write justification for each CO-PO mapping.

5. Curricular Gap and Content

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					

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Dr.Devananda S N

5					

Note: Write Gap topics from A.4 and add others also.

6. Content Beyond Syllabus

SNo	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Note: Anything not covered above is included here.

C. COURSE ASSESSMENT

1. Course Coverage

Module #	Title	Teaching Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Discrete Fourier Transforms and properties of DFT	15	2	-	-	1	1	2	CO1, CO2	L2
2	Additional DFT properties,Fast-Fourier-Transform (FFT) algorithms	10	2	-	-	1	1	2	CO3, CO4	L2
3	Radix-2 FFT algorithm for the computation of DFT and IDFT	12	-	2	-	1	1	2	CO5, CO6	L5
4	Structure for IIR Systems, Design of IIR Filters	13	-	2	-	1	1	2	CO7, C08	L5
5	Structure for FIR Systems, Design	13	-	-	4	1	1	2	CO9,	L5

	of FIR Filters								CO10	
-	**Total**	**63**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

2. Continuous Internal Assessment (CIA)

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	30	CO1, CO2, CO3, CO4	L2
CIA Exam – 2	30	CO5, CO6, CO7, C08	L2,L5
CIA Exam – 3	30	CO9, CO10	L5
Assignment – 1	05	CO1, CO2, CO3, CO4	L2
Assignment – 2	05	CO5, CO6, CO7, CO8	L2,L5
Assignment – 3	05	CO9, CO10	L5
Seminar – 1	05	CO1, CO2, CO3, CO4	L2
Seminar – 2	05	CO5, CO6,CO7,CO8	L2,L5
Seminar – 3	05	CO9, CO10	L5
Other Activities – define – Slip test		CO1 to Co9	L2, L3, L4 . ..
Final CIA Marks	**40 (Reduced to 20)**	**-**	**-**

Note : Blooms Level in last column shall match with A.2 above.

D1. TEACHING PLAN - 1

Module – 1

Title:	Discrete Fourier Transform	Appr Time:	15 Hrs
a	*Course Outcomes*	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Understand signal reconstruction from the samples at Nyquist rate	CO1	L2
2	Understand DFT behavior with input of Variable condition	CO2	L3
b	*Course Schedule*	-	-
Class No	**Module Content Covered**	**CO**	**Level**
1	Sampling of Analog signals.	C01	L2
2	Type of spectrum obtained.		

3	Sampling of Continuous spectrum to discretize it		
4	Reconstruction from samples		
5	Obtaining DTFT		
6	Conversion from DTFT to DFT		
7	Relationship of DFT with other Trasforms(ZT, DTFT, DTFS)		
8	DFT and IDFT definition		
9	Computation of DFT by expansion method		
10	Computation of DFT by Matrix method		
11	Examples to compute DFT for finite length input sequences		
12	Examples to compute DFT for N-pt input sequences		
13	DFT properties: Linearity Property	CO2	L2
14	Time shifting Property.		
15	Frequency Shifting Property.		
c	**Application Areas**	**CO**	**Level**
1	Analog to digital conversion and vice versa	CO1	L2
2	All Digital signal processing Applications	CO2	L2
d	**Review Questions**	-	-
1	Prove that the sampling of DTFT of a sequence x(n) result in N-point DFT	CO1	L1
2	Find the 4 point DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and angle of X(k)	CO1	L3
3	Find the DFT of the sequence $x(n)=0.5^n$ U(n) for $0\leq n \leq 3$ by evaluating $x(n)=a^n$ for $0 \leq n \leq N-1$	CO2	L2
4	Find the relation between DFT and Z transformation		
5	Find the 4 point DFT of the sequence x(n)=6 + cos(2π/N n)	CO2	L4
6	Find the 8 point DFT of the sequence x(n)=(1,1,1,1,1,1,0,0)		
7	Define N point DFT and IDFT of a sequence.		
8	An analog signal is sampled at 10KHZ and the DFT of 512 samples is computed Determine the frequency sampling between the spectral samples of DFT	CO2	L2
9	Compute the DFT of the sequence x(n)=cos(nπ/4) for N=4 and plot IX(k)I and angle of X(k)	CO2	L5
10	Find the IDFT of X(K)=(4,-2j, 0, 2j)	CO2	L2
11	Explain Linearity property of DFT with an example.	CO2	L3
e	**Experiences**	-	-
1		CO1	L2

2			
3			
4		CO3	L3
5			

Module – 2

Title:	DFT Properties	Appr Time:	10 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Compare DFT with FFT on efficient Computation	CO3	L4
2	Develop DIT-FFT algorithm to find DFT for a given input length	CO4	L3
b	***Course Schedule***	-	-
Class No	**Module Content Covered**	**CO**	**Level**
16	Circular concept.	CO3	L2
17	Circular time shift property	CO3	L2
18	Frequency shift property	CO3	L2
19	Circular convolution	CO3	L2
20	Symmetry property	CO3	L2
21	Circular folding property	CO3	L2
22	Complex conjugate property	CO3	L2
23	Circular correlation property	CO3	L2
24	DFT of real even and real odd sequences	CO3	L2
25	Parsevals theorem	CO3	L2
26	Comparision of DFT and FFT	CO4	L2
27	Computational complexity	CO4	L2
c	**Application Areas**	**CO**	**Level**
1	Use to find performance of algorithm	CO3	L3
2	Used in Searching and sorting	CO4	L4
d	**Review Questions**	-	-
12	If x(n)=(1,-1,1,-1), find the DFT of the sequence $y(n)=x((n-2))_4$	CO3	L1
13	Suppose x(n) is a sequence defined on 0-7 only as (0,1,2,3,4,5,6,7) a) Illustrate $x((n-2))_8$ b)what is the DFT of $x((n-2)_8$	CO3	L3
14	Compute the DFT of the sequence x(n)=-(1,0,1,0).Also find y(n) if $Y(k)=X((k-2))_4$	CO3	L2

15	Compute the 5 pointDFT of the sequence x(n)=(1,0,1,0) and hence verify the DFT properties	CO4	L4
16	The First 5 points of the 8-point DFT of a real valued sequence are (0.25,0.5-j0.5,0,0.5-j0.86,0).Find the remaining 3 points	CO4	L2
17	Find 4 point circular convolution of the sequences x1(n)=(1,2,3,1) and x2(n)=(4,3,2,2).	CO3	L5
18	Prove the commutative property of circular convolution.	CO3	L2
19	Find the energy of 4 point sequence x(n)=sin(2pi/N*n), 0<=n<=3	CO3	L3
e	**Experiences**	-	-
1		CO1	L2
2			
3			
4		CO3	L3
5			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	CS501PC	Sem:	I	Marks:	30	Time:	75 minutes

Course:		Design and Analysis of Algorithms			
-	-	**Note: Answer any 3 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Prove that the sampling of DTFT of a sequence x(n) result in N-point DFT	5	CO1	L1
	b	Find the 4 point DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and angle of X(k)	4	CO1	L2
	c	Find the DFT of the sequence $x(n)=0.5^n$ U(n) for $0\leq n \leq 3$ by evaluating $x(n)=a^n$ for $0 \leq n \leq N-1$	6	CO1	L2
	d	Find the relation between DFT and Z transformation	5	CO1	L2
2	a	Find the 4 point DFT of the sequence x(n)=6 + cos(2π/N n)	6	CO1	L2
	b	Find the 8 point DFT of the sequence x(n)=(1,1,1,1,1,1,0,0)	10	CO1	L2
	c	Define N point DFT and IDFT of a sequence	4	CO1	L2

					L2
3	a	An analog signal is sampled at 10KHZ and the DFT of 512 samples is computed Determine the frequency spacing between the spectral samples of DFT	6	CO2	L2
	b	Compute the DFT of the sequence x(n)=cos(nπ/4) for N=4 and plot IX(k)I and angle of X(k)	10	CO2	L2
	c	Find the IDFT of X(K)=(4,-2j, 0, 2j)	4	CO2	L2
4	a	If x(n)=(1,-1,1,-1), find the DFT of the sequence $y(n)=x((n-2))_4$	4	CO2	L2
	b	Suspose x(n) is a sequence defined on 0-7 only as (0,1,2,3,4,5,6,7) a) Illustrate $x((n-2))_8$ b)what is the DFT of $x((n-2)_8$	5	CO2	L2
	c	Compute the DFT of the sequence x(n)=-(1,0,1,0).Also find y(n) if $Y(k)=X((k-2))_4$	5	CO2	L2
	d	Compute the 5 pointDFT of the sequence x(n)=(1,0,1,0) and hence verify the DFT properties	6	CO2	L2
5	a	Prove that sampling of DTFT of a sequence x(n) results in N point DFT	9	CO1	L2
	b	Define N point DFT and IDFT of a sequence	3	CO1	L2
	c	Find the relation between DFT and Z-Transform	3	CO1	L2

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	CS501PC	Sem:	I	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Design and Analysis of Algorithms						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT16EC003	Find the 4 point DFT of the sequence x(n)=(0,1,2,3)	5	CO1	L2
2	1KT16EC004	Compute the DFT of the Sequence x(n)= cos(nπ/4) for N=4 and plot |X(k)| and < X(k).	5	CO2	L2
3	1KT16EC005	Find the 4 point DFT of the sequence x\(n)=6+sin(2π/4n)		CO2	L2
4	1KT16EC006	Find the 8 point DFT of the sequence x(n)=(1,1,1,1,1,1,0,0)	5	CO1	L2
5	1KT16EC008	Find the IDFT of X(k)=(4,-2j,02j)		CO2	L2
6	1KT16EC009	Compute inverse DFT of the sequence X(k)=(2,1+j,0,1-j)		CO2	L2
7	1KT16EC011	Find the DFT of the sequence $x(n)=0.5^n$ U(n) for 0<n<3 by evaluating $x(n)=a^n$ for 0<n<N-1		CO2	L2

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8	1KT16ECO12	Find the Relation between DFT and ZT		CO2	L2
9	1KT16ECO13	Prove that the sampling of DTFT of a sequence x(n) result in N-point DFT.		CO2	L2
10	1KT16ECO14	An analog signal is sampled at 10kHz and the DFT of 512c samples is computed. Determine the frequency spacing between the spectral samples of DFT		CO2	L2
11	1KT16ECO15	Define N-pont DFT and IDFT of a sequence		CO2	L2
12	1KT16ECO16	Compute the 5 pointDFT of the sequence x(n)=(1,0,1,0) and hence verify the DFT properties		CO2	L2
13	1KT16ECO17	Find the N - point DFT of x(n) = anfor 0 < a < 1.		CO2	L2
14	1KT16ECO18	A discrete time LTI system has impulse response h(n) = 26(n) output of the system if the input x(n) = {6(n) + 36(n – 1) + 26(n using circular convolution.		CO2	L2
15	1KT16EC019	Determine 8 - point DFT of the signal x(n) = {1, 1, 1, 1, 1, magnitude and phase.		CO2	L2
16	1KT16EC020	Compute the DFT of the sequence x(n) = cos -laI 4 for N = 4, plot 1x(k)1 d L x(k).		CO2	L2
17	1KT16EC021	ind the DFT of the sequence x(n) = 0.5" u(n) for 0 < n __. 3 by evaluating x(n) = a" for • '3 0. 0 < n < N —1		CO2	L2
18	1KT16EC022	state and prove the linearity property of DFT and symmetrical property		CO2	L2
19	1KT16EC023	Find the IDFT of X(K) = (255, 48.63 + j166.05, -51-4-j 02, -78 -78.63-j46.05, -51-j102, 48.63 — 166j}.		CO2	L2
20	1KT16EC024	State and prove the relationship between z-transform and DFT		CO2	L2
21	1KT16EC025	If w(n) = 1/2+ 1/2COS(2π/N(n-N/2)) what is the DFT of the window sequence y(n) = x(n).w(n) ? Keep the answer in terms of X(k).		CO3	L2
22	1KT16EC026	Compute the inverse DFT of the sequence X(k) = {2 , 1+ j, 0, 1- j)		CO3	L2
23	1KT16EC027	Given the following x(n) : x(n) = 8(n) + 8(n —1) + 8(n —2) (i) Find the Fourier transform $X(ej^{w})$ and plot the $IX(ej^{w})I$ (ii) Get the magnitude of the 4-point DFT of the first four samples of x(n) (iii)Get the magnitude of the 8-point DFT of the first eight samples of x(n)		CO3	L2
24	1KT16EC028	Consider the sequence x (n) = (0,1, 2,3, 4) and x, (n) = . Determine the sequence y(n) so that Y(K) = X1(K) X2(K). X1 (K) and X2(K) are 5-point DFTs of xi(n) and x2(n) respectively.		CO3	L2
25	1KT16EC029	X(t) is an analog signal having a bandwidth of 4 kHz. It is		CO3	L2

		desired to compute the spectrum of this signal using N = 2Mpoint DFT with a resolution better than or equal to 50 Hz. Determine the minimum sampling rate and the resulting resolution (M is an integer).			
26	1KT16EC032	Let xp(n) be a periodic sequence with fundamental period N. Consider the following DFTs DFT Xp(n)... Xi (k) Xp(n) X3(k). What is the relationship between xi(k) and x3(k)?		CO3	L2
27	1KT16EC033	Derive the DFT expression from the DTFT expression.		CO3	L2
28	1KT16EC034	Find the 4-point DFTs of the two sequences x(n) and y(n) , x(n) = (1, 2, 0, 1) y(n) = (2, 2, 1, 1)		CO3	L2
29	1KT16EC035	Find IDFT for the sequence : x(k) = {5, 0, (1 - j), 0, 1, 0, (1 + j), 0)		CO3	L2
30	1KT16EC037	Find 5-point DFT of the sequence x(n) = {1, 1, 1}		CO3	L2
31	1KT16EC038	Determine 8 - point DFT of the signal x(n) = {1, 1, 1, 1, and plot its magnitude and phase spectra		CO3	L2
32	1KT16EC039	State and prove Linearity property of DFT.		CO3	L2

D2. TEACHING PLAN - 2

Module - 3

Title:	FFT	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Develop DIT-FFT algorithm to find DFT for a given input length	CO5	L5
2	Develop DIF-FFT algorithm to find DFT for a given input length	CO6	L5
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Decimation in time FFT algorithm to compute DFT-Butterfly structure	C6	L5
2	Decimation in time FFT algorithm to compute IDFT-Butterfly structure	C6	L5
3	FFT Data flow structure for 8 point DFT,16 point DFT	C6	L5
4	In phase computation	C6	L5
5	Cooley turkey algorithm	C5	L5
6	Decimation in frequency FFT algorithm to compute DFT-Butterfly structure	C5	L5
7	Decimation in frequency FFT algorithm to compute IDFT-Butterfly structure	C5	L5

8	Chirp Z transformation	C5	L5
9	Goertzel Algorithm	C5	L5
10	Linear filtering of Long data sequences using DFT	C5	L5
11	Overlap save method	C5	L5
12	Overlap add Method	C5	L5
c	**Application Areas**	**CO**	**Level**
1	Real time Processing	CO5	L5
2	Telecommunication	CO6	L5
	Biomedical Signal Processing, image / speech / video Processing		
d	**Review Questions**	-	-
1	plain with necessary diagrams and equations the concept of overlap – save method for linear filtering	CO1	L1
2	Write a note on Goertzel algorithm	C6	L5
3	What is in-place computation? What is the total number of complex additions and multiplications required for N = 64 point, if DFT is computed directly and if FFT is used? Also find the number of stages required and its memory requirement.	C6	L5
4	rst five points of the 8 - point DFT of a real valued sequence is given by x(0) = 0, x(1) = 2 + 2j, x(2) = --4j, x(3) = 2 - 2j, x(4) = 0. Determine the remaining points. Hence find the original sequence x(n) using DIT - FFT algorithm.	C6	L5
5	Find the 4 - pt circular convolution of x(n) = { 1, 1, 1, 1} and h(n) = {1, 0, 1, 0} using radix 2 DIF - FFT algorithm.	C6	L5
6	In the direct computation of N-point DFT of x(n), how many i) Complex multiplications, ii) Complex additions iii) Real multiplications iv) Real additions and v) Trigonometric function evaluations are required	C6	L5
7	Find the output y(n) of a filter whose impulse response h(n) ={1, 2} and input signal x(n) = {1, 2, -1, 2, 3, - 2, - 3, -1,1,1, 2, -1} using overlap save method	C6	L5
8	Develop 8-point DIT-FFT radix-2 algorithm to compute DFT and draw the signal flow graph.	C5	L5
9	Develop 8-point DIT-FFT radix-2 algorithm to compute IDFT and draw the signal flow graph.	C5	L5
10	Develop 8-point DIF-FFT radix-2 algorithm to compute DFT and draw the signal flow graph.	C5	L5
11	Develop 8-point DIF-FFT radix-2 algorithm to compute IDFT and draw the signal flow graph.	C5	L5

e	**Experiences**		
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Module – 4

Title:	IIR FILTER	Appr Time:	16 Hrs
a	*Course Outcomes*	-	**Blooms**
-	The student should be able to:	-	**Level**
1	Implement IIR structures using DF-1 &2 from IIR filter co-efficients	CO7	L5
2	Design an IIR filter using analog filters to meet given specification	CO8	L5
b	*Course Schedule*		
Class No	**Module Content Covered**	**CO**	**Level**
1	Filter introduction	CO7	L5
2	Direct form realization of IIR filters	CO7	L5
3	Parallel realization of IIR filters	CO7	L5
4	Cascade realization of IIR filters	CO7	L5
5	Classification of Analog filters	CO7	L5
6	Butterworth filters	CO7	L5
7	Frequency transformation	CO7	L5
8	Design of Low pass Butterworth filters	CO7	L5
9	Chebychev filters	CO7	L5
10	Digital filters	CO8	L5
11	Bilinear Transformation method to design IIR filters	CO8	L5
12	Impulse Invariant Transformation method to design IIR filters	CO8	L5
13	Backward difference method to design IIR filters	CO8	L5
c	**Application Areas**	**CO**	**Level**
1	Design of IIR filter where linear phase is not a constraint	CO8	L5
2	Communication Application.	CO7	L5
d	**Review Questions**	-	-
1	Obtain direct form-I, direct form – II, cascade and parallel form realization for the following t t system: y(n) = 0.75y(n -1) – 0.125y(n	CO7	L5

	– 2) + 6x(n) + 7x(n –1) + x(n – 2)		
2	Design an analog Chebyshev filter with the following specifications : Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : –60 dB for Q 50 rad/sec.	CO7	L5
3	Derive the expressions of order and cutoff frequency of a analog butter worth filt	CO8	L5
4	Obtain Direct form I and II , Cascade and Parallel form realization for the following system Y(n)=0.75y(n-1)-0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)	CO7	L5
5	Design a Chebyshev analog filter (low pass) that has a -3dB cutoff frequency of 100 rad/sce .9., O and a stopband attenuation 25dB or greater for all radian frequencies past 250 rad/sec	CO8	L5
6	Compare Butterworth and Chebyshev filters.	CO8	L5
7	Let H(s) = 2 1 represent the transfer function of LPF with a passband of 1 s + s +1 frequency transformation (Analog to Analog) to find the transfer function of fitter with passband 10 rad/sec and a centre frequency of 100 rad/sec		L5
8	Obtain block diagram of the direct form I and direct form II realization for a digital IIR fitter described by the system function. 8z3— 4z 2+11z — 2 H(z) = (10 Marks) (z— 1)(z2—z+ 1 2)		L5
9	Design a Chebyshev filter to meet the following specifications: i) Pass band ripple 2 db ii) Stop band attenuation 20 db iii) Pass band edge : 1 rad/sec iv) Stop band edge : 1.3 rad/sec		L5
10	Derive an expression for order of a low pass Butterworth filter.		L5
11	Explain how an analog filter is mapped on to a digital filter using impulse invariance method. What are the limitations of the method?		L5
12	Obtain direct form – I and lattice structure for the system described by the difference equation y(n) = x(n) + 2 x(n –1) + 3 x(n – 2) + 1 x(n-3).		L5
e	**Experiences**	-	-
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Dept:EC

Prepared by Checked by

Approved by

M.Nagaraja Mrs.Mythreye

Dr.Devananda S N

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	CS501PC	Sem:	I	Marks:	30	Time:	75 minutes
Course:	Design and Analysis of Algorithms						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Obtain block diagram of the direct form I and direct form II realization for a digital IIR fitter described by the system function. $8z^3 — 4z/ Z^2+11z — 2$	20	CO5	L1
	b	Obtain block diagram of the direct form I and direct form II realization for a digital IIR fitter described by the system function H(z) $(z— 1)/(z^2—z+ 12)$			L2
2	a	Obtain direct form – I and lattice structure for the system described by the difference equation y(n) = x(n) + 2 x(n −1) + 3 x(n – 2) + 1 x(n–3).	20	CO7	L2
	b	Obtain Direct form I and II , Cascade and Parallel form realization for the following system Y(n)=0.75y(n-1)-0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)			L4
3	a	Derive the expressions of order and cutoff frequency of a analog butter worth filt	20	CO8	L1
	b	Compare Butterworth and Chebyshev filters.		CO8	L2
4	a	Explain how an analog filter is mapped on to a digital filter using impulse invariance method. What are the limitations of the method?	20		L2
	b	Design an analog Chebyshev filter with the following specifications : Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : -60 dB for Q 50 rad/sec.			L2

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	CS501PC	Sem:	I	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Design and Analysis of Algorithms						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	**USN**	**Assignment Description**	**Marks**	**CO**	**Level**

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M.Nagaraja | Mrs.Mythreye | Dr.Devananda S N

1	1KT16ECOO3	Compute the eight point DFT of the sequence x(n) = { ½, ½, ½, ½, 0,0,0,0} using the inplace radix-2 decimation in frequency FFT algorithm.	5	CO8	L2
2	1KT16ECOO4	Explain the Goertzel algorithm and obtain the direct form II realization.	5	CO9	L3
3	1KT16ECOO5	Obtain the cascade realization for a system described by H(z) = .		CO10	L4
4	1KT16ECOO6	Explain the design of IIR filter by Impulse invariance technique.	5	CO9	L3
5	1KT16ECOO8	Determine the order and cut off frequency of Butterworth analog highpass filter to meet the specifications: Maximum passband attenuation = 2 dB, Minimum stop band attenuation = 20 dB, Passband edge frequency = 200 rad/sec, stopband edge frequency = 100 rad/sec.		CO10	L4
6	1KT16ECOO9	Obtain the parallel realization of the system function H(z) =		CO9	L3
7	1KT16ECO11	Design a digital low pas Butterworth filter using bilinear transformation to meet the specifications: i) -3 dB cut-off frequency at 0.5 π rad, ii) -15 dB at 0.75π rad. Obtain H(Z) assuming T=1 sec			
8	1KT16ECO12	What are the characteristics of Chebyshev filters? Define its magnitude response and list the properties of polynomial for type I Chebyshev filters.			
9	1KT16ECO13	What are the characteristics of Butterworth filters? Define its magnitude response and list the properties of polynomial			
10	1KT16ECO14	Obtain direct form-I, direct form - II, cascade and parallel form realization for the following t t system: y(n) = 0.75y(n -1) - 0.125y(n - 2) + 6x(n) + 7x(n -1) + x(n - 2)			
11	1KT16ECO15	Design an analog Chebyshev filter with the following specifications : Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : -60 dB for Q 50 rad/sec.			
12	1KT16ECO16	Derive the expressions of order and cutoff frequency of a analog butter worth filt			
13	1KT16ECO17	Obtain Direct form I and II , Cascade and Parallel form realization for the following system Y(n)=0.75y(n-1)-0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2)			
14	1KT16ECO18	Design a Chebyshev analog filter (low pass) that has a -3dB cutoff frequency of 100 rad/sce .9., O and a stopband attenuation 25dB or greater for all radian			

		frequencies past 250 rad/sec			
15	1KT16EC019	Compare Butterworth and Chebyshev filters.			
16	1KT16EC020	Let H(s) = 2 1 represent the transfer function of LPF with a passband of 1 s + s +1 frequency transformation (Analog to Analog) to find the transfer function of fitter with passband 10 rad/sec and a centre frequency of 100 rad/sec			
17	1KT16EC021	Obtain block diagram of the direct form I and direct form II realization for a digital IIR fitter described by the system function. 8z3— 4z 2+11z — 2 H(z) = (10 Marks) (z— 1) (z2—z+ 1 2)			
18	1KT16EC022	Design a Chebyshev filter to meet the following specifications: i) Pass band ripple 2 db ii) Stop band attenuation 20 db iii) Pass band edge : 1 rad/sec iv) Stop band edge : 1.3 rad/sec			
19	1KT16EC023	Derive an expression for order of a low pass Butterworth filter.			
20	1KT16EC024	Explain how an analog filter is mapped on to a digital filter using impulse invariance method. What are the limitations of the method?			
21	1KT16EC025	Obtain direct form - I and lattice structure for the system described by the difference equation y(n) = x(n) + 2 x(n -1) + 3 x(n - 2) + 1 x(n-3).			
22	1KT16EC026	How to convert Analog High pass filter to analog low pass filter,write the frequency transformation.			
23	1KT16EC027	How to convert Analog Low pass filter to analog low pass filter,write the frequency transformation.			
24	1KT16EC028	How to convert Analog Band pass filter to analog low pass filter,write the frequency transformation.			
25	1KT16EC029	How to convert Analog Band elimination filter to analog low pass filter, write the frequency transformation.			
26	1KT16EC032	What are the characteristics of Butterworth analog filter			
27	1KT16EC033	Write the design steps for design of IIR filter using Bilinear transformation.			
28	1KT16EC034	Write the design steps for design of IIR filter using Backward difference method			
29	1KT16EC035	Write the design steps for design of IIR filter using Impulse invariant method			
30	1KT16EC037	List the number of Adders required for direct form-1,direct form 2 method of IIR filter implementation.			

31	1KT16EC038	Compare direct form-1,direct form 2 method of IIR filter implementation.			
32	1KT16EC039	Write a note on Analog filters.			

D3. TEACHING PLAN - 3

Module - 5

Title:	FIR FILTER	Appr Time:	16 Hrs
a	***Course Outcomes***	-	**Blooms**
-	The student should be able to:	-	**Level**
1	ImplementFIR structures using DF-1 &2 from IIR filter co-efficients	CO9	L5
2	Design an FIR filter using window method to meet given specification	CO10	L5
b	***Course Schedule***		
Class No	**Module Content Covered**	**CO**	**Level**
1	Filter introduction	CO9	L5
2	Direct form realization of FIR filters	CO9	L5
3	Parallel realization of FIR filters	CO9	L5
4	Cascade realization of FIR filters	CO9	L5
5	Types of of windows	CO10	L5
6	Rectangular window sequence and its frequency response.	CO10	L5
7	Barlet window sequence and its frequency response.	CO10	L5
8	Blackman window sequence and its frequency respons	CO10	L5
9	Hanning , Hamming window sequence and its frequency response.	CO10	L5
10	FIR Digital filters	CO10	L5
11	Window method to design FIR filters	CO10	L5
12	Frequency sampling method to design FIR filters	CO10	L5
13	Backward difference method to design FIR filters	CO10	L5
c	**Application Areas**	**CO**	**Level**
1	Design of FIR filter where linear phase is a requirement.	CO9	L5
2	Communication application.	CO10	L5
d	**Review Questions**	-	-
1	Realize the linear phase FIR filter for the impulse response h(n)= □(n) + ¼ □(n-1)- ½□(n-1)+ ¼ □(n-3)+ □(n-4) using direct form	CO10	L1
2	Describe the frequency sampling realization of FIR filter.	CO10	L3
3	Determine the filter coefficients of an FIR filter for the desired	CO9	L2

	frequency response Hd(ω)=e^{-j2w} w<pi/4 , $H_d(w)$=0 otherwise Use rectangular window function. Find the frequency response H(ω) of the filter.		
4	Consider an FIR lattice filter with coefficients K1=0.65, K2=-0.34 and K3=0.8. Find its impulse response and draw the direct form structure.	CO9	L4
5	Determine the impulse response of an FIR filter to meet the specifications: Passband edge frequency of 1.5 KHz, Stopband edge frequency of 2 KHz, Sampling frequency of 8 KHz. Use the Hamming window function		L2
6	Compare the different window functions used in FIR filter design		L5
7	Design a normalized linear phase FIR filter having the phase delay of T 40 dB attenuation in the stopband. Also obtain the magnitude /frequency response Use rectangular window.		L2
8	Determine the frequency response of the FIR if Hamming window is used with N = 8.		L3
9	Compare IIR filter and FIR filters		L4
10	A FIR filter is given by, y(n) = x(n) + 2 x(n -1) + 3 x(n - 2) + x(n - 3). Draw the direct form I and lattice 4 structure .		L1
11	Design a linear phase low pass FIR filter with 7 taps and cutoff frequency of W_c, = 0.3pi rad, using the frequency sampling method.		L4
e	**Experiences**	-	-
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E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code	15EC52	Sem:V	I	Marks:	30	Time:	75 minutes
Course:	Design and Analysis of Algorithms						

-	-	**Note: Answer any 2 questions, each carry equal marks.**	**Marks**	**CO**	**Level**
1	a	Consider an FIR Lattice filter with coefficients k1=0.65, k2=-0.34, k3=0.8. Find its impulse response and the direct form structure	20	CO9	L5
	b	Realize the FIR filter H(Z)= ½ + 1/3 Z^{-1} +Z^{-2} + ¼ Z^{-3}+Z^{-4} + 1/3 Z^{-5} +1/2 Z^{-6} in Direct form			L5
2	a	Compare the different window functions Used in FIR filter design	20	CO10	L5

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Dr.Devananda S N

	b	Detremine the filter co-efficients of a FIR filter for the desired frequency response $Hd(w)=e^{-j3w}$, $\|w\|< 0$ $3\pi/4< \|w\| < \pi$ Determine the frequency response of the FIR filter if Hamming window is used with N=7			L5
3	a	Determine the Impulse response of an FIR filter to meet the specifications a) Pass band edge frequency of 1.5KHZ, b) stop band edge frequency of 2KHz c) Sampling frequency of 8KHz. Use the Hamming window function.	20	CO10	L5
	b	The frequency response of an FIR filter is given by $H(w)=e^{-j3w}(1+1.8\cos3w + 1.2\cos2w + 0.5\cos w)$.Determine the coefficient of the impulse response of the FIR filter.			L5
4	a	Describe the frequency sampling realization of FIR filter.	20	CO10	L5
	b	Determine the filter coefficients of an FIR filter for the desired frequency response $Hd(\omega)=e^{-j2w}$ w<pi/4 , $H_d(w)=0$ otherwise Use rectangular window function. Find the frequency response $H(\omega)$ of the filter.			L5

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	CS501PC	Sem:	I	Marks:	5 / 10	Time:	90 – 120 minutes
Course:	Design and Analysis of Algorithms						
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1	1KT16EC003	Consider an FIR Lattice filter with coefficients k1=0.65, k2=-0.34, k3=0.8. Find its impulse response and the direct form structure	5	CO9	L2
2	1KT16EC004	Realize the FIR filter $H(Z)= ½ + 1/3 Z^{-1} +Z^{-2} + ¼ Z^{-3}+Z^{-4} + 1/3 Z^{-5} +1/2 Z^{-6}$ in Direct form	5	CO9	L3
3	1KT16EC005	Compare the different window functions Used in FIR filter design		CO10	L4
4	1KT16EC006	Detremine the filter co-efficients of a FIR filter for the desired frequency response $Hd(w)=e^{-j3w}$, $\|w\|< 0$ $3\pi/4< \|w\| < \pi$ Determine the frequency response of the FIR filter if Hamming window is used with N=7	5	CO10	L3
5	1KT16EC008	Determine the Impulse response of an FIR filter to meet the specifications a) Pass band edge frequency of 1.5KHZ, b) stop band edge frequency of 2KHz c) Sampling frequency of 8KHz. Use the Hamming window function.			
6	1KT16EC009	The frequency response of an FIR filter is given by $H(w)=e^{-j3w}(1+1.8\cos3w + 1.2\cos2w + 0.5\cos w)$.Determine the			

		coefficient of the impulse response of the FIR filter.			
7	1KT16ECO11	Describe the frequency sampling realization of FIR filter.			
8	1KT16ECO12	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use rectangular window function. Find the frequency response H(ω) of the filter.			
9	1KT16ECO13	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use Barlet window function. Find the frequency response H(ω) of the filter.			
10	1KT16ECO14	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use Blackman window function. Find the frequency response H(ω) of the filter.			
11	1KT16ECO15	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use Hamming window function. Find the frequency response H(ω) of the filter.			
12	1KT16ECO16	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use Hanning window function. Find the frequency response H(ω) of the filter.			
13	1KT16ECO17	Determine the filter coefficients of an FIR filter for the desired frequency response Hd(ω)=e^{-j2w} w<pi/4 , H_d(w)=0 otherwise Use Kaiser window function. Find the frequency response H(ω) of the filter.			
14	1KT16ECO18	Write the Rectangular window sequence and plot its magnitude and phase response			
15	1KT16EC019	Write the Barlet window sequence and plot its magnitude and phase response			
16	1KT16EC020	Write the Blackman window sequence and plot its magnitude and phase response			
17	1KT16EC021	Write the Hanning window sequence and plot its magnitude and phase response			

18	1KT16EC022	Write the Hamming window sequence and plot its magnitude and phase response			
19	1KT16EC023	Write the Kaiser window sequence and plot its magnitude and phase response			
20	1KT16EC024	Write the design steps to design FIR filter using rectangular window when window function is not given.			
21	1KT16EC025	Write the design steps to design FIR filter using rectangular window when window function is given.			
22	1KT16EC026	Explain lattice structure of FIR Filter realization.			
23	1KT16EC027	State and explain condition required for design of linear phase FIR filter.			
24	1KT16EC028	Realize the Linear phase FIR filter having the following impulse response $h(n)=\delta(n)+1/4\ \delta(n-1)-1/8\delta(n-2)+1/4\delta(n-3)$			
25	1KT16EC029	Prove parsevals relation as applied to DFT			
26	1KT16EC032	For x(n)={7,0,8,0} find y(n) if $Y(K)=X((K-2))_4$			
27	1KT16EC033	State and prove the following properties a)Symmetry property b) Parsevals therem			
28	1KT16EC034	State and prove convolution property			
29	1KT16EC035	Given x(n)={1,2,3,4} and h(n)={1,2,2} compute I) Circular Convolution ii) Linear convolution iii) Linear convolution using circular convolution			
30	1KT16EC037	First five points of the 8 – point DFT of a real valued sequence is given by x(0) = 0, x(1) = 2 + 2j, x(2) = −-4j, x(3) = 2 – 2j, x(4) = 0. Determine the remaining points. Hence find the original sequence x(n) using DIT – FFT algorithm.			
31	1KT16EC038	Find the 4 – pt circular convolution of x(n) = { 1, 1, 1, 1} and h(n) = {1, 0, 1, 0} using radix 2 DIF – FFT algorithm			
32	1KT16EC039	d the circular convolution of x(n) = {1, 1, 1, 1) and h(n) = { 1, 0, 1, 0 } using DIF-FFT algorithm			
33		Derive DIT-14F1 algorithm for N = 4. Draw the complete signal How graph?			
34		What are the differences and similarities between DIF-FFT and DIT-FFT algorithm?			

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Design and Analysis of Algorithms					Month / Year	May /2018
Crs Code:	CS501PC	Sem:	I	Marks:	100	Time:	180

									minutes	
-	**Note**	Answer all FIVE full questions. All questions carry equal marks.						**Marks**	**CO**	**Level**
1	a	Explain the frequency domain sampling and reconstruction of discrete time signals.						8	CO1	
	b	The first five points of the eight point DFT of a real valued sequence are {0.25, 0.125-j0.3018, 0, 0.125-j0.0518, 0}. Determine the remaining three points.						3		
	c	Determine the circular convolution of the sequences, x1(n) = {1,2,3,1}, x2(n)={4,3,2,2} using time domain approach.						5	CO2	
2	a	Obtain the relationship of DFT with the Z-transform.						5	C03	
	b	Show that the multiplication of two DFTs leads to circular convolution of respective time sequences.						7		
	c	Consider a finite duration sequence x(n) = {0,1,2,3,4}. (i) Determine the sequence y(n) with six point DFT Y(k) = Real[X(k)] (ii) Determine the sequence v(n) with six point DFT V(k) = Imaginary[X(k)]						4	CO4	
3	a	Explain the linear filtering of long data sequences using overlap-save method.						6	CO5	
	b	The 4-point DFT of a real sequence x(n) is X(k) = (1, j, 1, -j). Find the DFTs of the following. i) $x_1(n) = (-1)^n x(n)$, ii) ii) $x_2(n)=x((n+1))_4$, iii) iii) $x_3(n) = x(4-n)$						6		
	c	Explain the computational complexity of direct computation of DFT. What are the efficient algorithms for the evaluation of the DFT?						4	CO6	
4	a	Find the response of an LTI system with an impulse response h(n) = (3,2,1) for the input x(n) = (2, -1, -1, -2, -3, 5,6,-1, 2,0,2,1) using overlap and add method. Use 8 point circular convolution.						7	CO7	
	b	The 5-p0int DFT of a complex sequence x(n) is X(k)=(j, 1+j, 1+j2, 4+j). Compute Y(k), if y(n)=x*(n).						4		
	c	State and prove the property of circular time shift of a sequence.						5	C08	
5	a	Derive the radix-2 decimation in time FFT algorithm and draw the signal flow graph						8	CO9	

		for eight point DFT computation.			
	b	Find the number of complex additions and complex multiplications required for 128- point DFT computation using i) Direct method, ii) FFT method. What is the speed improvement factor?	3	CO10	
	c	Find the 4-point real sequence x(n), if its DFT samples are X(0)=6, X(1)=-2+j2, X(2)=-2. Use DIF-FFT algorithm.	5		
6	a	Compute the eight point DFT of the sequence x(n) = { ½, ½, ½, ½, 0,0,0,0} using the inplace radix-2 decimation in frequency FFT algorithm.	8		
	b	Explain the Goertzel algorithm and obtain the direct form II realization.	8	CO9	
	c				
7	a	Obtain the cascade realization for a system described by H(z) = .	5	C010	
	b	Explain the design of IIR filter by Impulse invariance technique.	6		
	c	Determine the order and cut off frequency of Butterworth analog highpass filter to meet the specifications: Maximum passband attenuation = 2 dB, Minimum stop band attenuation = 20 dB, Passband edge frequency = 200 rad/sec, stopband edge frequency = 100 rad/sec.	5		
8	a	Obtain the parallel realization of the system function H(z) = _	6		
	b	Design a digital low pas Butterworth filter using bilinear transformation to meet the specifications: i) -3 dB cut-off frequency at 0.5 π rad, ii) -15 dB at 0.75π rad. Obtain H(Z) assuming T=1 sec.	6		
	c	What are the characteristics of Chebyshev filters? Define its magnitude response and list the properties of polynomial for type I Chebyshev filters.	4		
9		Realize the linear phase FIR filter for the impulse response h(n)= □(n)+ ¼ □(n-1)- ½□(n-1)+ ¼ □(n-3)+ □(n-4) using direct form.	3		
		Describe the frequency sampling realization of FIR filter.	7		
		Determine the filter coefficients of an FIR filter for the desired frequency response $H_d(\omega)$	6		

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		Use rectangular window function. Find the frequency response H(ω) of the filter.			
10	a	Consider an FIR lattice filter with coefficients K1=0.65, K2=-0.34 and K3=0.8. Find its impulse response and draw the direct form structure.	7		
	b	Determine the impulse response of an FIR filter to meet the specifications: Passband edge frequency of 1.5 KHz, Stopband edge frequency of 2 KHz, Sampling frequency of 8 KHz. Use the Hamming window function.	6		
	c	Compare the different window functions used in FIR filter design.	3		

2. SEE Important Questions

Course:	Digital Signal Processing					Month / Year	May /2018
Crs Code:	15EC52	Sem:	5	Marks:	100	Time:	180 minutes

	Note	Answer all FIVE full questions. All questions carry equal marks.	-	-	
Module	Qno.	Important Question	**Marks**	**CO**	**Year**
1	1	Find the N point DFT of $x(n)=a^n$ for 0 <a<1	4		2016
	2	Compute the DFT of the sequence x(n)=cos(npi/4) for N=4	4		2015
	3	Find the relation between DFT and Z transform	4		2015
	4	Prove that sampling of DTFT of a sequence x(n) result in N point DFT	5		2014
	5	Find the IDFT of X(K)=(4, -2j, 0, 2j)	3		2016
2	1	Prove parsevals relation as applied to DFT	5		2016
	2	For x(n)={7,0,8,0} find y(n) if $Y(K)=X((K-2))_4$	6		2016
	3	State and prove the following properties a)Symmetry property b) Parsevals therem	8		2015
	4	State and prove convolution property	6		2016
	5	Given x(n)={1,2,3,4} and h(n)={1,2,2} compute I) Circular Convolution ii) Linear convolution iii) Linear convolution using circular convolution	8		2016
3	1	First five points of the 8 - point DFT of a real valued sequence is given by x(0) = 0, x(1) = 2 + 2j, x(2) = --4j, x(3) = 2 - 2j, x(4) = 0. Determine the remaining points. Hence find the original sequence x(n) using DIT - FFT algorithm.	10		2016
	2	Find the 4 - pt circular convolution of x(n) = { 1, 1, 1, 1} and h(n) =	10		2016

		{1, 0, 1, 0} using radix 2 DIF - FFT algorithm			
	3	d the circular convolution of x(n) = {1, 1, 1, 1) and h(n) = { 1, 0, 1, 0 } using DIF-FFT algorithm	12		2015
	4	Derive DIT-14F1 algorithm for N = 4. Draw the complete signal How graph?	8		2015
	5	What are the differences and similarities between DIF-FFT and DIT-FFT algorithm?	4		2014
4	1	Design an analog Chebyshev filter with the following specifications : Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : -60 dB for Q 50 rad/sec.	12		2016
	2	Derive the expressions of order and cutoff frequency of a analog butter worth filter	8		2016
	3	Design a Chebyshev analog filter (low pass) that has a -3dB cutoff frequency of 100 rad/sce and stop band attenuation 25dB or greater for all radian frequencies past 250 rad/sec	14		2015
	4	Compare Butterworth and Chebyshev filters.	03		2015
	5	Let H(s) = 1/(s2+s+1) represent the transfer function of LPF with a passband of 1 rad/sec .Use frequency transformation (Analog to Analog) to find the transfer function of fitter with passband 10 rad/sec and a centre frequency of 100 rad/sec	03		2015
5	1	Design a symmetric FIR low pass filter whose desired frequency response is given as : $H_a(w) = e^{-jw}$ for length of the filter should be 7 and w_0, = 1 rad/sample. Use rectangular window.	10		2016
	2	Design a normalized linear phase FIR filter having the phase delay of T= 40 dB attenuation in the stopband. Also obtain the magnitude /frequency response of the filter	10		2016
	3	Obtain the direct form realization of linear phase FIR system given by $H(z) = 1 + 2/3\, z^{-1} + 15/8\, z^{-2}$	03		2015
	4	Compare IIR filter and FIR filters	6		2015
	5	The desired frequency response of a low pass fitter is given by Hd(w)=e-j3w for |w| < 3pi/4 0 ,otherwise. Determine the frequency response of the FIR if Hamming window is used with N = 7.	10		2015

Dept:EC

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